Targeting the Logistical Packaging System

A Study of the Telecom Equipment Industry

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Titel
Title
Identifiering av det logistiska förpackningssystemet
En studie av teleutrustningsindustrin

Targeting the Logistical Packaging System
A Study of the Telecom Equipment Industry

Författare
Author
Per Ackerholt & Henrik Hartford

Sammanfattning
Abstract
Background: Due to outsourcing, the material flows in the telecom equipment industry have undergone major changes, which in turn has imposed new challenges for packaging supplier Nefab who delivers to the industry. In order to achieve market intelligence, Nefab wants to map the material flows, and investigate possibilities of further reusable logistical packaging systems.

Purpose: The purpose of this thesis is to describe the typical features of the logistical material flows in a technically based, rapidly growing industry, and analyze the driving forces and obstacles, which influence the selection of logistical packaging system.

Procedure: After developing a theoretical framework consisting of general logistical theories and theories related to logistical packaging, we have interviewed companies in the logistics channel of Ericsson Radio Systems.

Results: We have found the main characteristics of material flows in our investigated industry to be Variations in Demand, Focus on Time-to-Customer, and Globalization of Logistics Channels. Regarding driving forces and obstacles in the selection of logistical packaging systems, we have identified Transportation Characteristics, Customer Demands, Quality, Handling & Administration, and Current Packaging System as important factors.

Nyckelord
Keyword
Logistics, packaging, packaging system, telecom equipment industry, Roland Sjöström

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Targeting the Logistical Packaging System
A Study of the Telecom Equipment Industry

Författare Per Ackerholt & Henrik Hartford
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Sammanfattning
Abstract
Bakgrund: Som ett resultat av outsourcing har logistikflödena av material inom teleutrustnings-industrin förändrats avsevärt och detta har i sin tur medfört nya utmaningar för emballage-leverantören Nefab, som levererar till industrin. För att förvärva marknadsintelligens ämnar Nefab kartlägga materialflödena i industrin och undersöka möjligheterna att introducera ytterligare returförpackningslösningar.

Syfte: Syftet med denna uppsats är att beskriva typiska karaktäristika för logistiska materialflöden inom en teknisk, snabbt växande industri, samt analysera de drivkrafter och hinder som påverkar valet av förpackningssystem.

Genomförande: Efter att ha utvecklat en referensram bestående av generella logistikteorier samt förpackningsrelaterade teorier har vi intervjuat företag i Ericsson Radio Systems logistikkedja.

Resultat: Vi har funnit att karaktärsdragen för de materialflödena inom vår undersökta industri är variationer i efterfrågan, fokusering på time-to-customer och globalisering av logistikkedjan. Gällande drivkrafter och hinder som påverkar valet av förpackningssystem har vi identifierat Transportkaraktäristika, Kundkrav, Kvalitet, Hantering & Administration samt nuvarande förpackningssystem som viktiga faktorer.

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(In order of Appearance)

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Henrik Hartford & Per Ackerholt

Linköping, January 19, 2001

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LIST OF ABBREVIATIONS

CLM:	Council of Logistics Management
EMS:	Electronic Manufacturing Services
ERA:	Ericsson Radio Systems
ESD:	Electrostatic Discharge
GSM:	Global System for Mobile Telecommunications
ITU:	International Telecommunication Union
JIT:	Just-in-Time
OECD:	Organisation for Economic Co-operation and Development
OEM:	Original Equipment Manufacturer
R&D:	Research & Development
RSA:	Ericsson Radio Access
SCM:	Supply Chain Management
SOU:	Statens Offentliga Utredningar
S&S:	Segerström & Svensson
TTC:	Time-to-Customer
TTM:	Time-to-Market
WTO:	World Trade Organization

READER'S GUIDE

Chapter 1 – Introduction
This chapter gives the background to our project and a brief presentation of the company who commissioned this thesis. Important concepts in our problem area are then presented, and the chapter is concluded with the purpose of this thesis and how we have narrowed our research.

Chapter 2 – Scientific Approach
This chapter shows our view on science, knowledge, objectivity, and our paradigm. In addition, we describe the method approach we have chosen in our research, and from what scientific perspective we originate.

Chapter 3 – Research Procedure
The objective of this chapter is to present our course of action and the different methods we have been using when conducting our research. Finally, a criticism of our different sources is outlined.

Chapter 4 – Logistical Theories
This chapter presents general logistical theories, which we feel can be applicable when analyzing our problem area of logistical packaging systems.

Chapter 5 – Packaging Logistics
The objective of this chapter is to introduce the reader into the area of packaging logistics and what factors to consider when selecting a logistical packaging system.

Chapter 6 – Problem Specification
This chapter contains the specific questions, whose answers will help us to fulfill our purpose. Based on the theories from Chapter 5, we also present an analysis model, which lays the foundation for the forthcoming chapters.

Chapter 7 – Field of Investigation

This chapter consists of the empirical data we collected through our interviews. The chapter contains one section for each company, and the structure is based on our analysis model from the previous chapter.

Chapter 8 – Analysis

In this chapter we analyze our empirical data based on our generic analysis model and our presented problem questions. We draw connections with relevant theoretical frameworks, and also present our personal opinions and thoughts of related issues.

Chapter 9 – Conclusions and Final Remarks

In this chapter we present the general conclusions of our research. Furthermore, we evaluate ourselves from accepted scientific ideals and give suggestions on future research in the area of logistical packaging.

chapter 1

INTRODUCTION

The objective of this chapter is to give the background to our project, and explain why this thesis has been written in the first place. Since our investigated area contains a number of important concepts, which may not be known to the greater majority, these are described in order to facilitate further reading. The chapter is concluded with a problem discussion, the purpose of this thesis, and how we, due to various reasons, have narrowed our research.

1.1 Background

This thesis, which is commissioned by Nefab AB, deals with the structure of the logistical flows in the Swedish telecom[1] equipment industry, and the flows' influence on the selection of logistical packaging system[2].

There is an old Egyptian proverb, stating that when dogs drink from the Nile they do so while running, in order to avoid becoming a prey of the voracity of the crocodile. We would like to argue that this is the mentality on which this thesis is founded; Darwin called it the survival of the fittest – for any company competing in today's global economy it may be translated to market intelligence. Again reflecting on the "canine metaphor", experience show that any dog fed water from a bowl for a longer duration most certainly would have difficulties remembering how to drink and run simultaneously.

An "old dog" and market leader[3] of the packaging industry, Nefab AB, has since its establishment in 1949 been providing packaging solutions to a large variety of customers. Nefab operates within two business areas, export packaging – or one-way systems, and reusable transport packaging systems. Since the late 1960s, when co-operation with Ericsson was initiated, Nefab's development has been closely related to the telecom equipment industry. (Nefab, 2000a) Currently, the telecom market segment accounts for 47 percent of Nefab's total sales (Nefab, 2000b). Due to the enormous growth of the telecom equipment industry and the huge business potential following in its wake, Nefab has, however, focused its efforts on keeping up with expansion to meet existing demand, rather than on building and maintaining market intelligence (Strömberg, 2000).

The rapid speed of developments in information technology makes it difficult and costly for companies to remain updated with trends, and to finance development costs for all components included in a product. One of the strongest industry trends in the 1990s has therefore been the concentration on core business, i.e. that area where the company possesses

[1] The abbreviation telecom is used when referring to telecommunications.

[2] For a definition of logistical packaging system, see Section 1.2.6.

[3] In the area of transport packaging with plywood as the foremost packaging material. For further information about Nefab, we refer to Appendix A.

a competitive advantage[4]. In today's international business community, a company can no longer survive by maintaining only a decent level of performance; it has to be excellent. Since simultaneous out-performance in many areas is very difficult to sustain, a concentration on core business often occurs, and activities which do not fall into this category may be purchased from other players on the market. This transfer of processing value to subcontractors is called *outsourcing*, or subcontracting. (Paulsson et al, 2000) Through outsourcing, companies can obtain competitive advantage in terms of increased flexibility, enhanced quality, lower costs and shared risk-taking. (Lambert & Stock, 1993)

Due to the outsourcing trend, and also as a result of mergers and acquisitions, the telecom equipment industry has undergone major changes. The result is an industry in transformation, where single companies in charge of the entire production is replaced with a vast array of suppliers and subcontractors. An increasing number of Original Equipment Manufacturers (OEMs)[5] are focusing on their core businesses and concentrating resources on R&D, design, marketing and sales. (http://www.segerstrom.se [a]) Production and assembly are either outsourced to subcontractors, or to major global suppliers known as Electronic Manufacturing Services (EMS)[6], who are becoming responsible for an ever greater part of the entire manufacturing process. Through outsourcing, the OEMs can enjoy several benefits, e.g. shorter time-to-market[7] and enhanced asset utilization. (http://www.solectron.com) Moreover, since product life cycles tend to become shorter, demands for rapid development of new products increase, implying that the manufacturers to a greater extent want to purchase complete systems from the least number of suppliers possible. (http://www.segerstrom.se [a])

The changes in industry structure have had great impact on the logistical flows of material within the telecom equipment industry. As a result thereof, and also due to increasing competition on the market, Nefab has realized, that acquiring market intelligence is vital in securing future profitability and sustaining market leadership. Therefore, Nefab is

[4] A position of permanent superiority over competitors in terms of customer preference.

[5] A company who manufactures and customizes products under own brand name.

[6] Also in some literature referred to as Contract Electronic Manufacturer (CEM) or Contract Manufacturer (CM)

[7] The time it takes from product development until the product hits the market.

currently stressing the need of investigating the logistical flows of products and logistical packaging in the telecom equipment industry. By mapping important actors on the market, the features of logistical flows between them, and the reasons behind the adoption of a particular logistical packaging system, Nefab hopes to improve its future competitiveness.

1.1.1 Packaging System

Traditionally, the main focus of logistical packaging in all industries has been on the implementation of one-way, disposable packaging systems. (Rosenau et al, 1996) The developments in the telecom equipment industry and Nefab have been no exception from this rule (Strömberg, 2000). It has been recognized, however, that expendable packages are not always the most cost-effective alternative. Purchase and disposal costs can be substantial, especially for products regularly shipped in larger volumes. (Rosenau et al, 1996) In line with these arguments, and also due to a concentration of suppliers in the telecom equipment industry in for instance business parks, Nefab has realized the potential of future market growth and increased profits in the reusable packaging field. (Strömberg, 2000)

Reusable packaging has been a U.S. success story of the 1990s (primarily in the automotive industry), and this development is seen as a result of increased consumer awareness regarding environment and packaging materials. The environmental concern has driven many companies to investigate new ways of packaging and transporting their products, and many of them have changed from traditional corrugated cardboard packaging to plastic returnable packaging. (Modern Material Handling, 2000) Similarly, Strömberg (2000) views the growing interest for the utilization of reusable packaging as a result of increased environmental awareness in combination with potential cost-savings.

1.2 Important Concepts

1.2.1 Logistics

This thesis discusses the concept of logistics – or Logistics Management. The Council of Logistics Management[8] has adopted the following definition of logistics, which has been internationally accepted:

> *"Logistics is the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw-materials, in-process inventory, finished goods and related information from point-of-origin to point of consumption for the purpose of conforming to customer requirements."*
>
> (Taylor, 1997, p. 9)

From this definition we can conclude that the two primary objectives of logistics are to achieve appropriate customer service, and to do so in a cost-effective manner. (Taylor, 1997) An alternative description of logistics is made through the seven Rs; to ensure delivery of the *right* product, in the *right* quantity, the *right* condition, at the *right* place, at the *right* time, for the *right* customer, and at the *right* cost. (Coyle et al, 1992)

> *"The concept of logistics is ancient…We have been warehousing goods since the days of the ancient Egyptian grenadiers. We have been moving things by transport since man first learned that logs float down stream. We have been storing goods since man first discovered that was a way to survive a long cold winter. There is nothing new in the field of logistics. What is new is how we do it."*
>
> (Glaskowsky, 1970)[9]

As described in the quotation above, logistics has old traditions. The importance of the concept has, however, primarily been recognized in the latter part of the 20th century, as logistics became one of the most significant business trends, and in many cases a critical success factor. (Christopher, 1998) Kent & Flint (1997) describe the evolution of the

[8] Definition by The Council of Logistics Management (CLM) in 1986. The CLM is a major international interest organization within the logistical field.

[9] Taken from OECD (1996) p. 40-41.

logistics concept in several stages. Until the 1960s, the logistics trend was mostly focused on functional perspectives, with focus on single activities, for instance physical distribution and warehousing. Then, from the 60s to early 70s, logistics developed towards a more integrated system view, with focus on total costs, and from early 70s to mid 80s the emphasis was on customer service. Then, in the mid 80s, supply chain management (SCM) arose together with concepts as reverse logistics and globalization, a trend which continues today. Christopher (1998) views SCM as no more than an extension of logistics. Whereas logistics primarily aims to optimize flows within the organization, SCM demands co-operation and co-ordination over organization boundaries. The supply chain is defined as:

> *"…the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of product and services in the hands of the ultimate consumer."*
>
> (Christopher, 1998, p. 12)

By managing the supply chain, leading companies recognized that it became more competitive. Through optimization and integration of the flows between companies, value could be added, and overall costs could be reduced. (Christopher, 1998)

1.2.2 Logistical Flows and Logistics Channel

According to Paulsson et al (2000), a supply chain consists of three general flows, all of different character:

- **The Physical flow –** consisting of goods, packaging, containers, and means of transportation.
- **The Information flow –** whose main objective is to effectively and efficiently administrate the physical flow.
- **The Financial Flow –** which encompasses the payment to suppliers for the goods and services rendered.

Lumsden (1995) further divides the physical flow into material flow and resource flow. Material flow comprises all aspects of movements of raw materials, work in process, and finished goods between companies, whereas the flow of resources consists of mobile resources, which are used

up or put into circulation. Used-up resources are for instance labor, and circulating resources are for example containers between vehicles.

This thesis focuses on investigating the physical flows, which generally travel forward in the supply chain, whereas for instance the financial flows normally flow in the opposite direction (Paulsson et al, 2000).

In the literature, several words are used for describing the flows between companies. We have already introduced the supply chain, but henceforth, we will use the term logistics channel when referring to those companies participating in the flows of materials between suppliers and customers. (See Figure 1:1) Novack et al, (1992) view the logistics channel as an integration of both the marketing channel and the distribution channel, and this integration would include all firms in the channel, from raw material source to final customer.

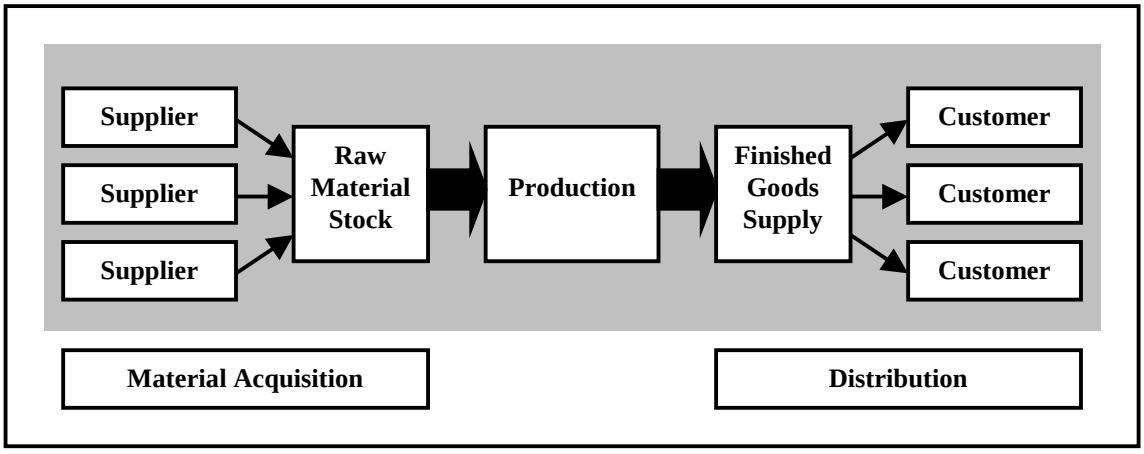

Figure 1:1 – Logistics Channel
Source: Persson (1998, p. 17) (Revised by the authors)

1.2.3 Reverse Logistics

The world has come to a situation in which society considers environmental awareness an absolute necessity. As a result there has been increasing recycling and reuse of products and materials in recent years. This development is, however, not only stimulated by environmental responsibility and government regulations; several companies see commercial opportunities in performing these tasks. (Kroon & Vrijens, 1995) The management concept within this field is called reverse logistics.

The Council of Logistics Management (CLM) has developed the following definition of this concept:

> *"Reverse logistics encompasses the logistics management skills and activities involved in reducing, managing, and disposing of waste. It includes reverse distribution, which is the process by which a company collects its used, damaged, or outdated products or packaging from end-users."*
>
> (The CLM, 1993)[10]

This thesis deals partly with reusable packages, which after usage are transported in the opposite direction of the normal material flows, and therefore, reverse logistics is an important issue for us to consider.

1.2.4 Logistical Activities

Porter (1985, 1990) claims that the process of adding value to a product in a firm consists of primary and support activities in a value chain as described in Figure 1:2 below. Each company has its own value chain, and the overall value chain is a combination of supplier, manufacturer, and distribution channel user, i.e. the overall value chain is synonymous to what we call a logistics channel.

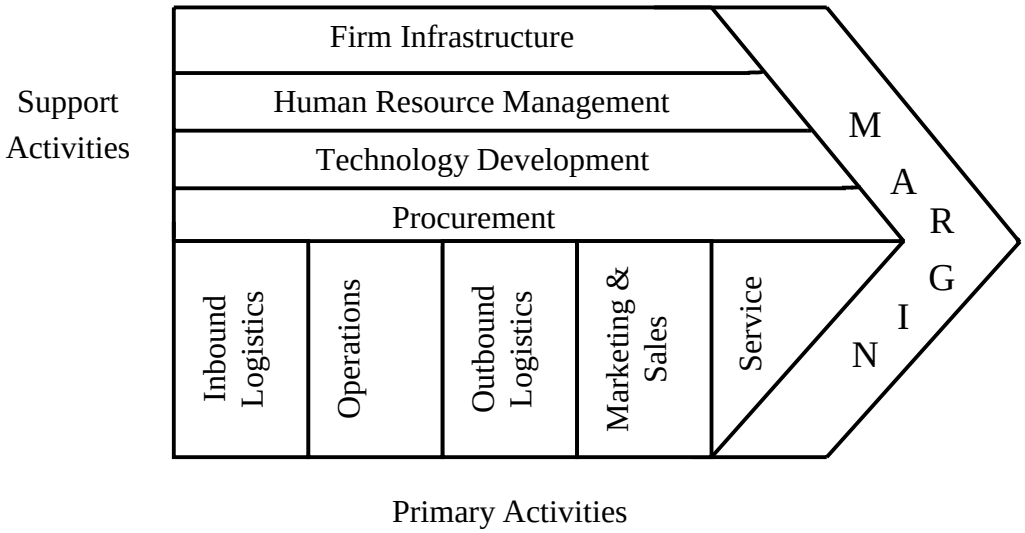

Figure 1:2 – The Value Chain
Source: Porter (1990, p. 41)

[10] Taken from Stahre (1996), p. 8.

Hence, there are three main fields of logistical activities. To simplify, inbound logistics deals with the reception of materials from suppliers, and examples of such activities are materials handling, warehousing, inventory control, scheduling, and returns to suppliers. Activities within operations are, for instance, machining, packaging and assembly, and finally, outbound logistics activities includes finished goods distribution, warehousing, materials handling, delivery vehicle operation and order processing. (Porter, 1990) It is obvious, however, that activities related to packaging take place throughout the logistics channel (and not only within operations). Therefore, we find the logistical activities classification of for instance Coyle et al (1992) and Lambert & Stock (1993), where packaging is regarded as one of the main logistical activities, more relevant to us than that of Porter.

• Customer service	• Plant and warehouse site selection
• Demand forecasting	• Procurement
• Distribution communications	• Packaging
• Inventory control	• Return goods handling
• Materials handling	• Salvage and scrap disposal
• Order processing	• Traffic and transportation
• Parts and service support	• Warehousing and storage

Table 1:1 – Logistical Activities

Source: Lambert & Stock (1993, p. 16)

1.2.5 Packaging

Packaging is all around us, and is part of the daily life of consumers and companies. The need for packaging permeates our economy, and any kind of conservation or transportation of products requires packaging. We find it relevant to present a packaging definition we consider useful. According to The EU Packaging and Packaging Waste Directive (94/62/EC):

> *"Packaging shall mean all products made of any materials of any nature to be used for the containment, protection, handling, delivery, and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer."*
>
> (http://europa.eu.int)

According to SOU (1991:76), packages are generally categorized into three main types:

- **Primary or consumer packaging** – A packaging containing one sales unit to end-user or consumer.
- **Secondary or multi-unit packaging** – A packaging designed to contain a number of primary packages to a retailer/store.
- **Tertiary or transport packaging** – A packaging that facilitates transport and handling of a number of primary or secondary packages with the aim of preventing damage to the product.

This thesis is delimited to include transport packaging, which henceforth will be addressed as logistical packaging.

1.2.6 Logistical Packaging Systems

Twede (1992) argues that research about logistical packaging is needed, since available packaging literature often is market-oriented with a focus on consumer packaging and their design. The definition of logistical packaging is:

> *"…what facilitates product flow during manufacturing, shipping, handling and storage."*
>
> (Twede,1994, p. 114)

A logistical packaging consists of shipping container, dunnage and a unit load[11] and can be of either one-way or reusable[12] character (Twede, 1992). A one-way packaging is only used once for its original purpose, whereas the reusable packaging is constructed for re-utilization, i.e. to be used more than once. Hence, when referring to logistical packaging systems, they are either one-way packaging systems or reusable packaging systems. (Packforsk, 2000)

[11] For instance a pallet.

[12] Some authors use the term returnable. In this thesis we consider the two words completely synonymous.

According to Jönsson (1991), logistical packaging systems can be divided into the following components:

- Packaging types
- Packaging materials
- Combination of packaging type and packaging material

The packaging type and materials we are focusing on in this thesis are plywood packages, both of standardized size and customized nature to fit particular products. In addition, we deal with packages made out of corrugated cardboard, load pallet with collars[13], and plastic containers.[14]

Regarding deeper analyses, there is a scarcity of research in the field of reusable packaging systems:

> *"…there has been very little research on returnable packaging and none on the decision process for implementing a returnable logistics system. Although there are some articles reporting the use of returnable systems, none have drawn comparisons across firms."*
>
> (Rosenau et al, 1996, p. 145-146)

A number of articles about the implementation of returnable packaging, primarily in the automotive industry have been published in the United States, but most of these are relatively superficial, and do not completely explain the implementation process and driving forces behind the choice of packaging. (Stahre, 1996)[15]

1.3 Problem Discussion

According to Packforsk (2000), it is neither from an environmental, nor from an economical viewpoint, possible to unambiguously stipulate the

[13] Throughout Europe a standardized pallet size is mostly used, measuring 800*1200 mm.

[14] For examples of different packaging types, we refer to Appendix C.

[15] During a conversation in December 2000 with Fredrik Stahre at Logistics and Transport Systems, Department of Management and Economics at Linköping University, he stated that few reports have been published since 1996.

superiority of either packaging system. The advantages of different systems depend on outer and inner environment of the packaging, i.e. the product, and market/distribution channels. (Ibid) Twede (1993) also views the process of adapting and selecting a new packaging system of either one-way or reusable character, to be dependent on several factors, which have to be weighed against each other prior to the packaging selection. Rosenau et al (1996) argue that returnable logistical packaging systems can offer significant cost savings over traditional one-way packaging in some logistics channels. The development towards an increasing usage of returnable packages is a result of higher disposal costs in the last decades, deregulation of transports, and a trend towards more integrated logistics.

We believe that to fulfill the objective of logistics, to reduce costs, the packaging system naturally has to be as cost-effective as possible. What are the most decisive factors when selecting a logistical packaging system? Packforsk (2000) mentions the influence of distribution channels as important. Distribution channels form part of logistics channels, which we intend to investigate, and our interest lies in conducting research of the physical flows in a rapidly growing, technically based industry. How do the characteristics of the flows throughout the logistics channel influence the choice of logistical packaging system? To what extent do delivery volumes, number of actors in the logistics channel, delivery frequencies, and the packaging destination have an importance? A common belief is that the product type influences the packaging choice. This is likely to be true also in our case, since technically advanced valuable components naturally require solid packages with a great deal of dunnage.

The decision to implement a new type of logistical packaging can be a complex process, requiring analyses, planning, management support, and negotiations between entities in the logistics channel. (Witt, 1997) Therefore, several companies might hesitate to change, and appear quite satisfied with their current packaging system. Johansson et al (1997) argue, that decisions of incorporating a new packaging system can be a question of both strategic and operational nature, and have to be made on different hierarchical levels. With this discussion in mind, we find it interesting to speculate about the future of logistical packaging systems, and reusable systems in particular. Are there any obvious obstacles hindering the implementation of more reusable systems and what other possibilities are distinguishable in the logistical packaging area?

1.4 Purpose

The purpose of this thesis is to describe the typical features of the logistical material flows in a technically based, rapidly growing industry, and analyze the driving forces[16] and obstacles, which influence the selection of logistical packaging system.

1.5 Narrowing the Field

We have conducted research within the telecom equipment industry, but delimited the thesis to include only companies delivering to Ericsson Radio Systems (ERA) As a result of choosing ERA, we will only deal with products and components included in mobile telecom systems, and thus, consumer products are not investigated. We have also chosen only to investigate the driving forces behind the selection of logistical packaging systems, and not the systems' possible effects over time.

We are aware that environmental issues and ergonomics can be of importance when analyzing the choice of logistical packaging systems. However, since these issues not to any greater extent are related to our educational background, we have chosen to not explicitly deal with them in this thesis. That a large environmental awareness is prevailing, signifies the fact that all interviewed companies are ISO 14000 or ISO 14001[17] certified.

[16] We define a driving force as an influencing factor, resulting in a certain behavior or action.

[17] ISO 14000 and ISO 14001 are international voluntary environmental standards recognized by major countries, and trade regulating organizations such as the WTO.

chapter 2

SCIENTIFIC APPROACH

To enable the reader to better understand how we have been thinking and discussing when developing this Master's Thesis, we will in this chapter describe our view on science, objectivity, knowledge, and our own paradigm, including what we aim to achieve with this thesis. In order to further clarify our standpoint, we will explain from which scientific perspective we emanate, which method approach we have adopted for our research, and how these two conceptions are connected to our problem area.

2.1 What is Science?

There are several opinions on what science actually is and what it means. Molander (1988) claims that science is public; it describes, certifies and explains. Chalmers (1999) argues that what is so special about science, is that it appears to be derived from the facts, rather than being based on personal opinions.

Our opinion is, that a report can be called scientific if it investigates a problem area, which appears relevant and interesting to a broader population. This investigation must then be presented logically, and well structured, resulting in some kind of new data, which hopefully begets increased knowledge for both researcher and targeted audience.

Our scientific opinion, which scientific ideal we possess, and from which scientific perspective we originate, will be further discussed when describing our paradigm and method approach in section 2.4.2 and 2.4.4 respectively.

2.2 Objectivity

Ejvegård (1996) is of the opinion that to be considered scientific, every report/thesis/dissertation published within the university world has to be impartial and objective. The demand for objectivity gives rise to the question what its actual meaning is. Molander (1988) claims that an objective description is impartially correct, remains with the subject, and is not misleading. Andersen (1994) argues that objectivity, for instance, implies being free from values and pre-conditions, and characterized by matter-of-factness, awareness and open-mindedness.

We find it more or less impossible to be completely objective conducting our research. As a result of our education, and by simply being up-to-date with developments in society, we have acquired a certain pre-understanding of our problem area, which to some extent will influence us as we write our thesis. Nevertheless, we strive to make this thesis as objective as possible, which according to Ejvegård (1996) can be achieved by adhering to certain rules. One requirement is that all different viewpoints in a controversial subject with shared opinions have to be reviewed. Other pre-conditions for objectiveness are the avoidance of

emotive words, a critical mind towards sources – meaning that it must be investigated whether the source is biased or even propaganda material – and finally, to thoroughly express what thesis statements derive from the researcher's personal opinions or interpretations. (Ibid)

2.3 Knowledge

Knowledge is another abstract concept, and how humans acquire knowledge has been widely debated throughout history. In ancient Greece, Plato argued that we can only have knowledge about the eternal and the unchangeable, and we can acquire such knowledge only by using our sense or our soul, and not through the organs of perception. These thoughts are fundamental for the *Rationalism* (Molander, 1988). The *Empiricism*, which prospered in 16–17th England, states contrary to the rationalists, that knowledge can only be acquired by sensory experiences; it has to be based on observations and not on logical thinking. (Alvesson & Sköldberg, 1994)

We believe that some knowledge is best acquired through empirical experiences by using our five senses, whereas we are of the opinion that other knowledge can be the result of human sense. Thus, we are neither accepting that extreme rationalism, nor extreme empiricism, is the perfect way of acquiring knowledge. Instead, we think that the ideal approach is more likely less conventional through a mixture of both.

2.4 Knowledge Development

How is knowledge developed when conducting research in social sciences? Arbnor & Bjerke (1994) allege that the development of knowledge is a result of a complex process with several determinants, and how the process evolves is depicted below in Figure 2:1.

Arbnor & Bjerke (1994) argue that to obtain meaningful results when conducting scientific research, it is crucial that the method is in accordance with the investigated problem and the fundamental conceptions of the researcher. Fundamental conceptions on how reality is organized are according to developed by every human, and those conceptions, which often are difficult to change, influence the way we view problems. The

fundamental conceptions originate from a paradigm, which also is the connection between fundamental conceptions and method approach. (Ibid)

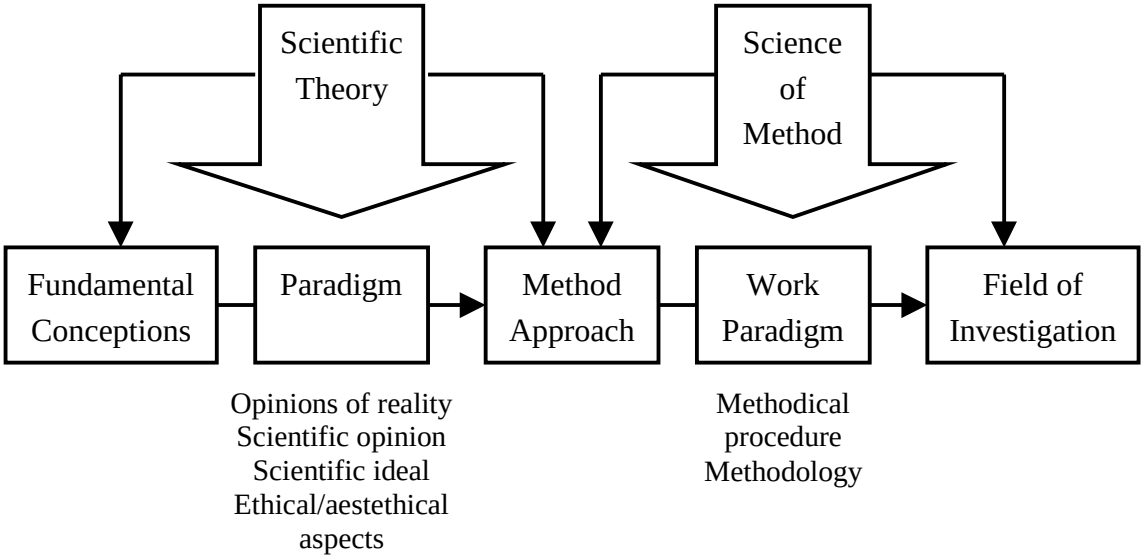

Figure 2:1 – The Process of Knowledge Development
Source: Arbnor & Bjerke (1994, p. 33) (Revised by the authors)

The method approach is two-folded, firstly, it contains fundamental conceptions, and secondly, it forms the so-called work paradigm, i.e. the methodical procedure and methodology[18]. In contrast to the paradigm, the work paradigm is continuously changing depending on the field of investigation. Simplified, methodical procedure implies the researchers way of organizing, developing, and modifying an already given technique (e.g. collection of data) in a method approach. Methodology is how one relates and adapts the created method of the techniques to the investigation plan, i.e. how the research is conducted. (Arbnor & Bjerke, 1994)

2.4.1 Paradigm

Arbnor & Bjerke, (1994) put forward an important difference in the meaning of paradigm between natural sciences and social sciences. In the former case, represented by for instance Thomas Kuhn[19], new paradigms by

[18] Our work paradigm, including the methods we have been using for our research, is further described in next chapter.

[19] Thomas Kuhn introduced the paradigm concept in his book "The Structure of Scientific Revolutions", published in 1962.

a paradigm shift entirely replace the old, while in the latter case, represented by Törnebohm, old paradigms often continue to co-exist beside the new. Our study is partly connected to paradigm shifts, since the introduction of a new packaging system can be considered as a shift in packaging paradigm. We hold it unlikely that old paradigms simply can cease to exist, and therefore associate us rather with the evolutionary paradigm view of Törnebohm (1974), which Arbnor & Bjerke (1994) interpret to consist of:

- *Opinions of reality* – which explains how reality is constructed.
- *Scientific opinion* – which is the knowledge gained through education, which has formed opinions about the investigated subject.
- *Scientific ideal* – which is connected to what the researcher aims to achieve with the research.
- *Ethical/aesthetical aspects* – which define what the researcher considers morally appropriate or not, and what is regarded as beautiful or ugly.

2.4.2 Our Paradigm

Opinions of reality

Our opinions of reality are slightly ambiguous. Generally, we believe that reality is a social subjective construction, i.e. a result of human values, opinions and norms, and a system where people interact with each other. To a certain extent, however, we believe in the existence of objective truths in reality.

Scientific opinion

During our studies at Linköping University and at foreign universities, we have assimilated a number of theories which are giving us ideas about our subject of investigation. We are for instance possessing a certain knowledge within the logistics field, and this will naturally influence us as we conduct our research. Regarding the area of packaging logistics, our scientific opinion is, however, more uncertain, since this is partly an area with little previous research and partly an area which was virtually unknown to us prior to this thesis.

Scientific ideal

What we aim to achieve with our research and this Masters Thesis conforms rather well with the three generic prerequisites on a research

report, stated by Eriksson & Widersheim-Paul (1999); it should be interesting, reliable and comprehensible. To be interesting implies that other persons than the researcher can perceive the investigated area as meaningful. Whether a subject is experienced as interesting is, however, naturally a question of subjectivity. Reliability means that there should be a logical, systematical consistency throughout the thesis, which facilitates for the reader to believe what is written. Comprehensibility implies that the final draft of the report should be easy to understand, and convey the image of the investigation as intended by the researcher. We believe that this can be achieved by having a logical structure of the thesis, and by writing in an impartial and intelligible way without unnecessary intricacies.

Ethical/aesthetical aspects

We think that the ethical aspects do not to any greater extent apply to our research, but naturally we feel that demands on anonymity and secrecy have to be entirely respected. Regarding the report's aesthetical aspects, for instance layout, we are advocating consistency and attractiveness, since this contributes to the report's overall impression.

2.4.3 Method Approaches

Arbnor & Bjerke (1994) state the existence of three method approaches outlined in the figure below: *the analytical*, *the system*, and *the actor's approach*.

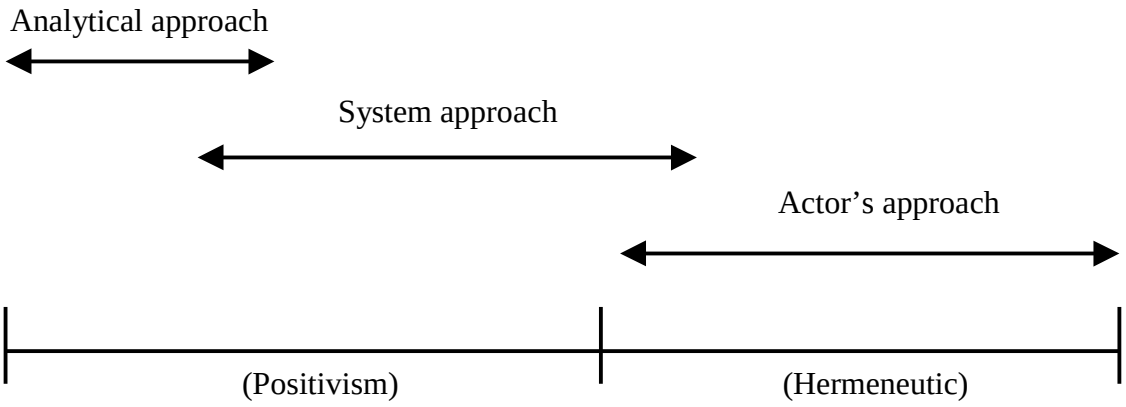

Figure 2:2 – Method Approaches

Source Arbnor & Bjerke (1994, p. 61) (Revised by the authors)

Supporters of the analytical approach are often called positivists (Arbnor & Bjerke, 1994). Developed in the 19th century by the French sociologist

Comte, positivism is a rationalistic science approach, which stipulates the existence of objective truths in the reality. Positivism emphasizes quantitative methods and the demand for reliable scientific facts. (Eriksson & Widersheim-Paul, 1999) The actor's approach agrees with the hermeneutic science school (Arbnor & Bjerke, 1994). Hermeneutic is a subjective approach, which focuses on interpretation. The hermeneutics approach a problem with a certain pre-understanding of the phenomena, and to be able to understand the different parts, they seek to acquire a holistic problem understanding. Once achieved, this will allow separate reinterpretation of the parts, and thus, a new problem understanding will be developed. (Patel & Davidsson, 1994)

2.4.4 Our Method Approach and Scientific Perspective

We primarily associate us with the system approach, which similarly to the analytical approach also accepts the existence of an objective reality. However, the system approach states that reality is organized through components mutually dependent on each other, and that the total sum of the components often differs from the sum of reality, due to positive or negative synergetic effects. Knowledge is dependent on the relation between the parts, and can only be explained on the basis of the complete picture. This approach denies the usefulness of causal connections and rather seeks to explain a process by finding expedient driving forces influencing the system as a whole. (Arbnor & Bjerke, 1994)

We believe that in some situations, particular driving forces cause certain effects, but facing other conditions those effects might be different. Thus, we do not strive to find clear relations between cause and effect, and therefore the analytical method approach does not appeal to us. At the other extreme, although we have performed interviews, our focus is not to explain social relations and behavior, but to focus on the concept of packaging as part of a logistical process, which lead us to affirm that the actor's approach is not sufficient if we are to fulfill our purpose.

We are considering the core of our study, logistical packaging systems, as part of packaging logistics, which in turn is part of the entire logistics system. We also believe that changes of any particular logistical activity, for example transportation, within, or between, any company in the logistics channel, may have impact on other entities or activities. Hence,

we believe that we have to take the entire system, i.e. the whole logistics channel, into account when we are investigating the selection of logistical packaging system. As a result, we regard the system approach as being the most appropriate for our study since it, due to possible synergetic effects, emphasizes the importance of a holistic perspective. Especially since packaging is a logistical activity that occurs at so many different instances along the logistics channel, we emphasize the system approach and argue that we have to take the overall logistics system into consideration. We will try to achieve what Arbnor & Bjerke (1994) describe as "finality", which is related to causality, but has less demanding requirements. For instance, we do not exclude the possibility of other explanatory causes as influential on the selection of logistical packaging systems. Especially since our research area is rather fragmented, and our time for this research has been limited, we do not feel certain enough to stipulate otherwise.

We strongly believe that there are several advantages and pitfalls of both positivism and hermeneutic, and would consider the approaches as two extremes on a continuum. Our education has formed us with influences from both ends, and thus, we consider ourselves as possessing a mixture of influences from both positivism and hermeneutic. Our objective is to explain the driving forces that influence the choice of logistical packaging in a rapidly growing, technically based industry. Within this area, we presume the existence of a number of objective explaining-causes in reality. In addition, we think that for example the choice of packaging in many cases is a result of the reality itself, and not the individuals acting in it. Hence, our perspective has similarities to the positivistic science approach.

On the other hand, the hermeneutic ideal appears useful to us since it is very difficult to conduct research without being colored by a certain degree of subjectivity. Performing our interviews, we have therefore received several different opinions about the logistical flows, and the choice of packaging in our investigated industry. Particularly when investigating future expectations on logistical packaging, including opportunities, obstacles, and ambitions to change packaging system, we assume that objectively correct answers are practically non-existent. Therefore it is in these situations important for us as researchers to interpret the answers of our interviewees and create a synthesis. Naturally, we aim to deal with all gathered information in a way which seems correct to us, and is as objective as possible.

chapter 3

RESEARCH PROCEDURE

This chapter deals with our research process, course of action and the methods we have been using when conducting our research. We are of the opinion that knowledge of these issues will enable the reader to follow the evolution of our thesis, and will contribute to enhanced trustworthiness. Due to the importance of regarding sources with a certain degree of skepticism, we conclude the chapter with a criticism of our sources.

3.1 Introduction

We felt that we did not only want to write a theoretical thesis, but also to some extent carry out research in the business community. We established contact with Nefab in October 2000, and since logistics is one area of business administration that appeals to us, we considered their project proposal highly interesting. In addition, we regard the telecom industry, due to its actuality, dynamic nature and fascinating technology, as one of the most exciting lines of businesses on the market.

As a result of our limited initial knowledge of the telecom equipment industry, our first objective was to attain a good market overview of major actors from the Original Equipment Manufacturer, the Electronic Manufacturing Services, and the supply side. In this process, which can be seen as a pre-study, we were able to identify more than 50 companies who all played key parts in the manufacturing of telecom equipment.

3.2 Research Process

Figure 3:1 below illustrates our research process, which we will make connections to throughout this chapter. The process contains different stages, from the point when our actual problem area was decided, until conclusions were drawn, and evaluation of our thesis was made.

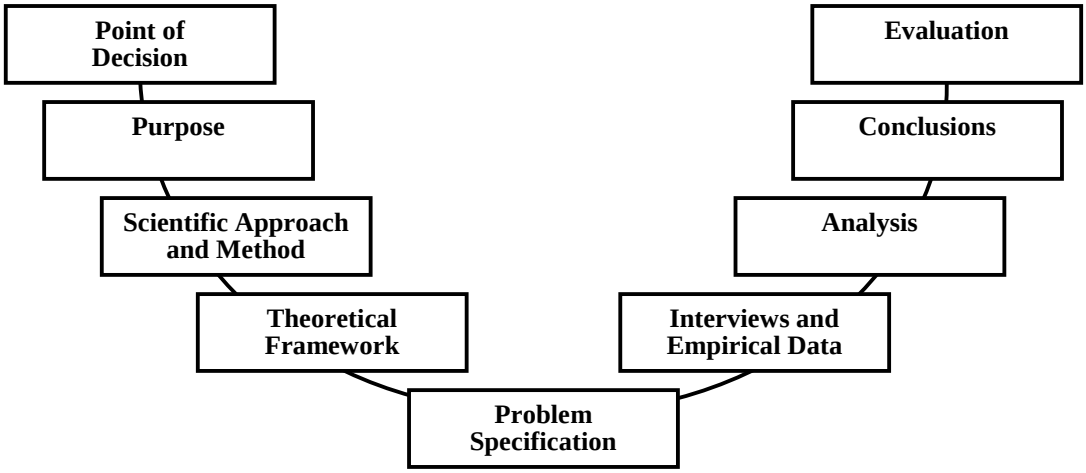

Figure 3:1 – Logical Levels in a Report

Source: Lekvall & Wahlbin, (1993, p. 254) (Revised by the authors)

Important to emphasize is that our research process has been of an iterative nature, which for instance means that we have revised our theoretical framework after the collection of our empirical data. We felt that this kind of procedure has been necessary to use, because of the limited time period we had at our disposal when creating this thesis, and constraints in acquiring applicable literature. Lekvall & Wahlbin (1993) state that before completing the report it is vital to compare different stages with each other. This includes, for instance, to evaluate whether the analysis and conclusions are in accordance with the problem specification and purpose[20].

3.3 Approach & Method

We have taken different alternative methods into consideration when creating our work paradigm, and the solutions we have chosen are described in this section.

3.3.1 Type of Study & Research Approach

Depending on the purpose, Lekvall & Wahlbin (1993) distinguish four different types of studies; explorative, descriptive, explanatory and predictive. A study is categorized as explanatory if the aim of the study is to explain a situation rather than only to describe it. Since this thesis not only is aimed at presenting a description of the logistical flows, but also to explain the driving forces behind the selection of packaging in the flows, we argue that it can be classified as having an explanatory objective.

Another classification deals with the research approach. If the purpose is to describe and analyze a single case in depth, the project is defined as a case study. (Lekvall & Wahlbin, 1993) In order to carry out this study, we concluded that the most efficient procedure would be to select one OEM company, and thereafter conduct an investigation and analysis of the physical flows in the logistics channel of that company. This leads us to affirm that the research approach of this report is similar to that of a case study. The natural choice of OEM company fell on Ericsson Radio Systems AB (ERA), which compared to its competitors presented us with a superior geographical closeness in terms of headquarter, EMS contractors

[20] We will perform an evaluation out from scientific ideals in Section 9.2.

and suppliers. In addition, Nefab's close relations with ERA could provide us with vital information regarding contact persons.

Lekvall & Wahlbin (1993) state that the boundary between descriptive and explanatory studies and various research approaches may be ambiguous. For instance, most descriptive investigations possess a certain measure of an explanatory ambition, but usually have a broader approach. Since our problem area deals with packaging logistics in the logistics channel of one company, we find the classification of this research project as explanatory rather than descriptive quite unambiguous.

3.3.2 Induction & Deduction

To draw conclusions from experiences and single observations is called induction, and is commonly utilized in social science research. This research method was used by the empiricists, often in areas where little previous knowledge exist. (Gustavsson, 1998) The opposite to induction is the logical scientific method known as deduction. Deduction implies formulating axioms and premises, and if the premises are true it means that the conclusion is true as well. (Alvesson & Sköldberg, 1994)

We will on the basis of our interviews formulate theories, which will certainly be true in some cases, but not always. Based on the information acquired from our research, we will make generalizations, which possibly could be valid for other players of the telecom equipment industry. This reasoning implies that our study has an inductive character.

3.3.3 Qualitative & Quantitative Method

> *"It is quality rather than quantity that matters"*.
>
> (Lucius Annaeus Seneca, 4 BC – 65 AD)

Another aspect of approach is whether the researcher uses a qualitative or a quantitative method. Lekvall & Wahlbin (1993) put forward a distinction between the two, in which quantitative studies are those where the collected data is expressed in terms of numbers and analyzed numerically. Since we have not expressed or analyzed numerical data, our study is not quantitative in this sense, but rather has a qualitative nature. A qualitative study has its origin in the hermeneutic tradition, and we have chosen this type of study even though we adhere to a scientific approach with some

positivistic features. The usual study object of qualitative research are individuals and the environment surrounding them (Patel & Tebelius, 1987). Holme & Solvang (1997) claim that the advantage of qualitative methods is that they enable a holistic understanding of the problem area. We argue, that by using the qualitative method, and interpreting the answers from our interviewees, we will have a good possibility of creating a holistic understanding of how individuals perceive different phenomena; in our case a logistical packaging system. We think that this reasoning also conforms well with our system approach, described in 2.4.4.

3.4 Primary & Secondary Data

> *"The ideas I stand for are not mine. I borrowed them from Socrates. I swiped them from Chesterfield. I stole them from Jesus. And I put them in a book. If you don't like their rules, whose would you use?"*
>
> (Dale Carnegie, 1888 – 1955)

In the data collection process, a distinction is often made between primary and secondary data. Primary data is obtained by the researcher, and is the result of own studies of the problem. Secondary data, on the other hand, may be the result of other people's research in the same problem area, or from other related problem areas. (Lekvall & Wahlbin, 1993)

In this research project, primary data has been collected through personal interviews and is gathered in Chapter 7 of this thesis. Secondary data related to logistics and the packaging field has been acquired through books, reports, articles, and from various Internet sources. Secondary data has been useful when describing important concepts of our problem area in the introduction chapter, and has also laid the foundation for our theoretical framework.

3.5 The Interviews

3.5.1 Choice of Interviewees

Information regarding the physical flows of Ericsson Radio System's logistics channel has primarily been obtained through interviews with persons from involved companies. Respondents have partly been contacted through already established relations of Nefab AB, and partly by sending e-mails or making phone calls to companies we felt could contribute to our investigation. As a result of our rather narrow field of investigation, the number of possible interviewees at respective company unfortunately turned out to be just as narrow. In addition, it soon became painstakingly obvious that logistics managers and other concerned individuals in the telecom equipment industry was quite a busy breed, and initial difficulties of booking interviews were many.

Efforts eventually paid off, however, and we managed to conduct six interviews. Apart from ERA, we interviewed two EMS companies – Flextronics and PartnerTech, and two of ERA's suppliers – Segerström & Svensson and LGP Telecom. In order to receive current information about logistical packaging systems, we also performed an interview with Packforsk, a Swedish Research Institute within the packaging field. The result of this interview is, however, dealt with in our theoretical framework, since obtained data not specifically is related to flows and logistical packaging of the telecom equipment industry.

3.5.2 Interview Technique

Patel & Tebelius (1987) classifies interviews as being either structured or unstructured. The structured interview gives the respondent very little freedom, and can be compared to a questionnaire with predetermined answer alternatives. If the interview is unstructured, the interviewee is given greater liberty of independent interpretations of questions, whereupon the answer can be given a personal touch. A further distinction is normally made between standardized and non-standardized interviews, where the degree of standardization is considered high where the interviewer asks the same questions in the same order to all respondents. In the non-standardized interview, the questions are formulated and asked in the order which the interviewer deems suitable. (Ibid)

The interviews during our research were all performed in Swedish, and to a relatively great extent, we followed a predetermined interview guide.[21] In order to give the respondent an idea about the questions we were about to ask during the interview, we sent an e-mail to each interviewee informing them about our areas of interest. This e-mail was, however, not as extensive as the interview guide later used. Even though we used the guide, the order in which our different questions were asked, and the attendant questions which arose on different occasions, have often varied. As a result, we argue that our interviews have been of a semi-standardized nature. In order to receive more extensive answers with a personal touch, our interviewees have been given rather much freedom for own interpretations when answering our questions. Therefore, we consider our interviews as being rather unstructured. After receiving permission from the interviewees, all interviews were recorded on tape to ensure that we did not miss or forget any important information.

3.5.3 Validity and Reliability

When conducting interviews, the danger of distortion of data and misinterpretations are always present. Lekvall & Wahlbin (1993) specify two types of possible imperfections; low validity and low reliability. Validity, which can be divided into several sub-levels, implies the danger of shortcomings in measuring the right thing. Lundahl & Skärvad (1999) distinguish between internal and external validity. Internal validity is supposed to exist when the measuring instrument (in our case the interview) measures what it is intended to, whereas external validity implies how well a measured value (in our case the answer to a question) is in accordance with reality. (Ibid) Reliability refers to the authenticity of the measurement method, i.e. its ability to avoid the influence of chance. An important demand for reliability is also that, if the investigation is performed once again by any researchers using the same methods, the results should be the same as the first time. (Lekvall & Wahlbin, 1993)

In our opinion, we have through our literature study attained a good overview of the most applicable of the existing theories in the logistical packaging field. With those theories in mind, we created our interview guide. We therefore think that the questions we asked were relevant for our problem area, and that the answers enabled us to fulfill the purpose of our

[21] An English translation of the guide is enclosed in Appendix B.

thesis. Thus, from our viewpoint, we have managed to obtain a sufficient level of inner validity in our empirical data. Regarding the outer validity, this is more difficult to estimate. Our interviewees could not provide us with extensive answers in all instances, but by asking attendant questions, where we considered it necessary, and also on occasion submitting supplementary questions by e-mail when we felt that some data was incomplete, we think that we have, although not perfect, attained an acceptable level of outer validity.

We believe that, since our interviewees, occasionally due to lack of knowledge, responded vaguely, basing their answers on their personal opinions at the particular time for the interview, we are not entirely certain that the answers would be exactly the same if the interview would be performed once again. Nevertheless, all our interviewees were very friendly, and they assured us that we could contact them again if anything was unclear. For approval, we also submitted the complete written interview by e-mail to the respondents. Hence, we believe that this has contributed to reducing the risk of misinterpretations and enhanced the reliability of our thesis.

3.6 Criticism of Sources

> *"I was provided with additional input that was radically different from the truth. I assisted in furthering that version."*
>
> (Colonel Oliver North)

Holme & Solvang (1997) argue that the problem with secondary data is that it is almost never is entirely adjusted to the interest area of the researcher. Furthermore, when possible, it is important to determine the origin of the sources, and to use several sources in order to get a complete picture of the problem area. We believe that we, after overcoming initial constraints, have managed to find enough sources to create a trustworthy picture of the packaging field, and since our research area is relatively new, we regard the majority of our sources as actual and valid.

Even if we possess theoretical knowledge of the logistics concept, none of us have any previous experience within the field of packaging logistics. Therefore, it was sometimes difficult to know which issues that were important and also occasionally which questions we should ask, and how

some data should be interpreted. However, by time we obtained a deeper knowledge of our problem area, and mistakes initially made could be corrected.

When dealing with qualitative data based on personal interviews, we feel that credibility is a very important factor that needs to be addressed. Since this information is subjective by nature and there is no guarantee against biased opinions, it is mainly up to us as interviewers, to judge the credibility of our sources. The persons we interviewed were only possessing knowledge of the particular production facility where they worked, and could not to any greater extent provide inputs about the structure of logistical flows originating from other production plants. Particularly due to limited time for our research and difficulties in establishing contacts with the most competent persons regarding packaging solutions, we were in some situations unable to obtain such comprehensive answers of our interviewees as we initially hoped[22]. Occasionally, this also resulted in instances where the interviewees seemed to speculate, and merely gave their personal opinions, although an objectively correct answer was likely to exist.

[22] One interesting reflection in this matter is mentioned by Johnsson (1998) in his dissertation. Out of 906 sent questionnaires regarding packaging logistics, only 170 were returned, and the reason behind the low return rate is that most companies simply do not have a packaging department, or even a responsible person for packaging-related issues.

chapter 4

LOGISTICAL THEORIES

The purpose of this chapter is to present a theoretical framework of logistical theories. Since we consider the logistics channel as a system, and packaging as one of the logistical activities which forms part of this system, we feel that it is useful to present these theories and their possible connection to our problem area. In addition, we think that familiarity of these theories will enable the reader to better understand our analysis on logistical packaging in our investigated industry, which will be performed later on.

4.1 Strategy Influence on Logistics

When observing the logistics channel as a complete system, consisting of companies, which in turn consist of processes containing logistical activities, we assume that general strategies for the entire logistics channel have great influence on strategy choices on lower levels in the system. Of great importance when mentioning strategy is also the structure, defined by Chandler (1962) as the design of organization through which the enterprise is administered. According to Novack et al (1992), it is generally accepted that structure follows strategy, i.e. that strategy is developed first, and then the structure necessary to implement the strategy is designed. The assertion that the overall channel strategy and structure influence underlying strategies is supported by the following quotation:

> *"The strategy-structure of the channel influences the strategy-structure of the firm, which influences the strategy-structure of the process or function, e.g. logistics. The strategy-structure interactions at all levels in the channel must "fit" with one another so conflicts are eliminated and all participants in the chain are striving for the same goal."*
>
> (Novack et al, 1992, p. 245)

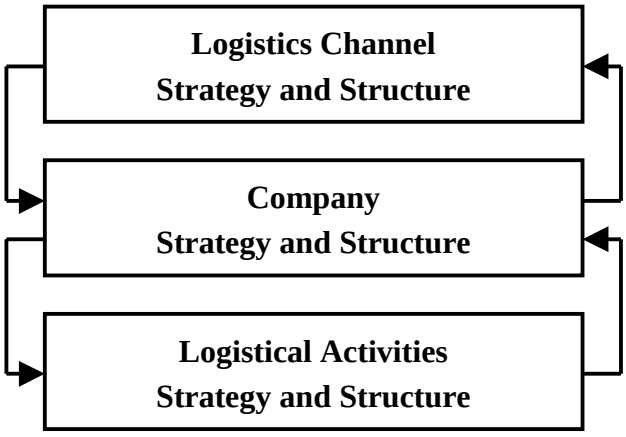

Figure 4:1 – The Impact of Strategy and Structure on Logistics
Source: Novack et al (1992, p. 246) (Revised by the authors)

Noticeable in Figure 4:1 above, is the possibility of vertical influences in both directions. Translating this discussion to logistical packaging systems, we believe that the overall strategy of a logistics channel, in for instance the telecom equipment industry, influences the strategy of the companies

belonging to the channel and these strategies in turn affect which logistical packaging system the firms will implement. Moreover, we are of the opinion that the strategy of a packaging system most probably will exert some influence on higher levels in the logistics system.

4.1.1 Packaging Strategy

Johansson et al (1997) stresses the necessity of developing a packaging strategy if a company is to reach its goals for its packaging system. The packaging strategy is defined as the planning process concerning the total packaging needs of a company. It comprises all requirements, needs, functions and activities related to the packaging of products, and aims to facilitate for the company to obtain best possible efficiency at lowest possible price. The position of packaging strategy in relation to other company strategies is decided mainly by the strategic position of the packaging in the company. According to Johansson et al (1997), packaging strategy is an integrated part of the marketing strategy for an increasing number of firms. In those companies, packaging is considered important enough to motivate adding a fifth P for *Packaging* to the classical four Ps of the marketing mix; Product, Price, Place, and Promotion.

4.2 Contingency Theory

The Contingency Theory implies that there is no one best way of organizing, but the effectiveness of the outcome is dependent on something (Galbraith, 1973). Persson (1990) concurs with the Contingency Theory approach, and describes it from a logistical point of view:

> *"In a contingency theory model, one seeks to describe the patterns which lie behind the contingency dependence of logistical strategies. That implies that one seeks to map patterns which enable to specify under which conditions, i.e. in which situation, a certain logistical strategy is to be preferred."*
>
> (Persson, 1990)[23]

[23] Taken from Stahre (1996), p. 45.

In the selection process of logistical packaging system, the Contigency Theory implies that the particular situation at hand determines what packaging system is more appropriate.

4.2.1 Contingency Factors

Pfohl & Zöllner (1997) present one of the most extensive discussions about contingency factors for logistics; environmental relations of the organization, product line of the organization, production technology, and organization size.[24] Since packaging activities take place throughout the logistics channel, it is argueable that all these contingency factors might be important considerations when selecting the strategy for a company's packaging system. The structure of environmental relations, i.e. the logistical flows, and the organization's product line appears to us as the most relevant factors for this study, and therefore, they will be more thoroughly described below.

FLOW OF PRODUCTS
Complexity of the environmental relations
- Number of purchased raw and auxiliary products, operating supplies and trade goods. - Number of finished products, semi-finished products (spare parts) and trade goods
- Number of sources to supply - Number of customers to be supplied - Geographical distribution of suppliers and customers.
- Number of deliveries
- Variety of transportation, storage and handling procedures for suppliers and distributed products
Dynamics of environmental relations - Rate and regularity to change
- The time of delivery and the amount in supply and demand delivered
- Channels of procurement and distribution demand
- The structure of suppliers and customers

Table 4:1 – Environmental Relations of the Organization from a Logistical Viewpoint
Source: Pfohl & Zöllner, (1997, p. 308)

[24] Pfohl & Zöllner point out, however, that the contingency factors influence the design of logistical activities only to a certain extent. The organization strategy and management's assessment of the importance of logistics are other influential factors.

Pfohl and Zöllner (1997) claim that the complexity and dynamic of the environmental relations determine the logistically relevant elements of the environment. Examples of elements, which we consider influence the selection of logistical packaging system, are presented in table 4:1 above.

The product line of the organization implies the kind and extent of products manufactured and/or distributed in a certain time limit. According to Pfohl & Zöllner (1997), there are two key factors in this matter that are logistically relevant; degree of homogeneity among products and degree of homogeneity in the market. This means the degree by which a company can use logistical equipment for order processing, transportation, handling, storing and packaging and to what degree one can combine these logistical activities on the way to the customers. From this reasoning we can derive the following conclusion: With a large degree of homogeneity between the products and markets, there is a better possibility of combining logistical equipment, e.g. packages for transportation, handling and storage of products, which can result in increased efficiency.

4.3 Logistics & Competitive Advantage

> *"Not since the Knights of the Round Table set out to find the Holy Grail has there been such a concentrated search as that we now see for the elusive objective of competitive advantage"*
>
> (Christopher, 1998, Foreword)

Effective logistics management can provide a major source of competitive advantage. At its most elemental, competitive advantage and commercial success derives either from a productivity advantage or from a value advantage, or ideally, a combination of both.[25] The productivity advantage gives lower operating costs and hence greater profit. It can for instance be achieved by economy of scale and the experience curve. The value advantage on the other hand, gives the product or service an "uniqueness" compared to competitors. To be successful in the automobile industry, for example, you either have to be a "Nissan", i.e. possess a productivity advantage, or a "BMW", i.e. possess a value advantage. (Christopher, 1998) Related to the other two strategies, Ernst & Whinney (1987)

[25] These ideas were actualized by Porter (1980) who stated the existence of the generic competitive strategies cost leadership and differentiation.

consider innovation as an alternative source of competitive advantage. Instead of relying on performing the traditional approach best, companies thus develop a new approach.

Witt (1998) gives an example from the packaging industry how a company has gained a competitive advantage by offering superior customer service, i.e. a kind of value advantage. To meet the increasing competition, the company has now recognized innovation as a key to success and is therefore constantly launching new packaging solutions to stay ahead of competitors.

4.3.1 Flow-oriented Logistics

In a similar discussion as that of Christopher and Porter, Persson (1998) claims that the strategic importance of logistics in a material flow is determined by two factors:

- The logistics significance as "cost driver", i.e. the logistics part of the company's total costs.
- The logistics significance as "unique driver", i.e. to what degree logistics makes the company unique and creates a competitive advantage.

According to Persson (1998), the greater the significance of logistics in competition, and/or the greater the part of total costs, which can be considered as logistics costs, the greater the importance of logistics. Persson (1998) advocates flow-oriented logistics, which is a combination of cost-oriented logistics and performance-oriented logistics. Cost-oriented logistics focuses on, for instance, lower tied-up capital, lower transport costs, lower purchasing costs, lower handling costs, whereas performance-oriented logistics can be described in terms of lead-time, availability, and delivery precision.

A comparison between Christopher's (1998) and Persson's (1998) logistics strategies is presented in Figure 4:2, where the superior position for companies to strive for is located in the upper right hand corner of both matrices. Persson (1998) claims that if companies end up in the lower left hand corner of his matrix, logistics is of no or trivial strategic importance, and the company should concentrate on other matters than issues related to material flows. Christopher (1998) considers the world to be an

uncomfortable place for those companies finding themselves in the lower left hand corner of his matrix. Those companies are often in commodity market and they should either strive to the right, i.e. to cost leadership, or upwards by creating their own ”niche”.

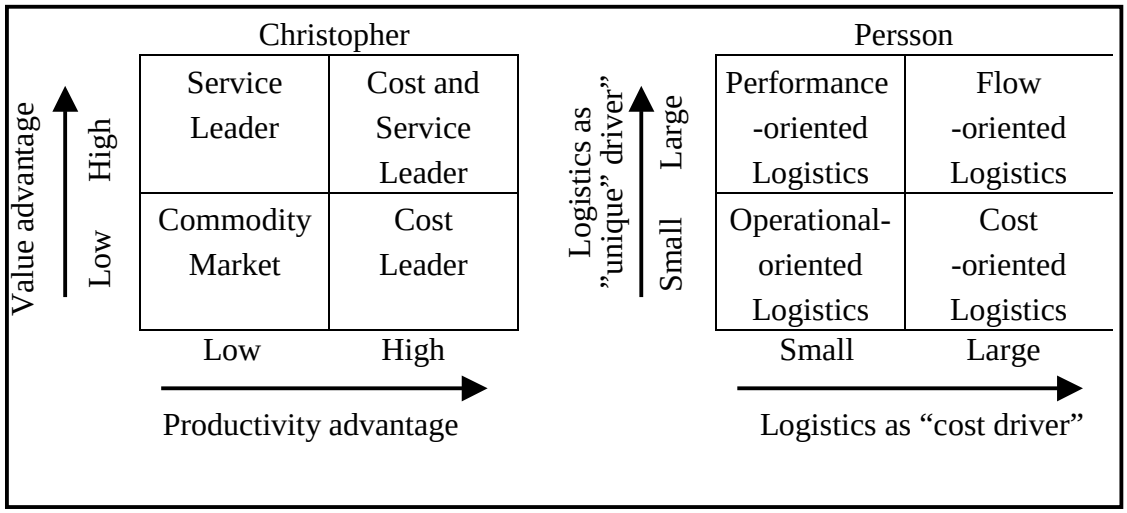

Figure 4:2 – The Strategic Importance of Logistics in the Material Flow
Source: Christopher (1998) & Persson (1998)

When comparing these logistics views, it appears to us that logistical packaging systems are primarily focusing on cost-oriented logistics, since the company’s packaging system according to Tiliander (2000), exerts a considerable influence on handling, transport costs, level of tied-up capital etc. We think that flow-oriented-logistics is likely to play an important role in the future in the packaging field, Johansson et al (1997) claim for instance, that the packaging can contribute to reduced lead-times by allowing rational filling and emptying, and enable handling with mechanical handling equipment. In addition, Johnsson (1998) has in his research concluded that effective packaging systems can contribute to improved customer service, if well integrated with the logistics system.

4.3.2 Value Chain

To obtain competitive advantage, Porter (1985) claims that the different activities in the firm's value chain have to be considered:

> *"Competitive advantage cannot be understood by looking at a firm as a whole…The value chain disaggregates a firm into its strategically relevant activities in order to understand the behavior of costs and the existing and potential sources of differentiation. A firm gains competitive advantage by performing these strategically important activities more cheaply or better than its competitors."*
>
> (Porter, 1985, p. 23)

As stated earlier, packaging is one of the important logistical activities, and is therefore one area where competitive advantage can be gained. Twede (1992) emphasizes the importance of packaging, and views logistical packaging as a unique activity that facilitates productivity throughout the logistics channel. She holds packaging to be one of the most systemic[26] of all logistical activities since the same packaging is transported, sorted and stored throughout a firm's logistics channel by each participant, and must meet each channel member's functional requirement for protection and efficiency.

4.4 Logistics Strategies & Trends

4.4.1 Time-to Customer & Just-in-Time

Saunders (1997) claims that time continues to be an important dimension of competition. The need to offer competitive lead-times and to meet them in a reliable manner may be order winning features for some companies. To achieve these goals requires coordinated efforts and joint planning throughout the logistics channel (Ibid).

From a customer perspective, only one lead-time is of interest; the time it takes from order to delivery, sometimes referred as the Order Cycle Time

[26] An activity which requires coordination and readjustment along several organizational units (Twede, 1992).

(OCT)[27] Clearly, this is a crucial competitive variable as more and more markets become increasingly time competitive. (Lambert & Stock, 1993) Equally important however is the reliability or consistency of that lead-time, perhaps even more important than the length of the order cycle itself. (Christopher, 1998)

Just-in-Time (JIT) is an American version of the Japanese production concept Kanban, developed by Toyota Motor Company. JIT is an approach to improve distribution, production, inventory and scheduling management. Four major elements characterize the JIT concept; zero inventories, short lead-times, small, frequent quantities, and high quality. Ideally, products should arrive exactly when a company needs them, with no tolerance for late or early deliveries. (Coyle et al, 1992) According to Schonberger (1983), JIT originates from productivity and quality. He considers JIT as a wide concept comprising several functions; as inventory control, as a means of quality and waste control, as incentive for a flow-oriented factory layout that increases production result, as a mean of balancing the production lines, and as a way of achieving motivated and interested personnel.

As a result of JIT systems, the number of packages in the logistical systems can be reduced, which in turn places higher demands on packaging quality and reduces the potential investment in returnable packaging systems. (Rosenau et al, 1996) Twede argues that JIT, along with reduced number of suppliers and attempts to reduce the geographical distance between supplier and customer, has favored reusable packaging. (Witt, 2000b) Even if adaptation of JIT philosophy has increased in Sweden, Tiliander (2000) claims that flows with pure JIT deliveries are rather unusual, but that many flows in spite of this fact are controlled by time.

4.4.2 Total Distribution Costs

This section intends to show the influence of packaging on total logistics costs. Christopher (1985) has developed a model for calculating the total distribution costs, a somewhat narrower approach than the total cost concept, represented by for instance Lambert & Stock (1993).

[27] Also referred to as Time-to-Customer (TTC), and henceforth, we will use this term.

Total distribution costs in form of an equation may according to Christopher (1985) be expressed as follows:
TDC = TC + FC + CC + IC + HC + PC + MC

TDC	Total distribution costs
TC	Transport costs
FC	Facilities costs (depots, warehouses)
CC	Communications costs (order processing, invoicing etc.)
IC	Inventory cost
HC	Materials handling costs
PC	Protective packing costs
MC	Distribution management costs (control and administration of the flows)

When calculating the costs of packaging systems, one has to take several cost sources into consideration; transport costs (and return transport costs for reusable systems), inventory costs for full and empty packages, handling of packages, and control and administration of the flows (and return flows).

According to Twede (1992), logistical packaging has a significant impact on the productivity of logistical channels. Twede (1992) not only considers the impact of packaging on productivity, but also the cost of purchasing packages, and the cost of packaging disposal, as major cost sources. However, because a firm's packaging department is usually managed from an engineering viewpoint rather than from a logistical perspective, a focus on single logistical packaging activities occurs instead of taking the total costs of the entire logistics channel into consideration. As a result, packaging-related logistical costs often tend to be over-looked and underestimated. (Ibid)

4.4.3 Globalization

Over the past decades, the global business environment has witnessed the fall of many trade barriers, and the general trend seems, with some exceptions, to be towards facilitating, rather than constraining trade over the borders.

According to OECD (1996), a number of key independent factors have been responsible for reshaping the activities of major companies, including:

- Growing market integration and sophisticated marketing
- Innovations in logistics
- Improved transports systems and infrastructure
- Currency fluctuations
- Economies of scale in business
- Varying prices of production resources in different parts of the world

The trend towards globalization in most industries constitutes a challenge for logistics management. A global company is more than multinational, it acquires materials components and materials and its manufactured products are sold worldwide. (Christopher, 1998) According to Coyle et al (1992), truly global markets would, however, not be possible if it was not for the acknowledgement and homogenization of global needs and wants. Due to new information technology, people throughout the world are expressing the desire to have the same products. We regard the conditions and pattern of the telecom equipment industry to be in accordance with this development, since, as written in Ericsson's Annual Report (Ericsson, 2000), the products needed when constructing telecom infrastructure are rather homogeneous. Christopher (1998), however, argues that whilst the trend towards globalization is strong, the world is not homogeneous, and there is still a requirement for local customized variations in several product categories. In addition, for companies seeking to manage a global logistics channel, the result may be higher costs. Thus, Christopher (1998) claims that there are two related challenges to globalization, on the one hand how to offer local markets the variety they seek while still gaining advantage of standardized global production, and on the other hand how to integrate the links in the entire logistics channel.

chapter 5

PACKAGING LOGISTICS

Being a relatively new concept, the purpose of this chapter is to introduce the reader into the area of packaging logistics. In addition, we will outline important factors and possible constraints to consider when selecting and implementing a logistical packaging system. It is our opinion that, by assimilating those theories, the reader will attain a solid pre-understanding to use when confronting our empirical data in chapter seven.

5.1 Introduction

In many companies the packaging has led an obscure life, and has not been one of the highly prioritized areas. The current trend, however, as described in the following quotation shows that this is about to change:

> *"Once an afterthought for many companies, packaging is rapidly moving to the front and center of their overall distribution strategies."*
>
> (Modern Materials Handling, 2000, p.3)

Witt (1994) claims that logistical packaging is now more frequently being recognized as an integral factor in the flow of raw material to finished product. According to Tiliander (2000), the packaging has indirectly become increasingly essential since logistics today often focuses on optimizing the logistical flows, regarding time and space, between the companies in a logistics channel.

5.1.1 Definition of Packaging Logistics

The part of logistics management which deals with packaging is (not too surprisingly) called packaging logistics, which is defined as:

> *"…an approach aiming at developing (creating) packages and packaging systems that support the objectives of logistics…"*
>
> (Johansson et al, 1997, p. 19)

Since packaging logistics support the logistics' objectives, this implies that it focuses on how to best serve the customer and how to reduce costs (Witt, 1994). Johansson et al (1997) argue that the principal objective of packaging logistics is to create benefits to customers by providing an undamaged product in a manageable package, which easily can be disposed of. According to Johnsson (1998), packaging logistics will force packaging designers to analyze how the package is handled throughout the logistics channel, and enables people to understand how the packaging "interacts" with the logistics system and vice versa.

5.1.2 Functions of the Packaging

Logistical packaging has various functions. Robertson (1990)[28] outlines six general functions that a packaging performs:

- Containment – Products must be contained before they can be moved from one place to another.
- Protection – To protect the product from outside environmental effects. The packaging shall therefore be made to stand harsh climatic conditions.
- Apportionment – Reducing the output from industrial production to a manageable, desirable "consumer" size.
- Unitization – Permitting primary packages to be unitized into secondary packages, and then for secondary packages to be unitized into tertiary packages.
- Convenience – allowing products to be used conveniently.
- Communication – the use of unambiguous, easily understood symbols.

Twede (1992) views protection, utility, and communication as the main functions of the packaging, whereas according to Johansson et al (1997), the primary packaging functions originate from the flow, the market, and the environment. Of most interest to us is the flow function, which generally is related to the logistical flows, and aims at rendering more efficiency in the logistics channel. Three sub-functions of the flow function can be distinguished. Firstly, the packaging should protect the product against stresses in the distribution. Secondly, it should identify the product with respect to contents, areas of application, quality and receiver, and finally, the packaging should facilitate product handling in the entire flow, including provision of packaging, packing, distribution, unpacking, disposal and return handling. (Johansson et al, 1997)

The market function consists of the revenue generating aspects, such as design and layout, which give the product an increased value towards the end customer. The environmental function is aimed at facilitating recycling of packaging material, lessen the strains on the environment by reducing consumption of packaging materials, and advocate usage of reusable packages where appropriate. (Johansson et al, 1997)

[28] This information is taken from Lambert & Stock (1993) and not from the original article.

5.2 Selection of Logistical Packaging System

Johnsson (1998) advocates a horizontal integration by the choice of a logistical packaging system. This implies that the packaging system must be selected from a logistics perspective, and that the logistics system must be selected from a packaging perspective. This integration will then add value to the product in terms of increased selling price of the product. The package can also contribute added service value, which all companies in the logistics channel can take advantage of to make handling and distribution more cost-effective. Examples of added service values are more accurate and updated information, lower levels of products in storage, more efficient utilization of unit loads, less variants in packaging materials and packaging designs, less damage to products, increased handling efficiency, easier waste handling, and more effective recycling systems. (Ibid)

In the old view of logistical packaging systems it was important that the packaging could easily be disposed of. With the emergence of reverse/return logistics, and the usage of reusable packaging solutions, the conditions for logistical packaging systems have changed. Now also costs of recycling, return transports etc. have to be calculated. (Johansson et al, 1997) The difference between the two systems are depicted below.

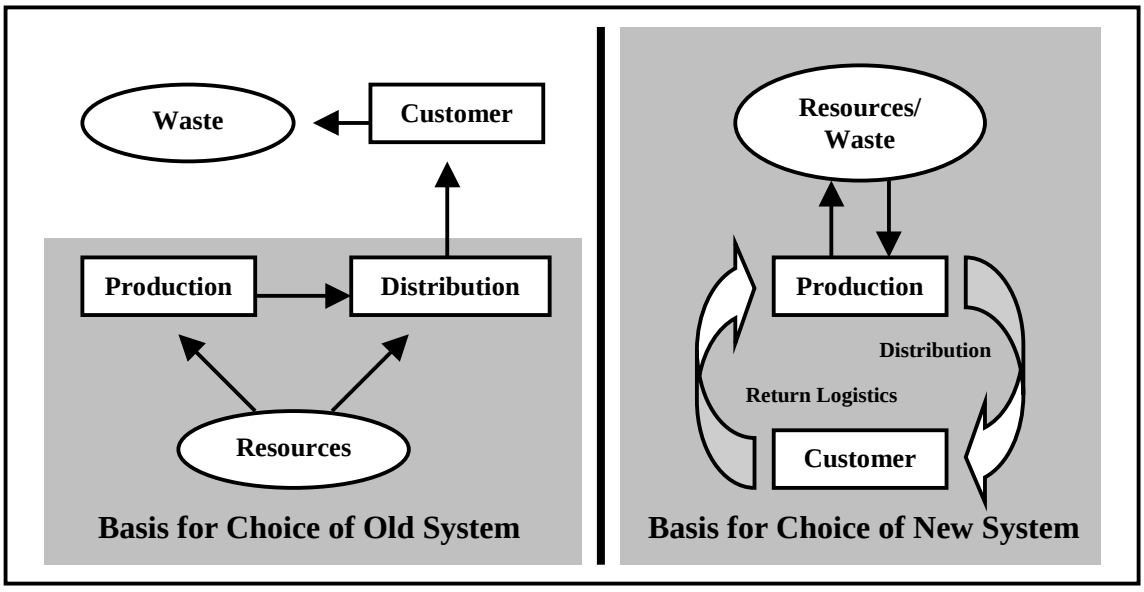

Figure 5:1 – Basis for Choice of Logistical Packaging System
Source: Johansson et al (1997, p. 70) (Revised by the authors)

5.2.1 One-way or Reusable Logistical Packaging System

Which is the ideal logistical packaging system? To be able to answer this question Tiliander, (2000) claims that several dimensions have to be taken into consideration. Since economic profitability is dependent on a number of factors, it is very difficult to decide whether a one-way system is more cost-effective than a reusable system or vice versa.

Moreover, a couple of constraints are present when performing an economical comparison between one-way and reusable packaging systems. In many cases, the packaging exerts large indirect influence on costs in different divisions of the company, and for instance reduced costs as a result of reusable systems may be hard to discover and can be very hard to estimate. In addition, since the logistical system often is different for one-way systems than for reusable systems, complications generally arise when trying to achieve fair distribution of costs between the different actors in the logistics channel. (Ibid)

5.2.2 Return Logistics Systems

The usage of reusable packages has led to the emergence of different return logistics systems. A consequence of the reusable packaging is that, after a packaging has been used for carrying products from a sender to a recipient, the packaging has to be transported back to the sender or possibly to another sender. In addition to transporting containers, the return logistics system also involves the cleaning and maintenance of packages as well as their storage and administration. (Kroon & Vrijens, 1995)

Lützebauer (1993)[29] distinguishes three types of return logistics systems:[30] switch pool systems, systems with return logistics, and systems without return logistics system. In a *switch pool system*, every participant is responsible for its own allotment of containers, including cleaning, control, maintenance and storage. Pool-participants are senders, recipients, and in some cases also carriers. Transfer of packages occurs when goods are delivered to the recipient. Either the carrier transports filled packages from

[29] This section derives from Kroon & Vrijens (1995), and not from the original article.

[30] The names originally used in German are: Tauschpoolsysteme, Mehrwegsysteme mit Rückführlogistik, and Mehrwegsysteme ohne Rückführlogistik.

sender to recipient, or empty packages from recipient to sender. Another possibility is that the carrier also possesses a number of packages. In that case, the carrier, when picking up a load of packages from the sender, gives the sender a corresponding number of empty packages. Hence, in this case the sender is not responsible for administering the return flows of packages.

In *systems with return logistics*, the packages are owned by a central agency. The agency is also responsible for returning the packages after they have been emptied by the recipient. The main prerequisite for such a system is that the recipient compresses the empty packages and stores them until a sufficient number has accumulated for cost-effective collection. Within this system, Lützebauer distinguishes two variants: transfer system and depot system. Transfer system implies that the sender always uses the same packages and is only concerned with the return of packages from the recipient to the sender. The sender is responsible for tracking the packages, and their administration, cleaning, maintenance and storage. In the depot system, on the other hand, packages that are not in use are stored at container depots. From the depot, the sender is provided with the number of packages he needs. After having been transported to the recipient, the empty packages are collected and returned to a depot, where they, if necessary, are cleaned and maintained.

In *systems without return logistics*, the containers are also owned by a central agency. The user of this agency, the sender, rents the containers from the agency, and as soon as the sender no longer needs them, they are returned to the agency. The sender is responsible for all activities involving the packages, such as return transports, cleaning, control, maintenance and storage. By using this system, the sender can decrease its fixed costs by renting the specific numbers of packages as required.

Tiliander (2000) is also considering the possibility of leasing packaging by introducing, for instance a packaging pool system, which, however, requires that companies have close relations with their subcontractors. Furthermore, profitability of packaging pools is not always easy to obtain.

5.3 Driving Forces of Packaging Systems

5.3.1 Introduction

Twede (1993) states that deciding to invest in a reusable packaging system is a very different task from purchasing expendable containers. Generally, the decision involves a cost analysis between the two packaging systems, where purchase and disposal costs of expendable packages are weighed against purchase and return transport costs of reusable packages. A number of unexpected costs usually occur as well, including, sorting, tracking and cleaning of packages. In addition intangible factors like quality, improved handling, and warehousing must be taking into consideration when performing the comparison. Section 5.3.2 through 5.3.6 present a number of driving forces that in one way or the other influence costs of the respective packaging systems.

5.3.2 Product Demands on Packaging Quality

Protection of the product is one of the primary functions of the packaging, and therefore important to consider when selecting and implementing a logistical packaging system. Witt (1997) is of the opinion that plastic reusable containers offer better product protection against product damage and theft than most expendable transport packages, due to for instance reinforced corners which prevents denting or crushing when the containers are stacked. In addition, reusable packages close tightly and prevent dust, dirt or other contaminants from reaching the product. (Ibid)

When designing packages in industries with technically advanced products, there may be a necessity of furnishing the packaging with some kind of Electrostatic Discharge (ESD) protection, for instance plastic bags or crates. Simply explained, ESD implies the following according to Mason (2000): When the atoms in a product loses or gains an electron it becomes positively or negatively unbalanced. When an unbalanced component is brought close to, or touches something, a stream of charges might move, which tries to bring the atoms back to their balanced condition. This movement of charges is called a discharge, and can seriously damage electronic components. This threat of discharging is present throughout the logistics channel by the transportation, handling, storing, manufacturing and testing of an electrostatic sensitive product (http://www.sp.se).

5.3.3 Handling

Investigations have shown that handling is one of the key determinants when selecting and implementing a logistical packaging system, since the choice of packaging system directly, or indirectly affects the handling costs within the flow. It is vital to evaluate the handling from a holistic perspective, i.e. to consider all handling costs throughout the logistics channel. (Tiliander, 2000)

Some packaging materials are easier to handle than other. According to Lorentzon-Karlsson & Wäström (1996), the raising of load pallet with collars, for instance, is considered easier than with corrugated cardboard, but there is no particular difference compared to plastic or plywood boxes. Since reusable packages are to be used several times, they generally tend to be made sturdier and heavier than one-way packages (Ibid). Regarding ergonomics, Witt (1997) is of the opinion that expendable packages, and crates in particular, are often difficult to lift because they do not have handles. Overfilled corrugated cardboard packages therefore lead to incorrect lifting, which may contribute to back, arm and neck injuries.

Reusable systems, however, normally require increased handling when compressing the packages, which may have a significant impact on financial results. (Johansson et al, 1997) On the other hand, the firm can, according to Modern Materials Handling (2000), benefit from reusable packages if current costs for packaging disposal are high, and Witt (1997) also claims that elimination of disposal costs associated with one-way packages can result in long-term savings for the company.

Reusable packaging systems tend to impose increased handling in terms of extra administration. A well developed administrative system for follow-ups of the reusable system is a prerequisite, not only for maintaining a high rate of turnover, but also in order to prevent the number of packages to grow uncontrollably. To increase control, a deposit might be applied for the packaging within the system, something that also will provide incentives to increase the turnover rate and reduce losses. (Lorentzon-Karlsson & Wäström, 1996)

5.3.4 Number of Actors

In a logistical packaging system, accessibility to packages is dependent on the actors. The previous actor in the logistics channel can be seen as the supplier of packages to the next actor, making them dependent on each other. The number of actors affects the possibility of maintaining a high turnover rate of packages, and many actors also increases the risk of stockpiling packages with lesser flow-through as result. Thus, the number of actors is an important determinant when choosing a logistical packaging system. Since each actor implies some sort of costly handling, companies should strive to have as few actors as possible, and when employing reusable systems, also the return flow has to be considered. Moreover, in a scattered distribution network with many actors, it becomes increasingly difficult and costly to control and administrate the packaging flow if the company uses a reusable system. (Lorentzon-Karlsson & Wäström, 1996)

Rosenau et al (1996) agree with this reasoning and advocate a vertical marketing system and a short logistical cycle (in time and distance) as important conditions for usage of reusable packaging systems, and in order to minimize costs.. According to Kotler (1991) and Bowersox & Cooper (1992), a vertical marketing system is one where the sender and consignee are linked by common ownership, strategic alliance, and where channel members desire interdependence. Aaker (1998) mentions several possible advantages of this vertical integration, e.g. economies of scale, control of the product system, which ensures proper product quality, and enhanced technological innovation. Rosenau et al (1996) argue that it is particularly important to ensure the efficiency of this dependence relationship between members in the logistics channel, since it must be ensured that enough packages exist, and that these are circulating within the system.

Lead-time between various actors is another factor influencing the conditions for a packaging system. Few actors in the flow and a short lead-time between them are normally favorable conditions for reusable systems. However, even in a situation with few actors, long lead-times will result in poorer turnover rate and control difficulties for the reusable system. (Lorentzon-Karlsson & Wäström, 1996)

5.3.5 Tied-up Capital

One of the major cost sources of packaging systems is tied-up capital in inventory. The rate of turnover of a reusable packaging, i.e. the number of uses during a specific time period, has been shown to exert a major influence on the tied-up capital level. (Johansson et al, 1997) Twede (1993) and Rosenau et al (1996) emphasize that all partners in the logistics channel must co-operate to maximize packaging use in a reusable packaging system. This relationship with partners is especially important for co-ordination and control, and reduces the probability of lost, misplaced or forgotten containers in the back corner of a warehouse.

The capital tied up in packaging is inversely proportional to the package turnover, which implies that a high rate of turnover equals a low level of tied-up capital. A high turnover rate implies that the total number of packages necessary in the system can be reduced, which lessens the demand for a large buffer inventory of empty packages and reduces tied-up capital. (Johansson et al, 1997) Fewer packages also lower the initial packaging investment by the packaging introduction, which in turn lowers the depreciation time of the system. An additional advantage is increased flexibility by a future packaging change since fewer packages then have to be replaced. Another way of reducing tied-up capital is to strive for standardized packages, resulting in a limited number of packaging types. This might, however, be rather difficult to obtain in a flow containing a wide range of products in various sizes. (Lorentzon-Karlsson & Wäström, 1996)

Volume and Delivery Frequency

In a reusable packaging system, a certain volume is needed in the material flow to ensure reasonable costs per product. However, suppliers seldom have the possibility to influence the size of orders, and therefore smaller or custom-made orders – in order to increase volume efficiency – are often sent in one-way packages, and this occurs even if the supplier has introduced a reusable system. (Lorentzon-Karlsson & Wäström, 1996).

Another requirement for reduced costs per product in a reusable system is regular and frequent deliveries of filled packages and corresponding return deliveries of emptied packages. (Tiliander, 2000) However, even with large volumes, dispersed recipients and a low delivery frequency make it difficult to attain a reasonable turnover rate in the reusable system. Under

such conditions, the costs for administration return transports and tied-up capital usually exceeds the generated cost savings of the system. (Lorentzon-Karlsson & Wäström, 1996)

Variations in Demand

An even demand creates favorable possibilities for a high inventory turnover and thus low level of tied-up capital. (Tiliander, 2000) In flows with large but fluctuating volumes, balancing problems in terms of over- or under-supply of packages might occur. Increasing the number of packages in the system can solve insufficient supply of packages, but will unfortunately affect the level of tied-up capital. In addition, problems and costs of storing empty containers during periods of low demand may arise. (Lorentzon-Karlsson & Wäström, 1996)

Seasonal variations are less frequent in the electronics and manufacturing industry than other industries. However, due to short product life cycles and frequent product changes, packages might not fit future products and models, which may be a reason against reusable packaging systems. Major economic fluctuations impose a negative impact on reusable systems; when production volume is affected, the demand for packages will be affected in turn. The number of packages is set in time of prosperity, which means that some of these packages will have to be stored at significant costs during recessions. (Ibid)

5.3.6 Transport Distance

Transport costs constitute a major part of the total distribution costs in the electronic- and manufacturing industries. The weight efficiency[31] and volume efficiency[32] of the packaging affect the transport costs for deliveries to the market, and their total importance depends on transport distance. In general, a reusable packaging is less weight and/or volume efficient than a one-way packaging, since the reusable packaging is constructed to stand repeated use. (Johansson et al, 1997)

[31] The weight of the packaging in proportion to its size. (Johansson et al, 1997)

[32] Volume efficiency depends on the internal and external filling degree of the packaging, i.e. to what extent the product fills the inside of the packaging, and to what extent the packaging fills up the unit load. (Johansson et al, 1997)

Transport distance greatly affects the possibilities of introducing a profitable reusable packaging system, and particularly the costs of return transports are vital to consider. (Twede, 1993) One should strive for utilization of imbalances in the transport flows, i.e. use vehicles for return transports that otherwise would be empty. Whether the empty packaging can be compressed or not, will also, especially at longer distances, have a considerable effect on transport costs. (Johansson et al, 1997)

5.4 Opportunities and Obstacles of Reusable Packaging Systems

Witt (1997) claims that the conversion into a reusable packaging system is a complicated undertaking, which goes through three phases. The first phase is a *conversion analysis plan* of what the switching to the new system actually involves. The next step involves analyzing current manufacturing, material handling and shipping processes. The information gathered in the *analysis phase* then forms the basis for the next phase, *the implementation process.* In this phase the product container and the quantity of containers needed to support the logistics system are determined, and appropriate control and tracking measures of the packaging are developed. To ensure optimal performance of the system, active monitoring and management is necessary.

Tiliander (2000) mentions large investments as the major drawback of reusable packaging systems, as these always involve a certain risk. Since the investment is large, it has great strategic importance for the future, and therefore, the decision is not likely to be made by the person responsible for continuous packaging purchasing. Instead, the decision-making will take place on a higher level in the hierarchy, where the knowledge of packaging might be insufficient. Tiliander (2000) believes that this is one of the reasons why companies do not implement reusable systems, even where it could be profitable.

Witt (2000) and Rosenau et al (1996) are of the opinion that, since a reusable packaging system requires a large initial investment, it should be considered as a corporate asset rather than an expense item. This is, however, a new idea for most packaging and logistics professionals since packaging systems traditionally have been considered as expenses. Rosenau et al mean that this, however, requires a new attitude towards

reusable logistical packaging. It should be thought of as an important investment in the logistical system, which can contribute to overall corporate profitability.

Dwivedi (2000) discusses whether companies should own their packaging equipment or not, and if it is impossible to increase flexibility by creating a logistics channel involving multiple vendors, rather than companies trying to do everything themselves. He argues, that if companies are transferring most of the responsibilities of the packaging system to packaging suppliers, these companies can focus on core business, with increased efficiency as result. According to Witt (2000b), this development has been evident in the automotive industry, where a growing number of companies have increased focus on core business, i.e. building cars, and transferred the development of packages to container manufacturers. As a result, Witt (2000b) argues that packaging companies has taken over more responsibilities, and many are now providing everything from manufacturing and financing of packaging programs, to packaging consulting.

chapter 6

PROBLEM SPECIFICATION

In order to further specify our problem area, and show what we intend to analyze, we have included this chapter in the thesis. Firstly, we elucidate our problem by outlining the questions we aim to answer, in order to fulfill our purpose. Secondly, we have, based on the theoretical framework presented in the previous chapter, developed a generic analysis model, which shows what empirical data we intend to analyze. This model lays the foundation for the following two chapters, and facilitates for the reader to follow our reasoning.

6.1 Descending the Funnel

Before giving our investigation field a more concrete form, we find it relevant to repeat the purpose of this thesis: *"…to describe the typical features of the logistical material flows in a technically based, rapidly growing industry, and analyze the driving forces and obstacles which influence the selection of logistical packaging system."*

In order to arrive at the core of our problem area, and fulfill this purpose, our intention is to answer the following questions:

- What are the characteristics of the logistical material flows in a technically based rapidly growing industry?

- Which driving forces influence the choice of a logistical packaging system?

- Which are the possible obstacles of the implementation of a reusable packaging system?

6.2 Adjusting the Sights

What conclusions can be drawn from our literature study and models on logistical packaging? First of all, two possible packaging solutions are available, one-way and reusable logistical packaging systems. The choice of either system can ultimately be traced down to any given rational company's ambition to increase profits and cut costs, i.e. to increase competitiveness.

To make profits, a company either produces goods or provides services. The focus of this thesis lies in production, and to produce, the company must have raw materials – and eventually manufactured products have to be sold. Material acquisition, and distribution of finished goods, usually requires some kind of transportation, and this in turn requires a packaging for the product. This is where the costs come in; packaging costs money, and to cut costs, packaging activities have to be carried out as inexpensively as possible. However, through usage of an inappropriate packaging solution, severe negative effects on costs and product quality,

and therefore also on profits, may occur. Hence, it is vital that the company employs the best possible packaging solution.

We would like to emphasize that the perhaps most important lesson learned from our theoretical framework, is the absence of an ideal logistical packaging solution. Instead, the selection of packaging originates from a Contingency Theory approach, which implies that the characteristics of each individual case determine the packaging choice most suitable. That implementing of a reusable packaging system will cut costs and increase efficiency is therefore no absolute truth, and effects of a system shift are also far from obvious. Moreover, the full effect of profits resulting from a change in packaging will be evident only in the long term.

From our frame of reference, however, we can identify a preliminary guideline of parameters which all seem to influence the selection of logistical packaging system. These parameters are transport distance, handling, number of actors in the logistics channel, environmental relations, product line, product demands on packaging quality, and tied-up capital. Reflecting on these "prerequisites", we have chosen to combine these factors into three generic driving forces:

- **Product Demands on Packaging Quality.** Including what type of product is being sent, and what type of packaging that is needed to protect and assure the quality of that product.

- **Current Packaging System & Handling.** Including what type of packaging system the company is currently using, and how that system is being handled in terms of handling efficiency, number of cycles, delivery volumes and frequency, and level of tied-up capital etc..

- **Transportation Characteristics.** Including transport distance, i.e. how far the product is being sent, and number of actors in the logistics channel, i.e. how many actors handles the product before it reaches the "market".

Originating from these generic driving forces, our interviewees will enable us to identify the opportunities and obstacles that are present in each companies' implementation of reusable packaging systems. It is at this stage important to recognize two things:

- That changes in packaging system does not occur by chance; an ambition to change has to be present, deriving either from the existing situation or from future expectations and developments in the industry or the individual company.

- Moreover, that the opportunities and obstacles will be a major factor in setting such ambitions; for where only obstacles can be seen, there will be no incentive to change packaging system and vice versa.

From the discussion above, we can outline the following model of influences on packaging systems selection.

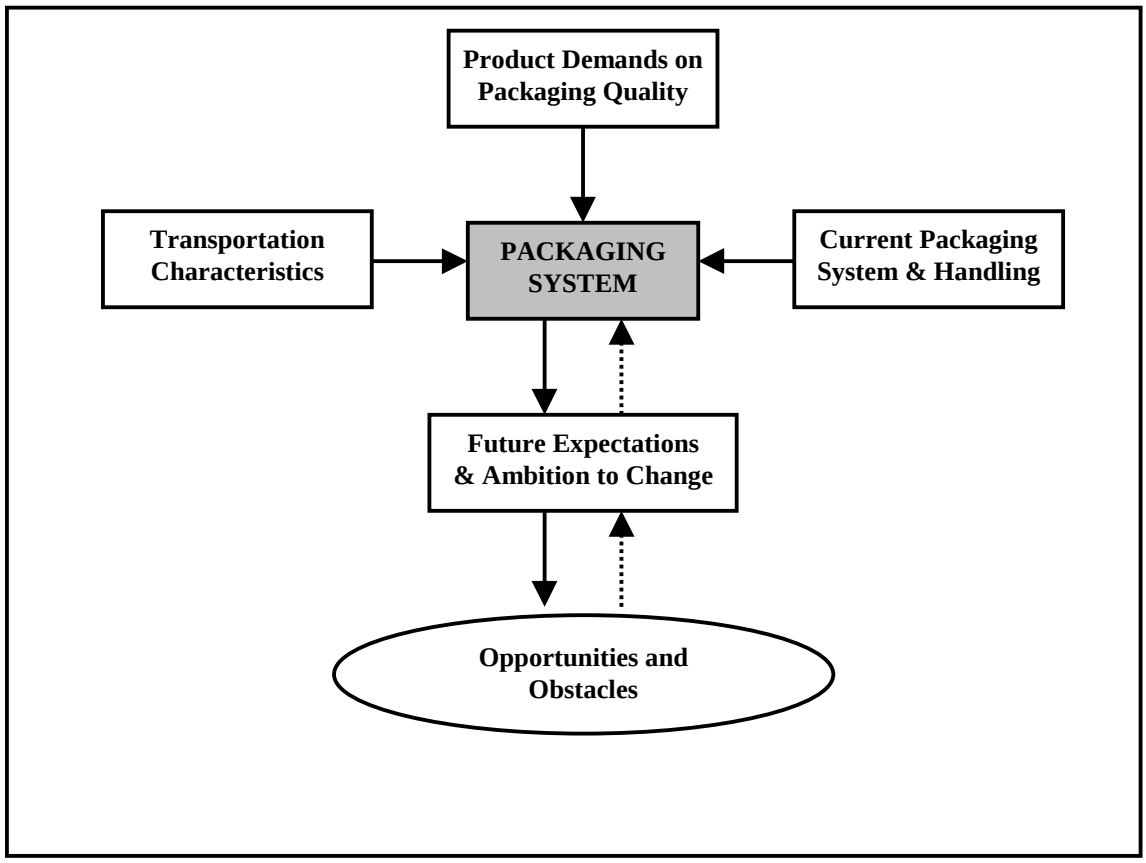

Figure 6:1 Generic Analysis Model

Source: Own Creation

Given the current packaging system and the surrounding determinants, future expectations and ambitions will result in discovering possibilities of implementing a reusable system. Depending on which factor, opportunities or obstacles, that outweighs the other, the system will either change or remain the same.

We do not exclude the possible existence of other determinants of packaging systems, especially since previous research conducted in our problem area is rather fragmented. Nevertheless, we believe that the driving forces we have chosen to focus on are the more significant.

Costs are, as we concluded earlier, the most important factor when selecting a logistical packaging system. However, since all driving forces mentioned above have a decisive influence on packaging system costs, we have chosen not to treat costs as a single factor.

chapter 7

FIELD OF INVESTIGATION

The objective of this chapter is to present the empirical data we have collected during our interviews in this project. Intending to elucidate attributes of our investigation field, we start by giving a brief industry introduction. In order to make the chapter as legible as possible for the reader to follow, the rest of the chapter is divided into five sections, one for each interviewed company. The structure is based on our generic analysis model, presented in the previous chapter.

7.1 Telecom Equipment Industry

The mobile telecom market is growing enormously worldwide, and demand is likely to increase further, with the construction of Third Generation (3G) mobile networks and the introduction of a universal mobile standard, replacing the existing frequencies of the GSM[33] network. (ITU, 1999) In order to provide mobile telecom services, there is a need for telecom infrastructure, which is manufactured and provided by companies in the telecom equipment industry. The growth in this industry has also been considerable in recent years. (Strömberg, 2000)

7.1.1 Logistics Channel

As a result of outsourcing, the complexity of the logistics channel in the telecom equipment industry has increased significantly, and many new players have appeared. (http://www.segerstrom.se [a]) The different industries supplying the telecom equipment industry with materials are depicted below.

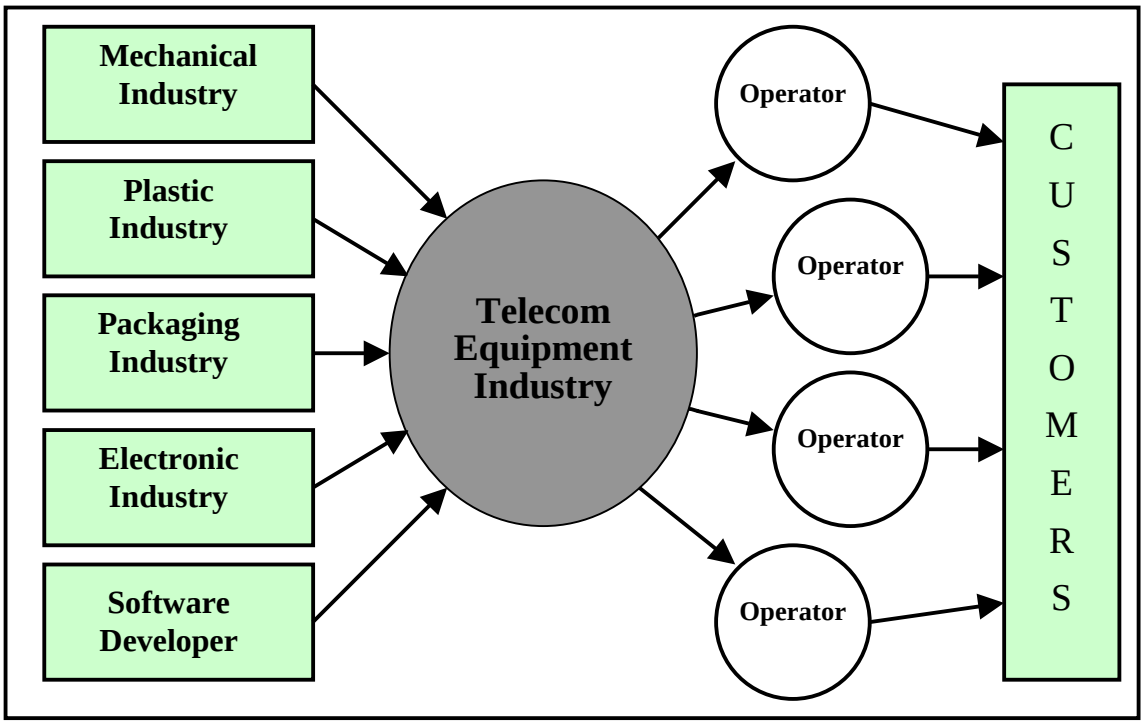

Figure 7:1 – Logistics Channel of Telecom Equipment Industry
Source: Nefab (2000a) (Revised by the authors)

[33] GSM = Global System for Mobile Communications. The world's most widely used mobile phone system, utilized on three different frequencies: 900, 1800 and 1900 Mhz.

7.2 Ericsson Radio Systems – Katrineholm

Where not else stated, all information in this section derives from our interview with Karin Bergström, Production Manager at Ericsson Radio Systems, Katrineholm, conducted on December 5, 2000.[34]

7.2.1 Introduction

Since 1876, Ericsson has been active worldwide and today operates in more than 140 countries. Ericsson is the world's leading supplier in telecommunications with the largest customer base, including the world's top-ten network operators. Ericsson provides total solutions covering everything from systems and applications to mobile phones and other communications tools. (http://www.ericsson.se)

Ericsson Radio Systems (ERA), with headquarters in Kista, is with 12.000 employees the largest division within Ericsson. ERA is the leading supplier of radio base stations[35] for mobile communication systems. (http://www.ericsson.com)

7.2.2 Product Demands on Packaging Quality

Ericsson's strength, which assures customer satisfaction, Bergström argues, is quality. This implies, that although ERA Katrineholm would welcome the possibility of implementing a greater number of reusable packages, including to domestic and foreign customers who are not members of Ericsson's packaging pool[36], quality has to be the first priority. One important factor is therefore the aesthetical appearance of the packaging when it reaches the customer:

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[34] Since our interviewees were performed in Swedish, the quotations presented throughout this chapter are the author's own translations.

[35] A mobile telephone network consists of several switches connected to the fixed telephone network. Each switch is in turn connected to a network of base stations. A mobile telephone call goes from the base station via the switches to the fixed lines. (Arkivator, 2000)

[36] The purpose of the packaging pool is to coordinate purchases and enable common utilization of standardized reusable transport packages. Cat Logistics in Huddinge administers the packaging pool in Sweden, and regarding European shipments a central facility in Aachen is responsible for the provision of packages.

> *"You stamp it, you attach labels to it, and it is not very pleasant to send the packaging to a customer with markings from previous shipments. You want it to reach them with only the stamps and labels which should be there; it has to look good when you send it."*

Another quality related aspect, Bergström argues, is that received packaging material made out of wood never follows the delivery to internal departments in charge of electronic production since it is not protected against electrostatic discharges (ESD). Instead, such internal deliveries are made using small plastic containers, which circulate through the plant.

7.2.3 Current Packaging System & Handling

Presently, the entire Ericsson group buys packaging material from 14 companies, so called "preferred suppliers", out of which four are suppliers of corrugated cardboard, four other deliver various types of dunnage, and two firms are supplying Ericsson with ESD-protected material. (Branke, 2000) Bergström reveals that ERA is very pleased with its packaging suppliers, and that ERA creates a prognosis showing the future demand for packages. This prognosis is based on the production pace at the time, and is sent to the packaging suppliers, including Nefab.

Few products at ERA Katrineholm have a tailor-made packaging. Instead, a general packaging, which can be used for several products is preferred since the storage of empty packages occupies a great deal of space. Reusable packaging is used only within the packaging pool, and is easier to handle than corrugated cardboard since wood facilitates outdoor storage, even under relatively harsh conditions. Most products shipped from ERA Katrineholm destined for export are sent in foldable plywood boxes or on pallets, which form part of Ericsson's packaging pool. According to Bergström, however, shipments to external customers who are not members of the pool are sent exclusively in one-way packages:

> *"If we send in pallet and collars to a company who is not member of the packaging pool, we will lose the pallet, and we will have to pay for it. Therefore, using a one-way packaging presents a much cheaper alternative."*

Level of Tied-up Capital

ERA ships about 400 cubic meters per week, including all sizes of packages. Inbound deliveries are made daily, averaging 10 to 15 trucks. In addition, there are two daily deliveries from the Swedish Post Office's "Företagspaket".

> *"There are a lot of speedy deliveries, attributed to the fact that we have to have our material almost on the exact hour in order to finish our production at the right time, and keep lead-time to a minimum."*

Ericsson has over several years been working conscientiously to reduce lead-times on all levels. By year-end 1998, Ericsson initiated a project called "TTC Global" which targets at shortening Time-to-Customer, by reducing lead-times in the logistics channel by 50 percent or more. One of the most important changes as a result of TTC Global is that products delivered to customers should be as ready to use as possible, for example, a base station should have all software installed and be ready to take into operation by simply connecting the necessary power and communications cables. At the same time, Ericsson is creating simpler and thereby faster ordering routines for customers by using Internet technology. (Ericsson, 2000)

> *"We are having some problems to meet Time-to-Customer, and this is partly due to the fact that our suppliers are not delivering certain important components on time, or that perhaps only part of the delivery is made"*

Bergström points out that variations in demand are significant in the industry, and that there is a great uncertainty about what the developments will be during the coming six months. To meet sudden peaks in demand requires great flexibility of machinery and personnel

7.2.4 Transportation Characteristics

Transport Distance

According to Bergström, the main supplier of ERA's facility in Katrineholm is Segerström & Svensson in Småland. Additional suppliers are Volex, who provides cables from factories in Östersund, Poland and

Castlebar in Ireland, and Solectron who delivers from Östersund, Austria, and Longuenesse in France. Another supplier, which has steadily increased its deliveries to ERA in Katrineholm is Flextronics, from their factories in Althofen, Austria, Karlskrona and Katrineholm.

Outbound deliveries are made to customers from all corners of the world; European shipments are passed through the central storage facility for the packaging pool in Aachen, Holland, where they are reloaded, whereas other deliveries are made directly to customers. About 50 percent of all deliveries are made through a reusable packaging system with pallet and collars of the packaging pool. This figure is falling however, since the level of direct shipment is increasing.

Destination Character and Number of Actors in the Logistics Channel
Base stations manufactured at ERA Katrineholm are sent either directly to customer or to the customer via Ericsson's distribution facility in Aachen. Since the packaging then follows the base station to its final destination, Bergström does not believe that a reusable packaging is suitable, except to Aachen, where pallet and collars from the pool can be used.

A simplification of the logistics channel of ERA Katrineholm is depicted in Figure 7:2, where the most important flows are outlined.

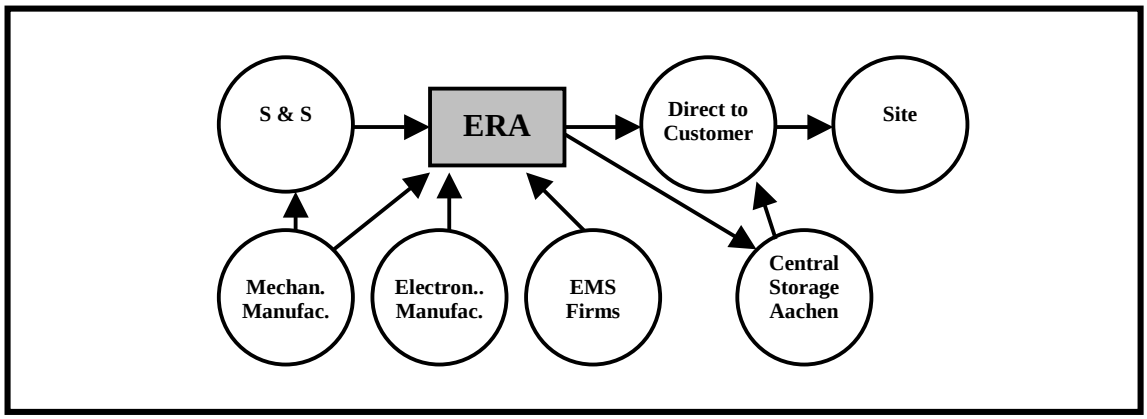

Figure 7:2 – Logistics Channel of Ericsson Radio Systems, Katrineholm
Source: Own Creation

7.2.5 Future Expectations and Ambition to Change

From year-end 2000, Nefab has been appointed as supplier of all packaging-related material to Ericsson. This implies that Nefab will not

merely provide Ericsson with plywood boxes, but also dunnage and other packaging solutions. This is part of the ongoing outsourcing trend in the industry, and implies that Ericsson no longer will develop any packaging solutions, but only concentrate on core business. (Branke, 2000)

Due to the nature of base stations, and the increased usage of direct shipments, Bergström considers the possibilities of implementing other reusable systems limited:

> *"Reusable systems could be implemented if one had the right kind of customers. But now, for instance, Croatia orders one base station from us, which is sent out and placed high up on an attic or somewhere. So, one-way packaging will most likely prevail."*

7.3 LGP Telecom – Solna

Where not else stated, all information in this section derives from our interview with Bo Sjösten, Manager of Customer Service at LGP Telecom, Solna, conducted on December 7, 2000.

7.3.1 Introduction

LGP Telecom[37], with more than 300 employees, is part of LGP Telecom Holding and has headquarters in Stockholm. LGP was established in 1993, and supplies the mobile communication market with products and system solutions that allows improvements or extension of a radio network's coverage. (http://www.lgp.se)

7.3.2 Product Demands on Packaging Quality

LGP manufactures products, which are connected to the base station on the site where it is being built. Therefore, Sjösten points out, they are naturally made to face harsh climate and even strikes of lightning, thus making the need for ESD protected dunnage obsolete.

[37] Henceforth referred to as LGP.

Sjösten is generally pleased with the quality of LGP's packages, and product damages due to insufficient packaging is not considered a problem:

> *"Now and then packages are sent back to us, and we can see how they have been treated. On occasion they are deformed, but sometimes completely intact. Damages mostly occur when trucks run into the packaging, and there is no good protection against that."*

7.3.3 Current Packaging System & Handling

Regarding packaging solutions for products to various customers, LGP selects the greater part of materials to be used. All LGP's products are sent in packages which are designed and manufactured by an independent packaging supplier. Outbound material is mostly sent by truck in corrugated cardboard boxes loaded on standard pallets with collars, using expanded polystyrene as dunnage. Sjösten reveals that, since LGP's location in Solna was not designed for any major storage capabilities, most packaging material is kept outside. Due to lack of space, an external storage facility is rented, pending the construction of LGP's new factory in Tullinge, which eventually will offer sufficient storage possibilities.

Inbound material is mainly received in the same manner as the outbound material is shipped, i.e. in pallet and collar, usually filled with smaller corrugated cardboard boxes. Contrary to LGP's products, however, delivered components are sometimes ESD protected, and delivered in plastic crates. Sjösten identifies the plastic crates and the pallets as the two reusable flows of packages at LGP.

Level of Tied-up Capital

LGP has few standards of packaging sizes and not so many variants in product sizes. Instead, the dunnage made of expanded polystyrene is custom-made to fit the products.

Sjöström explains that there are considerable variations in demand for LGP's products, and that forecasts are more or less non-existent. This is especially true concerning deliveries to Ericsson. However, in line with Ericsson's ambition to outsource production and LGP's prediction to triple sales within two years, deliveries are expected to be made more frequently.

> *"You can say that we are a second source to Ericsson. When they have capability to manufacture the product themselves, they won't buy anything from us. As soon as they are having problems to deliver, they come to us, wanting to buy."*

Shipments to Nokia, who has a central storage in Finland, where nearly all Nokia orders worldwide are sent, is practically made on a daily basis. Although Nokia has several foreign storage facilities, LGP's products go to Finland, where the base stations are manufactured. Since Nokia has to send the finished base stations from Finland anyway, Sjösten explains, they can reduce customs expenses by including LGP's product in the shipment.

Sjösten says that, since the largest part of the deliveries are unprogosticated lead-times negatively affected. To Nokia, the average Time-to-Customer is two weeks regarding prognosticated deliveries. However, since the greater part of Nokia deliveries, as well to other customers, are not forecasted, the overall average TTC is currently 29 days.

7.3.4 Transportation Characteristics

Transport Distance

LGP purchases material from between 50 to 100 different suppliers, out of which the main part, 90 percent, is located in Sweden. The suppliers also perform work on components used in LGP's products, such as for instance high-speed milling, silver plaiting and paint jobs. Mechanics is purchased from firms within LGP Telecom Holding, for example from Arkivator in Falköping and MG Instrument in Tullinge.

Besides network operators and base station manufacturers, Sjösten explains, foreign agents, serving as collection points and suppliers of spare parts for both operators and manufacturers in certain countries, are customers of LGP. Among the group's customers within the telecom industry are OEMs like Ericsson, Nokia, Motorola and Siemens and network operators like Bell South, Pacific Bell, and Telia (http.//www.lgp.se). Sjösten states, however, that LGP's key customer is Nokia, who in the fall of 2000 elevated LGP to the status of prime supplier.

In Sweden, LGP deliveries to ERA and to Ericsson Radio Access (RSA). Deliveries also go to Ericsson in the United States, Great Britain and Spain.

Destination Character and Number of Actors in the Logistics Channel
LGP purchases the main part of materials from domestic suppliers, both from external companies and firms of LGP Telecom Holding. Mechanical equipment may be shipped via a processing firm for high-speed milling or silver plaiting before it is assembled at LGP. Once finished, the product is delivered in its packaging directly to the site, via either a network operator, OEM or on occasion, a foreign agent.

After LGP's products have been delivered to the customer, they are usually placed in some kind of storage facility and remain in the original packaging until they are forwarded out to the location and assembled where the base station is built. This arrangement limits the possibilities of introducing a reusable packaging system, Sjösten says:

> *"On the site they don't have any possibilities of sending the packaging in return to us, so it therefore has to be as inexpensive as possible."*

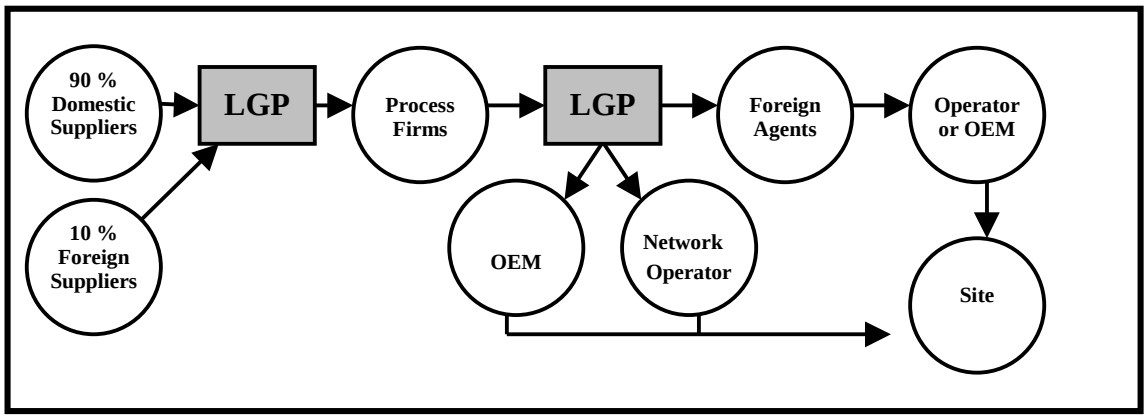

Figure 7:3 – Logistics Channel of LGP Telecom, Solna
Source: Own Creation

In the figure above, we have outlined a simplification of the logistical flows of LGP Telecom in Solna.

7.3.5 Future Expectations and Ambition to Change

Although LGP focuses on product improvement and leaves packaging improvement to its packaging supplier, efforts are being made to find better packaging solutions and materials. Sjösten is of the opinion that an implementation of more reusable systems would be very beneficial, and

admits that there are, in fact, some products for which he believes reusable systems should be used. Correspondingly, Sjösten argues that some of LGP's products are not suitable for reusable packages at all.

7.4 Segerström & Svensson – Forserum

Where not else stated, all information in this section derives from our interview with Lennart Hed, Supervisor of Shipping Department at Segerström & Svensson, Forserum, conducted on December 5, 2000.

7.4.1 Introduction

Segerström & Svensson is an international group with around 1,500 employees in seven countries worldwide. (http://www.segerstrom.se [b]) One business sector is Enclosure Systems[38], which manufactures enclosure systems for radio base stations, public switches, and corporate switches for the telecom and computer industries. (http://www.segerstrom.se [c])

7.4.2 Product Demands on Packaging Quality

At Segerström, losses of packaging material is not common, but happen now and then when pallets with collars are sent to customers outside the pool system. Using plywood one-way packages, Segerström's products are seldom damaged; only on rare occasions does the cabinet fall off a truck and has to be scrapped.

> *"It is important that the packaging is durable enough to face the demands imposed upon it from the environment and climate where it is sent."*

The "IRIS Cabinets", which are Segerström's main product to key customer Ericsson Radio Systems, are large products weighing close to 500 kilos. This makes them virtually impossible to be subjected to same, careless handling which smaller, less heavy packages are sometimes experiencing. Thus, the question has risen, if the robust plywood packaging could be replaced with less sturdy, and also less costly,

[38] Henceforth referred to as Segerström.

corrugated cardboard. The suggestion was investigated, and rejected, by Segerström's product technicians:

> *"They made the judgement that we would not be able to guarantee the quality of our products if we were to use corrugated cardboard. Since the cabinet is varnished, surface damages and scratches can easily occur. Even though the cabinet is often scratched when it is set up on the final site, we cannot deliver them that way."*

7.4.3 Current Packaging System & Handling

Segerström has experienced an enormous growth in recent years, and according to Hed, focus was therefore put on production instead of on the routines and practices around the production, e.g. packaging. As a result, particularly export shipments were affected, since pool pallets were sent to customers outside the pool system:

> *"We had a major problem there. From year-end 1999 until the beginning of the summer we were sending pallets and collars on export, which cost us a great deal of money."*

An internal project was initiated, consisting of several Segerström departments in collaboration, to find and implement a new export packaging system. The solution was a Nefab plywood packaging, situated on a pallet. Following the introduction of the new packaging system this summer, export deliveries by reusable pallets to customers outside the pool system have become rare. Occasionally, however, due to large unexpected orders or shortages in plywood packaging material, circumstances do arise where it is difficult to avoid:

> *"It happens that we send pool material to customers who are not members of the pool, practice and theory do not always go hand in hand – sometimes shipments must be made fast, and then it is sent with pallet and collar."*

Segerström's Forserum facility currently operates three major flows of packaging systems; the IRIS cabinet, which is sent in an one-way plywood packaging provided by Nefab, climate controllers which are delivered in a reusable Nefab plywood packaging from Skive, Denmark, and standard

pallets with collars from Ericsson's pool system. Regarding Segerström's deliveries to Ericsson, precise instructions are given on how to pack and which material to use.

Hed points out that the working environment is designed in order to make packaging handling practical and efficient. One drawback of the plywood packaging currently used at Segerström, however, is that it is made in one piece, which implies that the lifting height necessary when filling it with products is higher than with a pallet and collar system. In order to facilitate easy handling of the packaging, various lifting devices are developed to manage every type of packaging, from the size of a shoebox and up.

In an effort to employ efficient packaging solutions, customers are frequently monitored for opinions in order to receive feedback on how the packaging suits their needs and working environment. Hed states that developments and improvements in that area is constantly undertaken:

> *"There is a balance between Ericsson's packaging demands, the appearance of the product, and what kind of packaging Nefab has in stock. We have managed to find a solution which suits all parties, but new products, and the phasing-out of old products, produces a constant need for packaging development."*

Level of Tied-up Capital

Segerström Enclosures in Forserum has an average of four outbound truck deliveries per day, a type of charter traffic, which is shared between Segerström and Flextronics in Skillingaryd. North-bound, between Småland and Kista/Gävle, the truck ships IRIS cabinets, and south-bound it brings packaging material from Nefab in Alfta, and Poolpack in Lindesberg.

> *"We send an average of 500 cabinets per week, and that's only counting ERA. It is an up-going phase, we have increased our production rate of the IRIS Cabinet significantly".*

The number of packaging standards is kept at a minimum at Segerström, partly as a result of customer demands, partly because the packaging has to enable movement with various types of trucks.

7.4.4 Transportation Characteristics

Transport Distance

Segerström's main product to key customer Ericsson Radio Systems is the "IRIS Cabinet", and ERA deliveries are primarily made to Gävle. Climate controllers, which are mounted inside the cabinet are delivered from Skive, Denmark.

Other important customers include Allgon, Lucent, NEC, Nokia, and EMS companies Solectron, Flextronics and SCI. (http://www.segerstrom.se [b]) Hed mentions Solectron and SCI as important EMS customers, to which most are domestic deliveries, but shipments are also made to other parts of Europe, as well as more distant countries like the United States, Brazil, China, and Malaysia.

Destination Character and Number of Actors in the Logistics Channel

Once the manufacturing of the IRIS cabinet is completed at Segerström in Forserum, it is packed in a one-way plywood packaging designed to hold and protect the cabinet from Segerström to the final destination, i.e. the site where the base station is being built:

> *"The packaging goes with the cabinet to Gävle, where it is unpacked. They do some final mounting and perform a test of the cabinet, and then re-pack it using the same packaging, which then accompanies the cabinet to locations throughout the world."*

Hed mentions that Segerström has a storage in Nässjö, where the majority of the cabinets were formerly stored, before being sent off to ERA in Gävle. However, at present this storage is virtually empty, and Segerström is to a greater extent than before advocating shipments directly to customers.

In order to depict the general flows, the figure on next side shows a simplification of the logistics channel of Segerström & Svenssons' facility in Forserum.

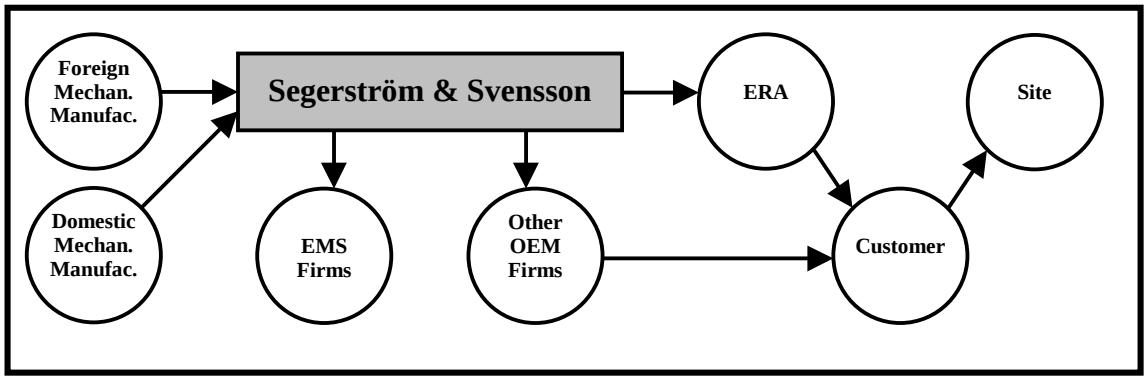

Figure 7:4 – Logistics Channel of Segerström & Svensson, Forserum
Source: Own Creation

7.4.5 Future Expectations and Ambition to Change

Hed thinks that the introduction of more reusable packaging systems in other flows is considered a possibility, but that the implementation of further reusable systems postulate the existence of material flows of in both directions:

> *"Considering the way we work, more reusable systems would be excellent, because we would not continuously have to buy one-way packages ourselves. Instead we would use material from a rotating system."*

Disadvantages which Hed regards as obstacles of implementing reusable systems, where one-way systems are used today, is that the current system is easy to handle, both from an administrative and practical viewpoint. A reusable system, on the other hand, has to be administered and handled with greater care:

> *"You have to book return transports and keep an eye on the packaging. A certain amount of documentation naturally follows – the reusable system is demanding in one way or the other."*

Hed concludes by stating, that improvements in packaging solutions are always going to be stressed and that savings can be made in that area.

7.5 PartnerTech – Åtvidaberg

Where not else stated, all information in this section derives from our interview at PartnerTech, Åtvidaberg, conducted on November 30, 2000. Four persons participated in the interview: Logistics Manager Anders Carlström, Purchaser Kenneth Nilsson, Inventory Manager Stefan Bengtsson, and Lennart Herg, from the Production Engineering Department.

7.5.1 Introduction

PartnerTech develops and manufactures electronic products under contract to leading companies, primarily in telecommunications, IT, and medical technology. PartnerTech performs advanced electrical and mechanical work in such areas as surface mounting, high-speed processing, and milling. Important product areas include radio base stations and test equipment. (http://www.partnertech.se)

7.5.2 Product Demands on Packaging Quality

Since most PartnerTech products consist of sensitive components, Carlström reveals that customers demand that all outbound products are packed in material which protect it from electrostatic discharges (ESD):

> *"If one were to touch a component, it takes only a small discharge to ruin it. In order to eliminate that risk, all material has to be isolated against these charges."*
>
> (Carlström)

Herge states, that since a great deal of inbound deliveries come from Asia, where ESD implementation still is in its infantile stage, unfortunately, not all incoming materials is ESD protected. PartnerTech co-operates with Packforsk[39] in order to test their packaging and find the ultimate packaging solution for the individual product.

[39] The Swedish Packaging Research Institute, who is active in different issues regarding all sorts of packaging, including, among other things, testing of packaging materials.

"There is a connection between choice of dunnage and the weight of the product. Statistics show that a packaging you can carry yourself will be thrown around a lot. Just look at the post terminal at Tomteboda, they throw packages all around the place. A product above 50 kilos, however, can only be handled with a truck, and will therefore not be subject to falls from any greater heights."

(Herge)

7.5.3 Current Packaging System & Handling

Carlström claims that PartnerTech often develops a packaging alternative, which is presented and discussed with the customer. Herge reveals that the most important thing in those instances is the handling; the customer normally wishes to store as many packages as possible on the smallest space possible. Regarding deliveries to Ericsson, however, Herge says that directions are given concerning the qualities of the packaging. Carlström mentions that for the products which PartnerTech manufactures the most, reusable systems are already in use, consisting of tailor-made plastic containers provided by Ericsson, or standard pallets with collars.

"We use the pallets for example in the flows between Åtvidaberg and ERA in Kista, Nynäshamn and Gävle."

(Herge)

Herge says that another reusable pallet system is used between Åtvidaberg and the customer Allgon, located in Solna. According to Bengtsson, PartnerTech receives most materials packed in pallet and collar. All inbound material is packed in boxes of corrugated cardboard or plastics inside the pallet, which implies production of an enormous waste amounts. Outbound material is to a large extent packed in plastic crates, leaving the received collars left over:

"If we, for example, receive material from ten suppliers using pallet and collar, we will, after our processing, ship this in special crates, leaving us with perhaps nine pallets and 25 collars. This represents a dilemma, and plywood and other special packages leave us with even more obsolete material."

(Bengtsson)

At PartnerTech Åtvidaberg improvements in handling efficiency are constantly sought after:

> *"We used to make a packaging for a product which was sent to ERA, where they applied a powerful printed circuit card. Initially, they had to unpack and repack that thing, but then we reconstructed the packaging so that they principally only had to open one side of the packaging. Big savings were made, quite a nice bundle of cash really…"*
>
> (Herge & Nilsson)

Herge mentions that besides improvements of the packaging itself, updates in packaging routines is also undertaken in order to enable more efficient deliveries:

> *"Allgon was one such example. We started out by using one carton per item, and then they raised the question if we could do some co-packing."*
>
> (Herge)

Level of Tied-up Capital

On the daily average, Carlström states, 300 modules for base stations are sent to ERA, and the reusable packaging is used on average ten cycles in the logistics system. Carlström points out, however, that the demand for PartnerTechs products witnesses large variations:

> *"The flows are like a merry-go-round, sometimes large deliveries are planned to Ericsson, but none are made, and sometimes no deliveries are planned when Ericsson suddenly wants major deliveries".*

It is always the customer who chooses which packaging to use, and as previously mentioned, PartnerTech's major flows are operating in a reusable system with custom-made packages, something that is avoided when it comes to smaller orders:

> *"If the volumes are small, a standard size packaging is used since they are easier to handle and thereby shortens lead-time"*
>
> (Nilsson)

> *"There is a plethora of packaging materials to choose from, and for a product manufactured in large volumes you want the cheapest, most effective packaging possible. For small volumes, customized packaging becomes much more expensive – it all depends on volume."*
>
> (Herge)

7.5.4 Transportation Characteristics

Transport Distance

According to Carlström, Ericsson shipments are made to Kumla, Ericsson Radio Access in Kista, Ericsson Microwave in Mölndal, and to ERA in Kista, Gävle and Nynäshamn. Other PartnerTech customers include Allgon in Solna, for which PartnerTech manufactures amplifiers for mobile phones he continues.

Destination Character and Number of Actors in the Logistics Channel

Carlström says that products never go directly to the end customer i.e. network operators, and this structure will most likely never change. PartnerTech's deliveries are often made through one of Ericsson's divisions or to an Ericsson central storage facility, from where they are redistributed:

> *"Our shipments are in turn sent to another Ericsson facility which connect them to the base station. In that sense, we do not manufacture any final products."*
>
> (Herge)

Currently, however, PartherTech's deliveries are, according to Carlström, witnessing a development where more direct shipments occur, for instance to Ericsson's American divisions.

Carlström explains that reusable systems are practically non-existent for inbound shipments, since a large proportion of materials are imported from Asia, where reusable packaging systems are very uncommon. Electronics are also purchased from Swedish distributors, which involves a middleman and some sort of re-loading. The greater part of the mechanical equipment bought, originates from Swedish companies.

In the case of PartnerTech, Herge says, it is always the customer who makes the packaging choice. Customers demand different solutions depending on where the product is being sent:

> *"If it is shipped to the final customer, a reusable packaging system is needless. If the delivery goes to an assembly facility or to a place where it is repacked together with other products, then a reusable system can be of more interest." Shipments are also made to storage facilities, from where it eventually is delivered in the same package – in those cases we cannot send a reusable packaging."*
>
> (Herge)

Herge further reveals that shipments to a customer in Japan has taken on the form of a reusable system, even though the flow itself, due to transport distance, is a typical case for implementing a one-way system:

> *"The Japanese do not have any disposal facilities. It seems to be more expensive for them to dispose the material than to send it back. For instance, we ship a packaging to them, the size of a pallet, and they send it back to us – completely empty. Even though we haven't requested it, this has become a return flow."*
>
> (Herge)

In order to illustrate general material flows of PartnerTech Åtvidaberg, we have created a simplification of its logistics channel in the figure below.

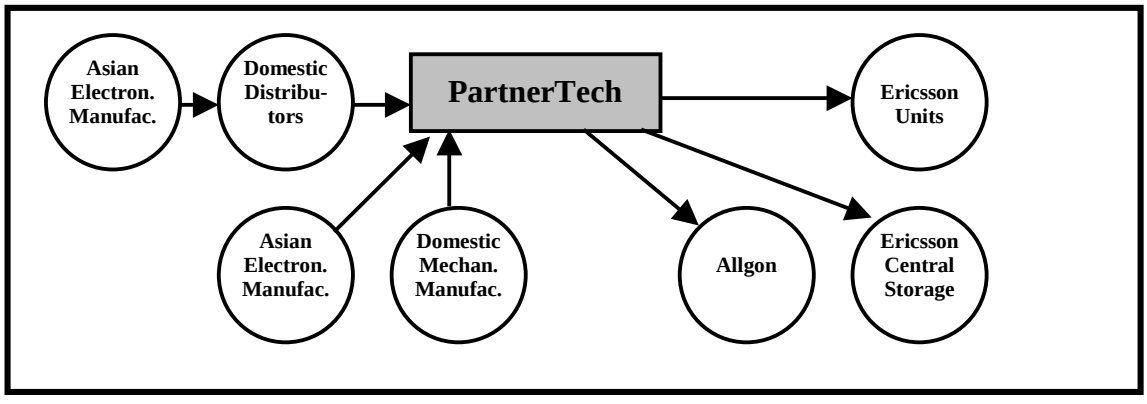

Figure 7:5 – Logistics Channel of ParterTech, Åtvidaberg
Source: Own Creation

7.5.5 Future Expectations and Ambition to Change

Carlström mentions, that further usage of reusable systems for longer distances other than those used today, are presently not under consideration at PartnerTech, due to expensive shipment costs.

> *"We definitely have to lower our level of tied-up capital, however, and to do that, we will have to make more frequent deliveries."*
>
> (Carlström)

Herge identifies economical savings as the biggest advantage that can result from the implementation of new reusable systems, since it is often cheaper to transport the packaging back than to buy a new packaging. Uncertainty and handling are seen as the big drawbacks, especially since it is considered difficult to determine how many cycles the packaging system will last, and when new packages have to be bought; thus, additional administration work will be necessary.

> *"It is different if you know that ten packages are needed. Then, you just purchase ten crates whose depreciation can start immediately…it is easier with one-way packages since you know the exact number of packages required."*
>
> (Carlström)

According to Herge, the new EU directive which is underway, will come to influence the choice of packaging, since it will limit the level of allowed dunnage. He believes that this will mean that testing and research of alternative packaging solutions will increase at PartnerTech. Herge closes by remarking, that future development in packaging is not exactly the highest priority, and that when for instance Ericsson develops a new product, a large number of factors have to be taken into consideration. Unfortunately, according to Herge, packaging is found at the very end of all those factors.

7.6 Flextronics Enclosures – Vaggeryd

Where not else stated, information in this section derives from our interview at Flextronics Enclosures, Vaggeryd. The interview was conducted on December 6, 2000, with Production Manager Lennart Fäldt, and Weine Rapp from the Material Planning Department.

7.6.1 Introduction

Flextronics International is a major global company and EMS provider with design, engineering and manufacturing operations in 27 countries and four continents. Customers are multinational OEMs such as Ericsson, Nortel Networks, Lucent Technologies, Nokia, and Philips. (http://www.flextronics.com) Flextronics Enclosures[40] is a part of Flextronics International and works with design and development, manufacturing, assembly, and testing of fully customized electronic cabinets. (http://www.swedform.se)

7.6.2 Product Demands on Packaging Quality

According to Fäldt, Flextronics uses Nefab plywood one-way packages to send products to final customers, and since the plywood material is very durable, articles are only on rare occasions damaged during transports. In addition, Flextronics' contribution to the base station consists of less fragile components. Even though the products inside the crates reach their destination undamaged, the crates themselves are in Fäldt's opinion subject to careless treatment, and for aesthetical reasons cannot be repacked and sent to the final customer more than once.

> *"We have sent shipments to the wrong destination on some occasions. This spring we were returned a shipment that had gone to China and back, and the crates didn't exactly look nice. They witnessed many re-loads; first by truck to Aachen and on to Luxembourg, from there by air plane to Shanghai, and from there by truck to a city 300 kilometers away."*
>
> (Fäldt)

[40] Henceforth referred to as Flextronics. In August 2000, Flextronics acquired Chatham Technologies, who formerly operated the Vaggeryd facility, and who in turn, had acquired the old Swedish company Swedform in June 1998.

Fäldt claims that quality is one important factor, which determines the choice of packaging material at Flextronics:

> *"There mustn't be any compensation claims related to poor packaging material. Ericsson is also very aware of that"*
>
> (Fäldt)

Rapp explains the importance of protecting the products properly. He mentions that the products manufactured at Flextronics are put inside a plastic bag, which is emptied from air and provided with a moisture protection, before the lid is applied to the crate. Ericsson has specified that all material sent to them must be ESD protected. If a static steel component delivered by Flextronics were to find its way into a base station, the entire station could be ruined:

> *"One static metal piece inserted in a base station, and discharged, could burn the entire site, and all that electronic costs a lot of money. So, it is justified if an electrostatic protected plastic bag costs a few pennies more."*
>
> (Rapp)

7.6.3 Current Packaging System & Handling

According to Fäldt, inbound materials received at Flextronics are mostly delivered in pallet and collar, but the usage of corrugated cardboard is rather extensive as well. A reusable system is in use between Norsk Hydro in Sävsjö and Flextronics in Vaggeryd.

Regarding outbound material, Fäldt states that all shipments to ERA is presently packed in a Nefab plywood packaging measuring two or three meters. Those plywood packages are bought from Nefab, and Flextronics' packaging needs are specified in a weekly prognosis to Nefab.

When comparing packaging materials, Rapp mentions that even though corrugated cardboard is a fairly durable material, and can stand the pressure of several metric tons when piled up correctly, plywood is even stronger:

> *"If you have a high pile of crates, there is always a risk of driving the truck fork through the side of the crate at the bottom which could fold, causing the entire pile to fall; and it goes through corrugated cardboard easier than plywood."*
>
> (Rapp)

Fäldt regards handling of plywood to be more flexible than with corrugated cardboard, which has to have a pallet under the box to enable lifting and transportation with truck. With plywood, however, the pallet is already attached to the package.

Since handling of corrugated cardboard most probably could be administrated as efficiently as plywood in the long run, other reasons may be decisive in choosing a new packaging material.

> *"The reason why we are investigating possibilities of using corrugated cardboard are costs. It has been said that the Nefab plywood box perhaps has too good quality, that it costs a little too much. Perhaps we don't need such strong material but could lower durability by, say 20 percent, and use corrugated cardboard instead."*
>
> (Fäldt)

Level of Tied-up Capital

Fäldt says that Flextronics performs daily deliveries of an average of 250 plywood boxes mixed in two and three meters sizes. This amount of goods, which is delivered to ERA's central storage facility in Huddinge, corresponds to 50 cubic meters.

7.6.4 Transportation Characteristics

Transport Distance

According to Fäldt, the greater part of inbound deliveries are made from Södermanland. Other important deliveries are made from screw suppliers, SAPA who delivers aluminum, and fram Norks Hydro in Sävsjö. In the flows from Sävsjö, approximately 50 kilometers from Flextronics' facility in Vaggeryd, a tailor-made reusable crate is used.

According to Fäldt, Flextronics delivers cabinet equipment accessories like fastening devices, cable lists and other ceiling mechanics to ERA's central

storage facility in Huddinge, Stockholm, administrated by CAT Logistics. Deliveries are also made to ERA Katrineholm, but the major distribution point is Huddinge, which is where products from suppliers and Ericsson divisions throughout Sweden are gathered.

Destination Character and Number of Actors in the Logistics Channel
According to Fäldt, all ERA deliveries from Flextronics are made directly by trucks to Ericsson's central storage facility in Huddinge, where the products are stored before being sent off as part of a base station kit, either by truck to Aachen in Holland, from where all European customers are served, or to other destinations throughout the world.

In order to show both inbound and outbound flows of Flextronics, we have created a simplified logistics channel, depicted below.

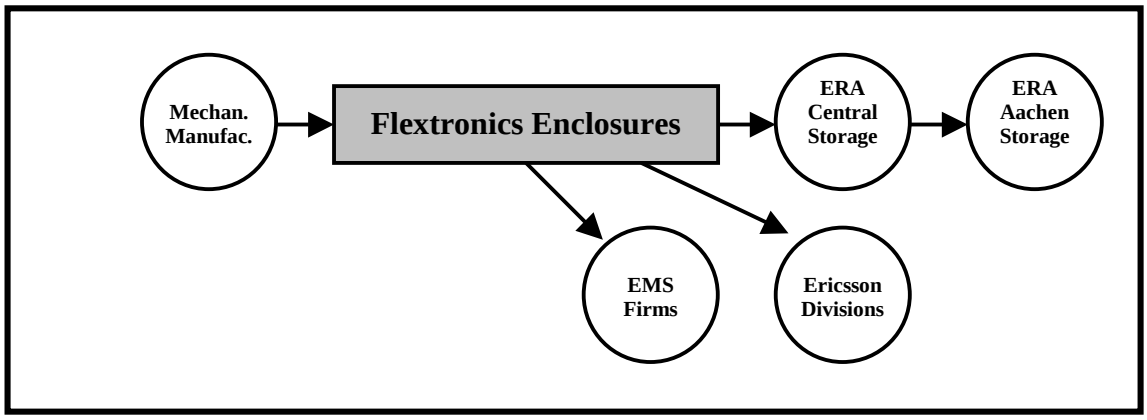

Figure 7:6 – Logistics Channel of Flextronics Enclosures, Vaggeryd
Source: Own Creation

7.6.5 Future Expectations and Ambition to Change

When Flextronics ships to customers outside Europe, one-way pallets are used. Even though a reusable system possibly could be introduced when volume and shipment frequency is taken into consideration, additional handling imposes an obstacle:

> *"If we were to receive 250 plywood crates in return, which we delivered a month ago, we would have to take care of them, and that would probably not be possible."*
>
> (Fäldt)

Recently, attempts have been made to replace the plywood packages with corrugated cardboard.

> *"We would save roughly SEK 60 – 70 per packaging if we were to pack in corrugated cardboard instead of plywood. However, our packaging routines are built around the Nefab crate, so we naturally like that best. If we were to start packing in corrugated cardboard, we would probably find ways of doing that efficiently also, but ultimately it is our customers who decide which material we use."*
>
> (Fäldt)

Even though Fält considers the possibilities of introducing corrugated cardboard to be feasible, he is very pleased with the benefits associated with plywood:

> *"Even though corrugated cardboard is less expensive, it is not quite as good as plywood. When we have packed in plywood, the crate can be stored excellently, and be delivered very easily. Every one is perfectly content with it."*
>
> (Fäldt)

Because Flextronics manufactures a finished product for ERA, no additional mounting or unpacking is necessary; moreover, Fäldt does not believe that the shipments to ERA could be done with reusable packages since the packaging accompanies Flextronics product to the site:

> *"… if they were to open up the packaging in Stockholm… it just wouldn't work"*
>
> (Fäldt)

From a general point of view, Fäldt believes that the implementation of more reusable packages is depending of whether or not a flow of products in the opposite direction can be located. If that is not the case, further introductions of reusable systems will become very difficult since transports are too costly, especially from Asia.

chapter 8

ANALYSIS

The objective of this chapter is to summarize the empirical information collected through our interviews and perform an analysis, partly with help from our theoretical chapters and our specified problem questions, and partly by presenting our personal opinions and thoughts. This chapter also focuses on the pieces of information which can be found "between the lines" in the previous chapter. Moreover, in order to further clarify what we learned during our interviews, a fine-tuning of our analysis model of generic driving forces will be performed.

8.1 In the Beginning there was Nothing

As we started out writing this thesis, we had nothing but a theory on what to investigate. Using literature from libraries and other sources, we set out on a journey to form a model, perform interviews with selected companies, and produce an analysis derived from the answers we would find. Now, as the end of the thesis is approaching, we would like to emphasize that striking similarities between "producing" a thesis and a product exists; a product starts out with just an idea on what to produce. Components are bought and assembled, and eventually construction is finished and the product is sold. The stages of production, from idea to delivered product, can, just as writing a thesis, be described as a journey. Transportation is one "component" of that journey, and the packaging its mode of transportation.

We aim to present the characteristics of the "typical road conditions", i.e. the characteristics of logistical flows of a technically based, rapidly growing industry. In addition, we outline a solution to the driving forces and obstacles to why some companies "take a taxi", while others "go by bus", i.e. why one type of logistical packaging system is preferred over the other.

8.2 Characteristics of Flows

As we mentioned in the first chapter, we have investigated the physical logistical flows of the telecom equipment industry, and in this section we will present what we found to be typical characteristics of these flows.

8.2.1 Variations in Demand

Several of our interviewed companies, for instance ERA, PartnerTech, and LGP, argued that variations in demand in the telecom equipment industry are considerable. Bergström (2000), for instance, claimed that estimating future developments and varations imposes difficulties on ERA. These variations, however, do not seem to be season-related, but occur very irregularly. We think that this phenomena is quite natural, however, due to the dynamic nature of the telecom industry. Especially now, with the emergence of third generation mobile telecom networks, as telecom OEM giants are fighting for every available contract to build networks for

telecom operators. We have received the impression, that negotiations in the telecom industry usually seem to be closed very rapidly, and whether an OEM receives a contract or not often imposes great influences on company development, and the entire logistics channel. If, for instance, a major telecom operator selects Ericsson as key supplier of infrastructure when constructing a mobile network, this will imply that ERA will hold responsibility for delivering large numbers of base stations, which in turn requires immediate inbound deliveries to ERA from its suppliers. We assume, that when Carlström at PartnerTech described that ERA suddenly requested large unplanned deliveries, this can be the result of successful negotiations, where Ericsson received large orders for base stations. Similarly, Sjösten at LGP mentioned that ERA only wanted to buy products when ERA's first supplier lacked the possibility to deliver enough to meet existing demand. We believe that the occasions where LGP receives orders from Ericsson, it is a result of Ericsson receiving large contracts for mobile network construction.

We assume that to meet peaks in demand naturally requires much cooperation in the logistics channel. According to Bergström it is possible for ERA to fulfil its undertakings thanks to their excellent relationship with their suppliers. Thus, we interpret ERA to possess a vertically integrated marketing system in accordance with Kotler (1991) and Bowersox & Cooper (1992).

8.2.2 Focus on Time-to-Customer

When Ericsson receives a large contract to construct a mobile network, Bergström (2000) revealed, the base stations often have to be deliver within a very short time period. Hence, Tme-to-Customer, which Christopher (1998) viewed as a crucial competitive variable, appears to be of great importance. Generally, as mentioned by Tiliander (2000) and Saunders (1997), time is of critical significance in logistical flows, and as Bergström (2000) argued, it is therefore crucial that ERA receives material from its suppliers punctually, to enable on-time deliveries to the telecom operators. We regard this relationship as having great similarities with a JIT flow, since ERA seeks to keep minimum inventories, and aims to receive material more or less exactly when it is needed in the manufacturing process, i.e. partly similar as what according to Coyle et al (1992) characterizes the JIT concept.

Christopher (1998) identified reliability and consistency of lead-times to be equally important as lead-times. Bergström at ERA, however, revealed that ERA occasionally, mostly due to late or insufficient deliveries from suppliers, have problems of meeting Time-to-Customer, which we believe is resulting in costly punishment settlements. We assume that this is a contributing reason behind the introduction of Ericsson's "TTC Global" program.

Lorentzon-Karlsson & Wäström (1996) advocated as few actors in the logistics channel as possible, since each actor implies some sort of handling. Without jumping to conclusions, we think that this handling also occupies a great deal of time, which thus, for instance, increases Time-to-Customer. When we have performed our interviews, we feel that a general trend at the moment seems to be that an increasing number of deliveries are made directly to customers. This, in turn, leads us to affirm that focus on Time-to-Customer must have been highlighted as a company priority, perhaps as a result of wanting to compete with lead-times in accordance with Saunders (1997). Segerström has, for instance, ceased to deliver its products via the storage in Nässjö, and instead, direct shipments to customers are performed. PartnerTech is still sending most of its products to a storage facility within Ericsson, but has, according to Carlström, also started with direct shipments.

8.2.3 Globalization of Logistics Channels

After having conducted our research, we have observed that the majority of our interviewed companies have a global presence in its logistics channel. For instance, ERA delivers base stations to countries all over the world, and Flextronics, PartnerTech, and ERA receive material from countries worldwide. This might perhaps not be regarded as any revolutionary discovery, since presently, globalization trends in most industries are significant. As Ericsson (2000) mentioned, the products for mobile network construction are relatively homogeneous, the components which certain mobile operators need for a network construction in one part of the world is often exactly the same as what was purchased for similar networks built at other locations. Christopher (1998) did not consider the world to be homogeneous, but rather saw a potential for local variations. It is our opinion, however, that these local variations are less obvious in the industry, since there are presently only a limited number of manufacturers of telecom equipment. The trend, according to Segerström & Svensson

(http.//www.segerstrom.se [a]), is that there will most likely be even larger global corporations in the future. In our opinion, only the large OEMs possess the proper knowledge required for network construction, and we think that – in sought of obtaining, or maintaining the already prevailing competitive advantage, in terms of what Christopher (1998) defines as productivity advantage and Porter (1980) as cost leadership – they are likely to offer the same base stations worldwide, without any local customizations.

By introducing web technology for customer ordering, as in the case of Ericsson, global customers can enjoy the same ordering routines and delivery procedures, regardless of where in the world the product will be put into operation. This reasoning conforms rather well with the statement of Coyle et al (1992), which regards the fact that people throughout the world request the same products, as a result of new improved information technology. As we see it, the reasoning that products tend to be homogeneous, also seems to be in line with what Coyle et al (1992) describes as a result of the recognition and homogenization of global needs and wants.

8.3 Product Demands on Packaging Quality

Tiliander (2000) mentioned costs as the ultimate rationale why companies select a particular logistical packaging system. This means that companies focus on what Persson (1998) designated as cost-oriented logistics. After having conducted our interviews, we feel confident enough to stipulate that also what Persson (1998) defines as flow-oriented logistics seems to a great extent be emphasized in the packaging field of our investigated industry. One aspect of performance, which can be related to Persson's delivery precision, is customer service, which is one important logistical activity according to Lambert & Stock (1993).

Johansson et al (1997) argued that the principal objective of packaging logistics is to create customer benefits by providing undamaged products. Similarly, for instance Twede (1992) and Witt (1994), viewed protection of the product as one of the main functions of the packaging. Naturally, all our interviewed companies are well aware that the packaging has to protect the quality of their products. For example, Bergström at ERA argued that

quality is Ericsson's strength, and therefore their first priority. Moreover, Hed at Segerström stated that corrugated cardboard, which represented a cheaper packaging alternative than the currently used plywood, was rejected in order to assure product quality. Similarly, Fäldt at Flextronics pointed out that focus on high quality packages was important in order to avoid compensation claims.

According to Flextronics, PartnerTech, and Segerström, product damages mostly seem to arise from unforeseen accidents during storage or transportation. However, none of our investigated companies have identified poor packaging quality in currently used systems as a contributor to product damages, which implies that the choice of packaging is no issue left to chance. One factor which we believe contributes to this is that, since most companies within a technically advanced industry deals with very sensitive and fragile material, i.e. expensive products, spending a little extra on high quality packaging material is deemed justified.

8.3.1 Materials Preferred

Witt (1997) argued that plastic reusable containers offered better product protection against damage than most expendable transport packages, due to reinforced corners and tight seals. In our interviewed companies, however, plastic containers are exclusively utilized for smaller shipments of ESD protected components, for instance, within the factory at ERA. Instead, preferred packaging materials are corrugated cardboard and plywood.

Corrugated cardboard is primarily used when several items are packed in a pallet and collar, whereas single packed items tend to be packed in plywood. For instance, most products shipped from ERA Katrineholm are sent in collapsible plywood boxes or on pallets. One reason stated by Bergström at ERA is that these materials are easier to handle than corrugated cardboard, since wood facilitates outdoor storage. Rapp, at Flextronics, argued that even though corrugated cardboard is a fairly durable material, plywood is preferred since it is stronger and can be piled more safely. However, they were now investigating whether a shift towards corrugated cardboard could be made, since plywood packages had too good quality and was too expensive.

8.3.2 ESD Protection

In Robertson's (1990) outline of the six general packaging functions, one was to protect the product from outside environmental effects. In line with this, one related aspect to the sensitivity of the product which we have identified as being very important in our investigated industry, is the necessity to protect components from ESD charges. All our interviewees with the exception of LGP, whose products are manufactured to resist strikes of lightning, strongly emphasized usage of ESD protected dunnage and packages. Since finished base stations often are very valuable, we think that the statement from Rapp at Flextronics, that one small discharged metal piece can ruin an entire site, clearly reflects the importance of ESD protection. Regarding literature within the ESD field, there seems to be a plethora of theories dealing with the subject, quite few of which, however, seem to be packaging-related. We assume that this probably is due to the fact that research within logistical packaging is limited, and to our knowledge, no extensive report has been written about packaging systems in an industry with such sensitive technical components.

8.3.3 The Packaging as Part of Quality

A pattern which we found to be visible, is that reusable packages are avoided for finished products delivered directly to customer. One reason is that the packaging is the first thing which the customer sees, i.e. the first impression, and therefore probably influences the judgement of the quality of the product. Both ERA and Flextronics argued that the packaging forms part of the aesthetical quality, and that it therefore has to look good when it reaches the customer. The respondents find that re-loads, labeling, handling and careless treatment result in aesthetically "challenged" and also less functional packages, which can result in product damages, were they to be used again.

8.4 Current Packaging System & Handling

Tiliander (2000) stated that handling is one of the key determinants when selecting and implementing a logistical packaging system, since it affects costs within the flow. The accuracy of that statement becomes obvious as we view the total distribution costs according to Christopher (1985), where

five out of the seven components could be directly attributed to handling activities, which also is a part of Lambert & Stock's (1993) logistical activities. Johnsson (1998) argued that packages can contribute to added service value, in terms of, for instance, lower levels of products in storage, fewer variants in packaging materials and packaging designs, less damage to products, increased handling efficiency, easier waste handling, and more effective recycling systems.

8.4.1 Selection of System

Regarding packaging solutions for products to various customers, LGP selects the greater part of materials to be used. PartnerTech develops suggestions of packaging solutions for most products, which later are presented and discussed with the customer. One interesting observation we made regarding the packaging choice, was that Ericsson provided all interviewed suppliers with extensive details concerning the qualities and appearance of the packaging.

Within our interviewed companies, the most obvious choice of packaging for smaller products is Ericsson's packaging pool, which is a type of reusable system, or return logistics system as Lützebauer (1993) preferred to call it. In our interviews we found out that the packages used in Ericsson's pool are owned by a central agency, and that the sender rents the number of packages from the agency which is required for his deliveries. As soon as the sender no longer needs the packages they are returned to the central agency. As a result of this reasoning, we have in accordance with Lützebauer (1993) identified Ericsson's packaging pool as a system without return logistics. The advantages for participants by using this system, is a possible decrease of fixed costs, for instance, lesser need of a buffer inventory of packages, since senders can decide to only rent the specific numbers of packages required.

Pool material, however, is only used for shipments to members of the pool, and external customers are primarily served with one-way packaging systems. We have identified the reasons behind this as being twofold. First, using pool material for deliveries to non-pool members negatively affects the sender, who has to pay for the pallet and collars. Secondly, since the site often is located in very remote or less accessible areas, transportation is very difficult, whereby the generally lighter one-way packaging may be preferred to the heavier reusable packaging.

8.4.2 Tied-up Capital

One aspect related to reducing the level of tied-up capital, is the way in which for instance ERA and Flextronics are submitting forecasts of their packaging needs on a regular basis to Nefab. The companies first try to estimate the demand for their products in the nearest future, then the prognosis of the number of packages needed to ship those products are submitted. By doing so, the companies reduce the necessity of maintaining large inventories of packages, which lowers tied-up capital. On the other hand, as Fäldt (2000) mentioned, the packaging must not control the rest of the production, and therefore the company has to have a certain buffer inventory of packages to enable speedy deliveries when unprognosticated orders are received.

That variations in demand negatively can affect companies within our investigated industry was seen at Segerström, where Hed stated that deliveries of pool material were sometimes used to non-pool members, which resulted in increased costs. The reason was that shipments had to be made rapidly, which indicated that Segerström on occasion, perhaps due to miscalculations of demand or large unprognosticated orders, lacked proper one-way packaging material.

8.4.3 Degree of Packaging Standardization

In line with Pfohl & Zöllner (1997), a large degree of homogeneity between the products and markets increases the possibility of combining logistical equipment, e.g. packages for transportation, handling and storage of products, which can result in increased efficiency. This implies that companies could lower packaging and handling costs by having as few packaging types as possible. This reasoning was stressed by Bergström at ERA, where tailor-made packages were avoided in favor of general packages, used for several different products. The standardized packaging was also preferred at ERA since it allowed better space utilization when storing empty packages before usage, which we believe to be in line with the opinions of Pfohl & Zöllner (1997), i.e. that the homogeneity of ERA products can result in increased logistical efficiency. Moreover, we interpret the standardized packaging to be favorable for ERA, since they manufacture finished product kits which will be sent directly to customers.

Where volumes are significant, however, transport and storage space efficiency can be increased by using tailor-made packages. At PartnerTech, for instance, tailor-made plastic containers provided by Ericsson were used for the products manufactured the most.

At Segerström and Flextronics, we have, in accordance with to Lorentzon-Karlsson & Wäström (1996), identified product size to be an important factor influencing the degree of standardization of packages. Their products consists of large cabinets, measuring over two meters in height, which therefore cannot be placed on standardized pallets, but have to be shipped in tailor-made packages. Moreover, at Segerström, a tailor-made plywood packaging was introduced after significant economic losses occurred when pool pallets were sent to customers outside the pool system.

Generally, the companies we have interviewed seem to prefer to limit the number of packages used in the system. According to Lorentzon-Karlsson & Wäström (1996) this can result in several advantages, such as reduced tied-up capital, lower initial investment in packages and increased flexibility by a future packaging change. We found the prime influences behind this "trend" to be handling and better space utilization.

8.4.4 Handling Efficiency

Lorentzon-Karlsson & Wäström (1996) stated that some packaging materials are easier to handle than others, e.g. that raising of pallet with collars is easier than with corrugated cardboard, but no particular difference exists compared to plastic or plywood boxes. Hed at Segerström, however, considered the plywood packaging to be more difficult to handle than pallets because of increased lifting height. Fäldt at Flextronics regarded handling of plywood more flexible than with corrugated cardboard, since the plywood solution already has the pallet attached to the package, which facilitated truck handling.

At Segerström and PartnerTech, developments and improvements of packages and working environment design were constantly undertaken in order to increase packaging handling efficiency. Moreover, customers of both companies were contacted for opinions on how the packaging suited their needs and working environment. Herge at PartnerTech pointed out that the most important consideration when developing packaging solutions is that customers want packaging to utilize the smallest space possible.

Waste Handling

Witt (1997) claimed that elimination of disposal costs associated with one-way packages can result in long-term savings for the company. From our interviews, it is obvious that disposal of the large amount of one-way packages and other waste materials received is extensive, and also very costly. However, we received no indications from any respondent that these costs were significant enough to justify a shift towards reusable packages.

8.5 Transportation Characteristics

While performing our interviews, we learned that shipment of products in the telecom equipment industry are facing somewhat different conditions than those of other industries. For example, in accordance with Lorenzon-Karlsson & Wäström (1996), we had expected the number of actors in the logistics channel to be a contributing factor in the packaging system selection. Surprisingly, this was not evident in any of the interviewed companies.

8.5.1 Transportation Distance

According to Pfohl and Zöllner (1997) and Twede (1993), transport distance, as a result of the geographical location of suppliers and customers, greatly affects the possibilities of introducing reusable packaging systems. Johansson et al (1997) argued that transport costs constitute a major part of the total distribution costs in the electronic- and manufacturing industries. In addition, since a reusable packaging, according to Lorentzon-Karlsson & Wäström (1996), normally is heavier than a one-way packaging, return transport costs from distant locations can be considerable.

One characteristic of our investigated companies was that the majority had a global presence in its logistics channel, which implies shipments are made from, and to, locations all over the world. Expensive return transports were by several respondents considered as a major drawback in the implementation of reusable packages. Thus, in line with Johansson et al and Twede's reasoning above, we expected usage of reusable packages to far away destinations to be exception rather than rule, which also, apart

from ERA's packaging pool deliveries to Aachen and PartnerTech's flow to Japan, turned out to be true.

8.5.2 Destination Character

More influential than actual distance, however, was what we have chosen to call "Destination Character". Contrary to most other products, ERA's base stations, to which all our interviewed companies deliver components, are often installed in remote or less accessible areas where handling and return shipments of emptied packages were considered virtually impossible. Another contributing factor is that several of ERA's suppliers are delivering finished products, which will be mounted to the base station on the site. This implies that the products, while stored at ERA, remain in the same packaging, which is not opened before the products are mounted to the base station on the site. That the products remain in the original packaging is also closely related to the packaging serving as a protector of the product. When, for instance, ERA purchases a finished product to be mounted on the base station on site, unpacking and re-packing is not recommended due to the sensitivity of the products, especially in those instances where they are ESD protected.

We believe, that an additional reason why reusable packages are avoided is that, since shipments to final customers usually concern smaller volumes than for instance shipments to central storage and processing facilities, reusable packages tend to be economically unjustified.

8.5.3 Destination-related Obstacles

From the reasoning above, we can conclude that usage of either one-way or reusable packages within the telecom equipment industry is primarily affected by where the goods are being sent, and whether the products are finished, or have to be further processed or attached to some other product.

Thus, the implementation of reusable packaging systems in flows of products, which, due to the fact that they are finished and have to be protected, remain in the original packaging until they are being mounted to the base station on the site, is not suitable. Furthermore, expensive return transports from remote destinations was identified by several respondents as a major obstacle of the implementation of reusable packages. We believe Destination Character and transport distance to be the most significant

aspects influencing the selection of packaging system in the telecom equipment industry, since customers are dispersed all over the world.

8.6 Future Expectations

All interviewed companies stated that improvements in packaging-related activities are continuously investigated. However, due to obstacles associated with Destination Character, the majority of our interviewees rejected possibilities of implementation further reusable systems, and only Hed at Segerström and Sjösten at LGP corresponded positively to this idea. Hed, however, and also Fäldt at Flextronics, argued, in line with Johansson et al (1997), that the implementation of more reusable packages is depending on the ability to find another material flow in the opposite direction.

Fäldt and Hed stated, in line with Johansson et al (1997), that reusable systems requires increased handling and administration, and saw this as major obstacles of further reusable systems implementation. From other interviewed companies, however, we have concluded that administration of reusable packaging systems, and the packaging pool in particular, although quite extensive, is not viewed negatively.

Tiliander (2000) mentioned large investments as the major drawback of reusable packaging systems, since these always involve risks. Uncertainty, which derives from risks, was an additional factor which were seen as an obstacle to introducing reusable systems at PartnerTech. In our opinion, the advantage of one-way packages in this instance was that packages needed for unexpected orders could be delivered relatively quickly by the packaging supplier, whereas covering shortages of reusable packages, which due to their design takes longer time to manufacture, would acquire more time.

Practices built around the current packaging system is most definitely one source of obstruction to the change of system. From what we have learned, the entire storage and shipping facility is in most cases planned around the packaging, and aims at making the packaging process as efficient as possible. Shifting to reusable packages were not considered at Flextronics, due to the extra handling which would be necessary when receiving used

packages. This conforms to Witt (1997), since he argued that changing a packaging system often is a complex process that goes through different phases and requires extensive planning and management support. That the current system can impose a major obstacle to change was revealed in our interview at Flextronics. Even though product quality could be assured if the company was to shift from using one-way plywood to corrugated cardboard packages, with major savings as a result, hesitation related to handling was evident. A switch from plywood to corrugated cardboard might also be complicated to accomplish, since logistical packaging, as Twede (1992) argued, is an activity that concerns the entire channel and therefore new handling methods and material disposal alternatives probably have to be developed by each individual channel member.

In our viewpoint, the reluctance to change packaging systems clearly seems to reflect the conditions of the telecom equipment industry; i.e. that the pace of production and development occupies too much time, and is considered more important than increasing efficiency in packaging and handling. A general impression received during our interviews, was that packaging strategies, as defined by Johansson et al (1997), were practically non-existent, with the exception of ERA, who distributed extremely specified packaging instructions to its suppliers. Even though we identified that our interviewed companies were improving some of their packaging routines, we hold the possibility of a complete shift in packaging material, from, for instance one-way plywood packages to reusable packages in flows where opposite flows are absent, as rather unlikely. As Tiliander (2000) pointed out, such a shift would require large initial investments in packages, and therefore, this decision is likely to be taken at management level, where packaging knowledge may not be sufficient. In addition, we think that, due to the investment size, management is likely to require an extensive investigation prior to decision, something which we believe can be viewed very negatively by many companies in the telecom equipment industry, especially due to extensive time consumption.

Due to the time necessary to develop new, efficient packaging solutions, we have identified that an ongoing trend in the telecom equipment industry is in line what Dwiwedi (2000) and Witt (2000b) stipulated; that manufacturing companies tend to focus on core business and transfer most of the responsibilities of the packaging system to packaging suppliers. As a result, packaging companies are transforming, from being merely suppliers of physical packages, to taking on the role of a complete packaging

solution supplier. We found that this trend was clearly visible at ERA, where Nefab, as described by Branke (2000) had been appointed as supplier of all packaging-related material to Ericsson.

8.7 Fine-tuning of Analysis model

To conclude our analysis, we observed that the most influential driving forces and obstacles in the selection of logistical packaging system in our investigated industry were Quality, Current Packaging System, Customer Demands, Handling and Administration, and Transportation Characteristics. Thus, at this stage, we feel that a fine tuning of our analysis model presented in Chapter six can be performed:

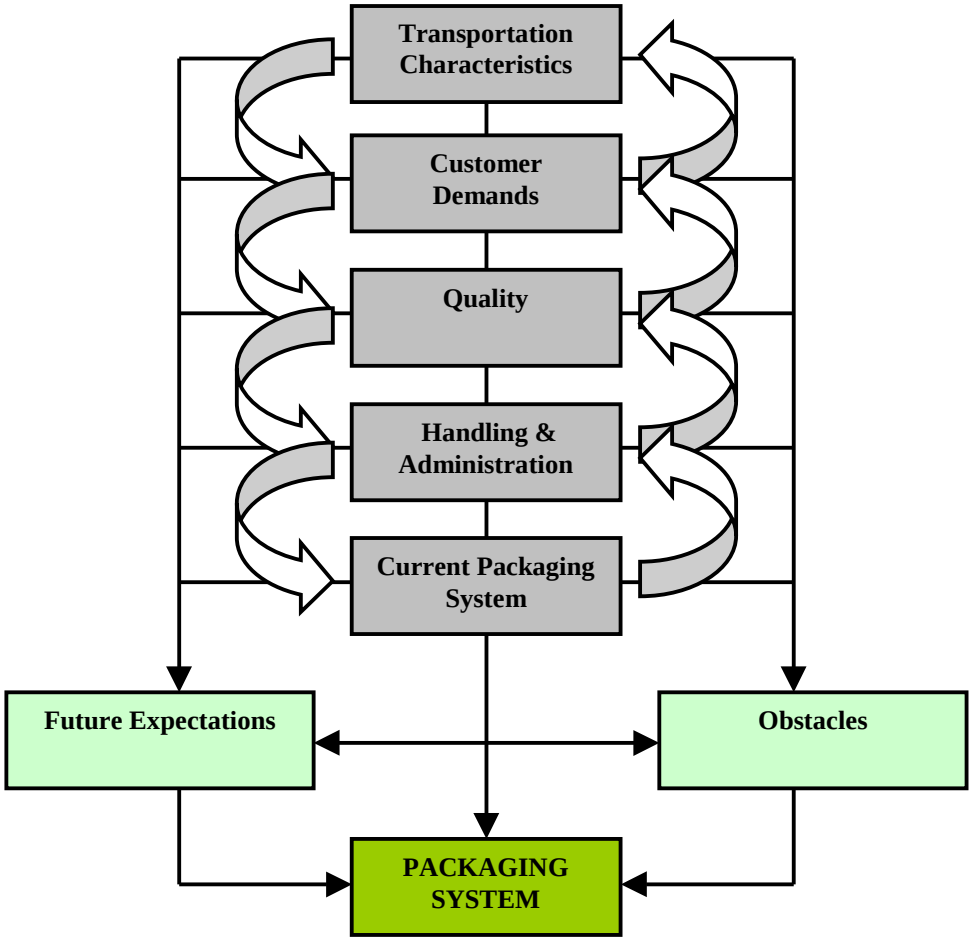

Figure 8:1 – Driving Forces of Packaging System Selection
Source: Own Creation

The most important thing to notice from Figure 8:1 is that, although described and analyzed separately, all factors, to greater or lesser extent influences the choice of packaging system. For example, customer demands on packaging is not a single independent factor, but can in turn be influenced by where that customer will have the packaging sent, the sensitivity of the products, handling practices etc.. Similarly, a change in packaging system, or obstacles to change, are influenced by several, if not all, mentioned factors. For example, a system change is not initiated merely due to changes in Destination Character, but it is rather quality aspects and customer demands related to the change in destination that would be the ultimate reason for doing so.

chapter 9

CONCLUSIONS & FINAL REMARKS

This final chapter aims to present the conclusions of our research in the logistical packaging field. By outlining our conclusions, we enable for the reader to judge whether we have fulfilled the purpose of this thesis or not. With the intention of showing our opinion about the scientific degree of this thesis, we then evaluate ourselves from generally stated scientific ideals, and then conclude by giving recommendations on future research in the logistical packaging field.

9.1 Essence of Our Observations

In order to fulfill our purpose, three questions were presented in chapter six of this thesis: *What are the characteristics of the logistical flows of material in a technically based rapidly growing industry? Which driving forces influence the choice of a logistical packaging system? Which are the possible obstacles of the implementation of a reusable packaging system?*

9.1.1 Characteristics of Flows

While performing interviews with representatives from five companies operating within the telecom equipment industry, which we hold to constitute the perfect example of a technically based industry with rapid growth, three characteristic features became apparent:

- ***Considerable Variations in Demand*** – which are not seasonal related, and thus increases the necessity of planning.
- ***Focus on Time-to-Customer*** – which has resulted in an increased level of direct shipments, and focus on efficiency.
- ***Globalization of Logistics Channels*** – implying that products are produced and received at, and delivered to, locations all over the world.

9.1.2 Driving Forces

When trying to answer the second question, we observed that the most influential driving forces of logistical packaging system selection in our investigated industry were:

- ***Quality*** – meaning that one-way packages were preferred for shipments destined to end-customers, since their aesthetical quality, which was considered part of product quality, was higher.
- ***Current Packaging System*** – implying that practices built around the existing system is made as efficiently as possible, and may thus be preferred even though benefits might eventually be greater if a shift in system was initiated.
- ***Customer Demands*** – where it in some instances was the preference of a company's customer which determined the system used.
- ***Handling and Administration*** – where possibilities of less handling and administration were considered benefits of one-way systems.

- ***Transportation Characteristics*** – where shipments of finished products and shipments to final customers talk in favor of one-way systems. The rationales behind this statement is that the packaging serve as a protector of the product, for instance, through providing ESD dunnage, and that unpacking often is made in remote or less accessible areas. In addition, shipments to distant customers tended to be done in one-way packages, due to expensive return transports of empty reusable packages. On the other hand, semi-finished products sent to distribution centers and storage facilities were reasons for utilizing reusable systems.

9.1.3 Obstacles of Reusable System implementation

When answering the third question, we observed that the most influential obstacles of the implementation reusable packaging systems were mostly associated with the same factors as the driving forces above, namely:

- ***Quality*** – to assure aesthetical quality of the packaging, direct flows to end customers were not suitable for implementation of reusable systems.
- ***Current Packaging System*** – implying that if the current system used is a one-way system, practices built around this constitutes obstacles to change towards the reusable system.
- ***Customer Demands*** – although a company could reap benefits by implementing a reusable system, customer demands of one-way packages might present an obstacle to change.
- ***Handling and Administration*** – by interviewed companies considered as obstacles to implementation of reusable systems, since these then tended to increase.
- ***Transportation Characteristics*** – where, in flows of finished products, which only require unpacking at end-user, the destination constitutes an obstacle for implementing reusable packaging systems. Moreover, since shipments to end-user, which increases due to more direct shipping, usually concern smaller volumes, reusable packages are avoided since they tend to be economically unjustified.
- ***Expensive return transports*** – of used packages, were by several respondents considered as a major drawback in the implementation of reusable packages.

9.2 Evaluation

In this section, we aim to evaluate our thesis, and from our point of view ascertain to what extent we consider having fulfilled the requirements usually imposed on scientific reports. Mårtensson & Nilstun (1988) state four general scientific ideals that every research report should fulfill: *the ideal of ethics, the ideal of availability, the ideal of relevance* and *the ideal of quality.* These are, however, rather vague, and may occasionally come into conflict with each other and also be subject to a number of exceptions.

The ideal of ethics implies that the report should be written in such a manner that no physical or psychical damage arise in connection to its publishing. Although not applicable to any greater extent in our research, one company required exclusion of some data in the thesis. Since we fulfilled this request, we believe to have satisfied this ideal.

The ideal of availability states that the research report should be immediately understandable for the intended target audience and other interested parties, and also be possible to be reviewed by experts. Our target audience is business students at Linköping University, other students investigating logistical packaging, and possible interested parties within the packaging field. We feel that we have fulfilled this ideal, since we have explained conceptions which may not be known to the broader population, and have presented our data in a systematical and logical way.

The ideal of relevance implies that the report should deal with questions, which could be expected to beget new ideas and knowledge, valuable for the society and its citizens. Since existing research of our problem area is rather fragmented, we think that our investigation, and further studies within this field are more than justified. In addition, since logistics has become a very important business concept in recent years, and the telecom equipment industry is one of the fastest growing industries on the market, it is our opinion that our thesis has met the requirement of relevance.

Finally, *the ideal of quality,* means that the report should fulfill generally accepted demands on problem formulation, method, and interesting presentation of results and arguments. In our opinion, we have also fulfilled this ideal, since we have motivated our chosen methods, explained important concepts, and presented conclusions, which fulfilled our purpose.

9.3 Recommendations for Further Research

As we have mentioned, it is an ongoing trend that companies concentrate on their core business and outsource all packaging related activities to packaging firms, which become responsible for providing complete packaging solutions. We think that it could be interesting to study what kind of new challenges this development imposes for packaging manufacturers.

Another point of interest, which we find could warrant further investigations, was identified during our interview at LGP Telecom. LGP's shipments of finished goods are sent through Nokia's facilities in Finland, where it is packed together with the base station before being sent off to a customer. This arrangement is done in order to achieve more beneficial custom terms, and to investigate the influence of customs could be one area subject to investigation.

We have concluded that Destination Character, i.e. the distribution point where the product is being sent, or unpacked, has impact on the selection of packaging system. We believe that this is also one potentially relevant area, where future research could be to conducted.

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APPENDIX A – NEFAB AB

Where not else stated, the information in this appendix derives from Nefab's "Annual Report 1999" (Nefab 2000a).

The packaging company Nefab was founded in 1949 and is market leader in the area of transport packaging with plywood as the foremost packaging material. Nefab with headquarters in Jönköping, Sweden has around 900 employees in 17 countries. The production units are distributed amongst nine countries – Sweden, Germany, England, France, Spain, the United States, Canada, China and Brazil. Nefab is listed on the "O-List" on the Stockholm Stock Exchange and sales totaled approximately SEK 1 billion in 1999. Nefab's vision is to be *"A global partner for complete packaging solutions"*. This vision implies that Nefab aims to provide everything from qualified advisory services and development, to supplies of inner packaging materials as a supplement to proprietary products.

Nefab's business concept is based on the following requisites:

- A leading market position
- A comprehensive knowledge of customer needs
- A unique expertise in customizing packaging solutions
- A reliable global organization with local service facilities.

Nefab operates mainly within two business areas, collapsible export packaging systems (ExPak) and reusable packaging systems (RePak). Nefab is focusing on multinational companies who manufacture transport sensitive products or goods that are especially liable to be stolen. An important target group are also companies with continuous flows suitable for reusable packaging systems. Customers are leading international industrial corporations primarily within the telecom equipment and automotive industries. The telecom equipment industry constitutes the most rapidly growing market segment, and Ericsson is the key customer.

Nefab has from year end 2000 taken over the total responsibility for Ericsson's packaging needs. Currently Ericsson accounts for approximately 25 percent of Nefab's total sales, and besides Ericsson, Nortel and Alcatel are other important customers for Nefab. (Borgström, 2000)

APPENDIX B – INTERVIEW GUIDE

Supplier Structure

- Which are your companies most important suppliers?
- What products/components does your company purchase from them?
- Where are the suppliers located – what is the transport distance?
- What are the average delivered volume?
- How are the deliveries made – mode of transportation?
- How often are deliveries made?
- Are deliveries made directly from suppliers, or via central storage, distribution center, etc..

Customer Structure

- Which are your companies most important customers?
- What products/components does your company sell to them?
- Where are the customers located – what is the transport distance?
- What are the average delivered volume?
- How are the deliveries made – mode of transportation?
- How often are deliveries made?
- Are deliveries made directly to customers, or via central storage, distribution center, etc..

Packaging Choice

- At what production development stage does packaging planning enter?
- At which point is the supplier/customer involved, and what influence do they have on the choice of packaging?
- What are your companies demands on suppliers packages?
- In which flows does your company currently use one-way, and reusable packages respectively?
- What type of materials are to prefer for shipment of your products?
- To what extent does product damages during shipment occur, and to what extent is the package damaged?
- How is/was the packaging choice made, and which factors do you look at when choosing between the two systems?
- What are the advantages of one-way versus reusable packages?
- What do you believe will be the future development in packaging at your company?
- What do you think about the possibilities of further reusable packages?

APPENDIX C – PACKAGING TYPES

Figures taken from http://www.nefab.com

A reusable Packaging

Pallet with Collars

A one-way Packaging