Improved Parts Packaging

A case study performed at Tetra Pak Technical Service AB

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Preface

This report is the result of our final stage of our education to achieve our master's degrees in industrial management and engineering, and mechanical engineering respectively. The project has been carried out during four months at Tetra Pak Technical Service AB in Lund in cooperation with the Division of Packaging Logistics, Department of Design Sciences, Lund University and its purpose was to improve the packaging of Tetra Pak's spare parts.

We would like to thank all Tetra Pak co-workers who have given us input to this report, and also all suppliers who admitted us and were kind enough as to answer all our questions. There is however a few persons whom we would like to mention extra:

Johan Månsson, our Tetra Pak tutor, for your enthusiasm, your ability to make us believe in ourselves and in our results, and for coming with new input when we encountered problems we did not now how to solve.

Fredrik Nilsson, our Lund University tutor, for all your support during the writing process as well as balancing our stress level by making us focus on what was most important.

Klas Wimmerstedt, our Tetra Pak assigner, for giving us the opportunity of performing this project, and foremost for emphasising the importance of our results, which made us achieve more than we thought was possible.

Lund 03/02/06

Anna Jernberg Sandra Svensson

Abstract

Title: Improved Parts Packaging – a case study performed at Tetra Pak Technical Service AB

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Purpose: The purpose of this project is to contribute to the development and implementation of an improved packaging solution to Tetra Pak parts that provides a higher customer value with the ultimate goal to strengthen the Tetra Pak brand.

Objectives: To evaluate a number of packaging solutions of corrugated board to a limited number of Tetra Pak unique Carton parts and produce recommendations regarding the number of package sizes needed to package these parts

To develop a suggestion regarding where and how in the supply chain to primary package the parts we have chosen earlier

To estimate the change in total cost deriving from the new proposed packaging solutions and new location of packaging activities

Methodology: Based on a selected number of Tetra Pak unique parts, a general packaging design, printed with the Tetra Pak logotype have been suggested. Moreover, qualitative and quantitative analyses and minor benchmarking studies have been done in order to establish whether the primary packaging of these parts shall be performed in-house or at the suppliers. The method can be characterised as a system's approach with inductive features.

Conclusions: We have concluded that the benefits of implementing a new packaging design to an increased number of Tetra Pak unique parts would increase the value of the Tetra Pak brand.

We therefore recommend Tetra Pak to increase the number of parts primary packaged in corrugated board boxes. We also recommend Tetra Pak to change the standard design to a white corrugated board box printed with the Tetra Pak brand. Furthermore, we recommend Tetra Pak to locate the primary packaging activities of the selected parts in-house.

Key words: Packaging logistics, packaging, logistics, branding, marketing, environmental aspects, packaging organisation, supply chain management, benchmarking, Tetra Pak, Tetra Pak Technical Service

Contents

1 Introduction

This chapter gives the background, the purpose and the scope of this report. Thereafter we will define our target group and give a brief company description in order to facilitate the understanding for readers outside Tetra Pak. Finally the layout of this report is presented and explained.

1.1 Background

Many companies within the manufacturing industry are experiencing a higher level of competition due to increased globalisation. Therefore, any means of differentiating the business from the competitors' and provide the customers a higher service level is of great importance to any business wanting to grow and gain global market share. An effective way to distinguish from the competitors and strengthen the company brand is by increasing the quality of the company's products. Since the package is a part of the product it is an important aspect to consider when a company wants to increase its products' quality and customer value.

The package represents the customer's initial contact with the product and it is therefore central that it communicates a message that is in line with the signals the company wants to send out. It is important that the function of the package, e.g. its protective ability, and its appearance, are not undermining other quality communicating efforts made by the company.

Apart from communicating the value of the product and protect it sufficiently, the package must be efficient to handle and transport throughout the entire supply chain. In addition, it must live up to environmental requirements and be efficient to produce.

1.1.1 The case study

Tetra Pak Technical Service (TS) provides parts to machineries sold by Tetra Pak to dairies around the globe. There is a high demand on these parts, both from a wear and tear perspective and from a perceived quality point of view.[1]

Tetra Pak's parts can either be standard, i.e. they can be bought from several companies, or unique, i.e. they can only be bought from Tetra Pak. The parts can also be classified as Carton parts or Processing parts depending on whether they are going to be used in machineries that belong to business area Carton Ambient or Carton Chilled (Carton) or in business area Processing.

Tetra Pak TS markets a very wide range of parts to its customers. These parts vary to a great deal, for instance in terms of how often they are sold and their size. The size in turn determines where the parts are stored when are delivered to Tetra Pak. The suppliers of the parts are geographically spread and they are all of different sizes;

[1] Tetra Pak Technical Service internal webpage (01/11/05)

some of them are small mechanical workshops and some are large multinational companies. Some of the suppliers package the parts in primary packages[2] by themselves and some deliver the parts to Tetra Pak TS bulked, i.e. not packaged singularly. Moreover, some parts are also primary packaged at Tetra Pak TS Distribution Centre in Lund. There are a number of different packaging materials that can be used to the parts, such as corrugated board boxes, plastic bags, tubes and nets. These packaging materials are delivered by different packaging material suppliers.

In previous Tetra Pak TS projects, the matter of *pre-packaging* has been investigated. Pre-packaging deals with all kinds of primary packages to the parts. The objective of these projects has been to better protect the product and render the handling throughout the supply chain more efficient. The majority of the recommendations produced in these projects have however not been realised and as a consequence the identified problems are still present.

1.2 Problem discussion

Tetra Pak TS representatives has identified a need of a project with a different starting point than previous pre-packaging projects, see 1.1.1 above, namely to investigate whether there are marketing and branding advantages to gain by means of the package, without disregarding the protection and logistics aspects. Moreover, they want to investigate the possibility of render the packaging of the spare parts more efficient and rational, and possibly outsource it to the parts suppliers.

In other words, there is a need of evaluating the consequences throughout the supply chain if a package is modified and to estimate the cost effects of such a change. Furthermore, there is a need of investigating where the primary packaging activities (pre-packaging) shall take place; in-house or at the parts suppliers.

After discussions with packaging logistics researchers[3,4] we understood that few studies have been made dealing with the change in total cost throughout the supply chain if a new package is introduced or if a package is modified. Moreover, the impact of placing packaging activities upstream or downstream in the supply chain needs to be measured in monetary terms, a thing that has not been carried out frequently in research studies. This thesis claims to contribute to the research debate in these areas.

1.3 Purpose

The purpose of this project is to contribute to the development and implementation of an improved packaging solution to Tetra Pak parts that provides a higher customer value with the ultimate goal to strengthen the Tetra Pak brand.

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[2] The primary package is the package being closest to the product inside it.
[3] Bramklev, C. (14/11/05)
[4] Johnsson, M. (22/11/05)

1.4 Objectives

The objectives of this master thesis are:

- To evaluate a number of packaging solutions of corrugated board to a limited number of Tetra Pak unique Carton parts and produce recommendations regarding the number of package sizes needed to package these parts.
- To develop a suggestion regarding where and how in the supply chain to primary package the parts we have chosen earlier.
- To estimate the change in total cost deriving from the new proposed packaging solutions and new location of packaging activities.

1.5 Delimitations

As mentioned in section 1.2 above, Tetra Pak TS has identified a need of a packaging project that also takes branding and marketing aspects into consideration. Due to the fact the pre-packaging has been treated before within Tetra Pak TS with varying success, we saw a need of focusing on the most important things in order to increase the chances that our recommendations could be realised. Then, our first problem was how to determine what was most important.

As stated in the objectives, we will base the new packaging solution on Tetra Pak unique Carton parts. It might be possible and desirable though that the recommendations produced concerning Tetra Pak unique Carton parts will be applicable onto Processing components and standard components as well. The exclusion of processing components was done since we were not able to get hold of any data regarding those components. The standard components were excluded since our assigner Tetra Pak judged the unique parts as being more important. Moreover, standard components are generally better packaged so the need of improving those packages is not as acute.

The delimitations of the project are presented in the following list in order to further clarify our scope and focus.

- We will not propose specific packaging solutions to all Tetra Pak unique Carton parts, but we will present a general design in a number of sizes that can be used to any component, provided that the size fits.
- We will not examine all Tetra Pak suppliers of unique parts.
- We will focus on the development of a corrugated board solution and will therefore not estimate the costs associated with pre-packaging using other packaging material than corrugated board such as tubes or plastic bags.
- We will primarily focus on parts being stored in the miniload[5] section but parts stored in the paternoster[6] section will not be entirely disregarded.

[5] The miniload section is one of Tetra Pak TS's storage applications. It is automated and used for relatively small goods.
[6] The paternoster is one of Tetra Pak TS's storage applications, see chapter 2 Definitions.

- We will only investigate parts that are distributed through the distribution centre in Lund.
- We will not investigate any parts that are classified as large or dangerous goods.
- We will not implement the proposed solutions just develop an implementation plan.

1.6 Target group

The primary target group identified for this report is employees working at Tetra Pak, particularly co-workers within Tetra Pak Technical Service and Tetra Pak Carton Ambient. Moreover, we also address this report to students with basic logistical competence.

1.7 Company description – Tetra Pak

Tetra Pak's mission can be described as follows: 'We commit to making food safe and available, everywhere'. The business can be structured according to the three business areas; Tetra Pak Carton Ambient, Tetra Pak Carton Chilled and Tetra Pak Processing Systems. Tetra Pak Market Operations consist of a number of market companies located in different geographical clusters. The market companies are responsible for the contacts with the end customers. The green squares in the bottom represent staff functions, such as Human Resources and Legal Affairs.[7] A general description of the Tetra Pak organisation can be seen in Figure 1 below:

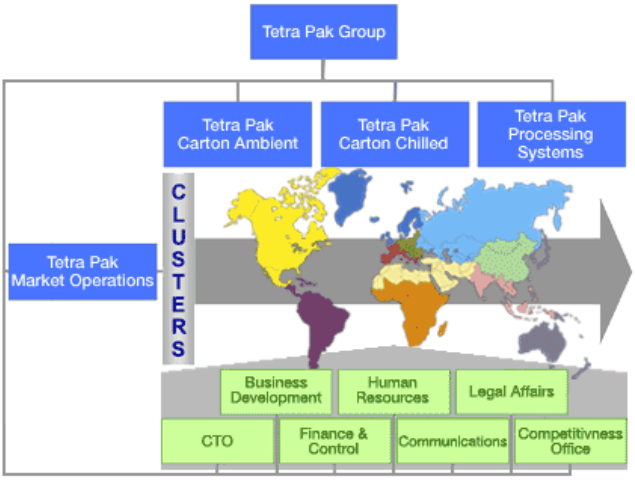

Figure 1: Tetra Pak's organisation[8]

[7] Tetra Pak's official webpage (21/01/06)
[8] Tetra Pak's official webpage (20/01/06)

Tetra Pak's business model consists of three legs; Capital Equipment, Packaging Material and Technical Service that can be seen in Figure 2 below. All of them have a goal to grow as profitable businesses.[9]

Technical Service markets spare parts that shall be used in the machinery being located under Capital Equipment. The Capital Equipment machineries, for instance filling machines, are used at the local customer plants, such as dairies, to fill the packaging material (produced in business leg Packaging Material) with different kinds of foodstuff.[10]

Figure 2: Tetra Pak's business model[11]

In the past, before the introduction of the business model, the main focus was on packaging material and the remaining businesses' main objective was to support the packaging material business. As a consequence, Tetra Pak TS provided the customers with spare parts practically free of charge. With the introduction of the new business model, all three legs must be profitable.[12] Therefore, Tetra Pak TS is now charging its customers for the spare parts, a fact that naturally increases the customers' demands.[13]

1.7.1 Tetra Pak Technical Service

Technical Service's business is to provide knowledge, technical competence development, spare parts, tools and methodologies to design, manufacture and support Tetra Pak products. 3400 employees are working within Technical Service world-wide of about 300 are based in Lund.

The organisational chart of TS can be seen in Figure 3 below. This master thesis is performed within Parts Supply Chain, the yellow box in the figure. Parts Supply Chain supports all market companies, in other words, there is just one Parts Supply Chain department. The same goes for all the functions, e.g Operations, and Product Management, being presented as boxes under the larger box Market Companies.

[9] Tetra Pak Technical Service's internal webpage (16/01/06)
[10] Strömmerstén, T. Non-commercial visits, (30/09/05)
[11] Tetra Pak Technical Service's internal webpage (16/01/06)
[12] Månsson, J., Project manager, (10/11/05)
[13] Berkström, D., Manager store operations, (13/09/05)

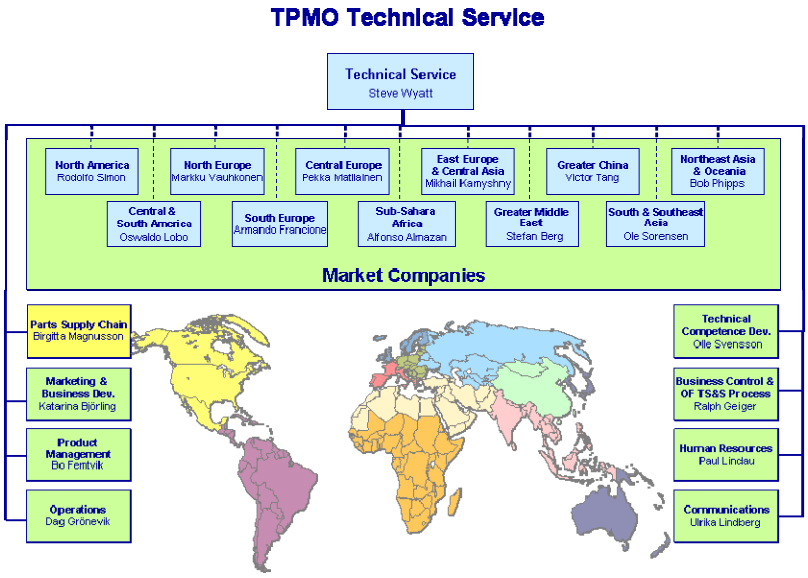

Figure 3: Technical Service organisation chart

Moreover, within Parts Supply Chain there are a number of departments. During this project we have been located within the Parts Service Business Development department, see the yellow box in Figure 4.

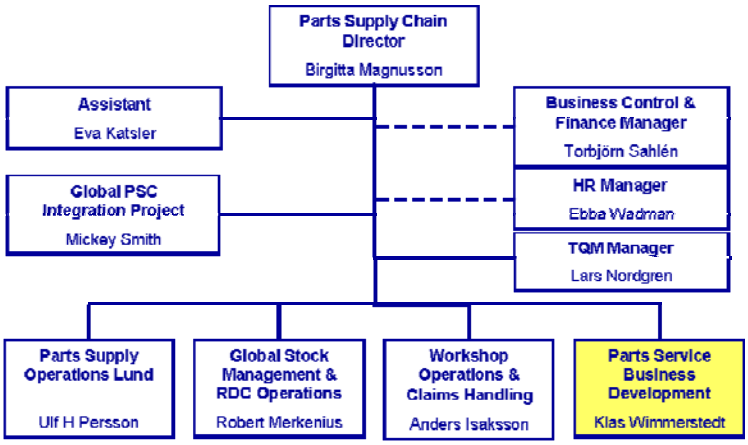

Figure 4: Parts Supply Chain Organisation

Technical Service manages a service product portfolio that shall be seen as a tool to support TS's sales process and to secure more effective customer interaction. One of the service products is Genuine Parts On-time, which will be described in the coming section.

1.7.2 Concurrent projects

As to present the surroundings of our projects, short presentations of concurrent projects are given in this section.

Genuine Parts On-time

One of the objectives with the ongoing Genuine Parts On-time project is to identify different delivery customer needs and adapt the storage and shipping behaviour according to those. Today, the supply chain is very responsive which means that a product is normally shipped the same day it is ordered and have one day's lead time in every stage of the chain. Genuine Parts On-time aims at stimulating the customers to plan their orders better and through that lower express shipping costs and the need of stock-keeping at market companies and distribution centres. Planned orders also make it easier to dimension the capacity and be more prepared for peaks and drops in demand.[14] As the stock-keeping decreases, the cost of capital tied up in inventory does the same.[15]

The overall purpose of the Genuine Parts On-time service is to visualise the values in the parts supply chain and thereby defend and increase Tetra Pak Technical Service's parts sales. The service consists of three delivery options based on customer needs and time requirements; Planned, Priority and Express.[16] The objective is to stimulate the customers to go from express orders to more planned orders.[17]

Pricing Carton Parts project

The objective of the Pricing Carton Parts project is to introduce a new pricing model where standard components and unique parts will be priced in a more logical way, i.e. replace today's cost plus model with a value based ditto. The previous cost-plus pricing system mirrored Tetra Pak's cost for producing a part and not necessarily the value of the part as perceived by customers.[18] The project is expected to be finished during 2006.

1.8 The layout of the report

In this section, the main chapters of the report will be introduced, one by one, and their presence and contribution to the expected results will be motivated.

Chapter 1: Introduction

This chapter gives the background, the problem discussion, the purpose, the objectives and the scope of this project. Finally the layout of this report is presented and explained.

Chapter 2: Definitions

This chapter is included in order to secure the reader's understanding and to avoid ambiguousness to largest possible extent.

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[14] Månsson, J., Project manager, (05/12/05)
[15] Tetra Pak Technical Service's internal webpage (06/12/05)
[16] Tetra Pak Technical Service's internal webpage (06/12/05)
[17] Månsson, J., Project manager, (05/12/06)
[18] Tetra Pak Technical Service's internal webpage (13/12/05)

Chapter 3: Methodology

In this chapter the methodological framework including our system definition and our conceptions of knowledge are presented. Thereafter we discuss our data collection methods as well as our methodological choices. Hereafter, our method of analysis is explained and the quality of our research approach is discussed.

Chapter 4: Theoretical framework

To be able to analyse the empirical framework and to get tools with which we can produce the expected objectives literature studies were made. The results of them are accounted for in this chapter.

Chapter 5: Present packaging of Tetra Pak parts

The empirical findings concerning Tetra Pak's parts supply chain and the packaging of Tetra Pak parts relevant for the purpose and objectives of this report are here presented. The chapter is finalised by summarising our findings.

Chapter 6: Results from benchmarking studies

The results of the benchmarking studies with Tetra Pak Hoyer, Volvo Cars and Sony Ericsson are presented in this section. The benchmarking studies were done in order to get a feeling for the packaging activities of other companies and get new ideas on how to organise them.

Chapter 7: Analysis of Tetra Pak parts packaging logistics

In this chapter, the empirical findings regarding Tetra Pak TS packaging and packaging logistics are analysed in order to present a proposal of a new packaging design.

Chapter 8: Organisation analysis

In this section, we will discuss how the organisations of Tetra Pak TS and Tetra Pak Carton Ambient affect the packaging of the parts. The objective of this chapter is to analyse whether there are better ways to organise the packaging responsibilities throughout the company.

Chapter 9: Supply chain analysis

During this chapter we will both quantitatively and qualitatively analyse where in the supply chain to pack the parts as well as analysing our findings regarding supply chain management.

Chapter 10: Conclusions and recommendations

In the Conclusions chapter, conclusions drawn from the analysis are presented and their implications are discussed. Moreover, we will present an implementation plan of our suggested proposals.

Chapter 11: Areas of improvement potential

Here we will present areas where we think Tetra Pak has the ability to improve and where we see a clear potential to do so.

Chapter 12: Future research

In this chapter, we briefly discuss the research gaps we have identified as well as present our proposals of further studies.

Appendix

In the appendix we have placed the questionnaires, survey questions, a requirement specification for corrugated board boxes and new proposed sizes of corrugated board boxes.

2 Definitions

This chapter explains concepts and definitions relevant to the understanding of this report.

Article number: All parts based on the same drawings have the same article number. Sometimes, the number is punched directly on the part. It does however occur that Tetra Pak buys several parts that together become one Tetra Pak article number. Then one article number may consist of several supplier article numbers.

Business area: Tetra Pak contains three business areas; Carton Ambient, Carton Chilled and Processing. The business areas are responsible for two out of three of Tetra Pak's business legs, namely packaging material (used to package food, not spare parts) and capital equipment, i.e. machinery used to package the foodstuff in the packaging material.

Business Objects: software application fetching statistics from SAP/R3, see also ERP.

ERP - Enterprise resource planning: A system that handles financial, human and material resource transactions within the boundaries of a single organisation.[19] In Tetra Pak's case called SAP/R3.

Export package: Tetra Pak uses boxes made of corrugated board as secondary packages and Tetra Pak call them export packages. These packages are normally brown and marked with the Tetra Pak logotype. An export package may also be a wooden box with pieces of ironwork on the borders. If a part is small, an export package might be used as a primary package.

House mark: Tetra Pak calls a part of its logotype for the house mark. The house mark can be seen in Figure 5 below.

Figure 5: Tetra Pak's house mark

Kit supplier: supplier delivering various types of kits used for upgrading machineries sold by Tetra Pak.

Miniload: highly automated warehouse application. The system is loaded with trays wherein the parts are stored. The trays move both vertically and horizontally using elevators.

Order line: When a customer places an order every article number that is ordered becomes an order line. The quantity of articles on an order line can therefore be any number.

[19] Schary, P.B., Skjött-Larsen, T. (2001), *Managing the Global Supply Chain* p..301

Part: Tetra Pak uses the word part synonymously with spare part.

Paternoster: A computer controlled storage system adapted for many and small parts. The paternoster moves the parts vertically and delivers the wanted parts to a picking station. [20]

Pre-packaging: Pre-packaging is the term that Tetra Pak co-workers use for all ranges of singular packaging of parts. Pre-packaging material can for instance be corrugated board boxes, plastic bags, bubble plastic, and tubes. The fact that a part is pre-packaged does however not necessarily mean that it is ready for direct shipment to customers since a part wrapped in bubble plastic is considered pre-packaged. The pre-packaging can be performed in Lund Distribution Centre or at the parts suppliers. Mostly, the term pre-packaging can be used synonymously to the term primary package, at least when the pre-packaging material is a corrugated board box.

Primary package: The package closest to the product. In this report a primary package may consist of two or more layers, for instance if a part is wrapped in bubble plastic and hereafter put in a small box made of corrugated board.

Secondary package: A package grouping a number of primary packages. The secondary package can be removed from the product without affecting its characteristics. Tetra Pak uses the term Export package for this type of packages.

System supplier: supplier delivering complete machine modules.

Standard parts: Parts that can be purchased from several suppliers on the market where Tetra Pak does not have any control over the drawings.

Tetra Pak Carton Ambient: Business area handling packaging material and capital equipment used for packaging foodstuff that can be distributed at room temperature. Examples of trademarks are Tetra Brik® Aseptic, Tetra Classic® Aseptic, Tetra Prisma® Aseptic, Tetra Wedge™Aseptic, and Tetra Fino™Aseptic.[21]

Tetra Pak Carton Chilled: Business area handling packaging material and capital equipment used for packaging foodstuff that requires refrigerated distribution. Examples of trademarks are Tetra Top, Tetra Rex and Tetra Brik.[22]

Tetra Pak Processing Systems: Business area responsible for development and production of processing equipment for the food industry.[23]

Unique parts: Parts whose drawings are developed by Tetra Pak. The part may be produced by a Tetra Pak supplier, but can only be bought from Tetra Pak

WCS - Warehouse Control System: The combination of the miniload system and the conveyor belts.

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[20] Knudsen, D. (2002), *Litteratur för kursen materialhantering VT-02*, p.55
[21] Strömmerstén, T., Non-commercial visits, (24/01/06)
[22] Ibid
[23]Tetra Pak Processing Systems' internal webpage (24/01/06)

3 Methodology

The point of departure of this chapter is our own working method, which we will relate to the existing methodology theory, an approach that can be described as having inductive features. We hope that this way of presenting the methodology will contribute to a deeper understanding of the methodological choices we have done as opposed to just go through the existing methodology theory.

3.1 Our methodological starting point and our conceptions of knowledge

After establishing the project's deliverables in cooperation with the steering group, i.e. our Tetra Pak assigner Klas Wimmerstedt, our Tetra Pak tutor Johan Månsson, and our tutor from Lund University Fredrik Nilsson, we identified the working methods we were going to apply to reach the objectives and be able to deliver what was asked for. Soon we understood that we needed to delimit the system we were aiming to study, and we have therefore chosen to first define our research system.

3.1.1 System boundary and system units

The components that build up the system of study can be seen in Figure 6 below. We have chosen to define our system of study according to the supply chain concerning parts and packaging material used to package these parts. The green boxes within the circle represent the units we will examine closer. As the figure shows, the units within the system we are studying are Tetra Pak parts suppliers, Tetra Pak's distribution centre in Lund and Tetra Pak parts packaging material suppliers. Each one of these components are going to be discussed further, e.g. in section 5.3-5.5, in order to discover aspects where the objectives of one unit do not correspond to the objectives of the others, or to the comprehensive objectives of the system as a whole. We would however want to clarify that even though the suppliers of parts and packaging material are included, our assigner is still Tetra Pak Technical Service, a fact that forces us to emphasise that part of the system in our analysis. We will try to find solutions that are beneficial to all actors but our main focus when it comes to recommendations is still Tetra Pak's business, not the suppliers' of parts or packaging material.

To get an understanding of the context to which the system is related and the information and physical flow in and out of it, units outside the system boundary are included in the figure as well, even though they will not be further analysed within the frames of this study. Starting from the left in the figure, we have *External packaging material suppliers*. These suppliers are not connected to Tetra Pak or Tetra Pak TS in anyway, but they still supply some of Tetra Pak parts suppliers with packaging material. The *sub suppliers* are suppliers delivering to Tetra Pak's parts suppliers. The supplier relationships will be further described in section 5.3.2.

From Lund Distribution Centre there are there are warehouse replenishment deliveries to the regional distribution centres, *RDCs*, (located in Singapore and Dubai), to *Tetra Pak Market Companies* that have small storages, and there are also direct deliveries to the *end consumers*, e.g. dairies. As the figure shows, the parts can also be delivered via the RDCs and/or a market company.

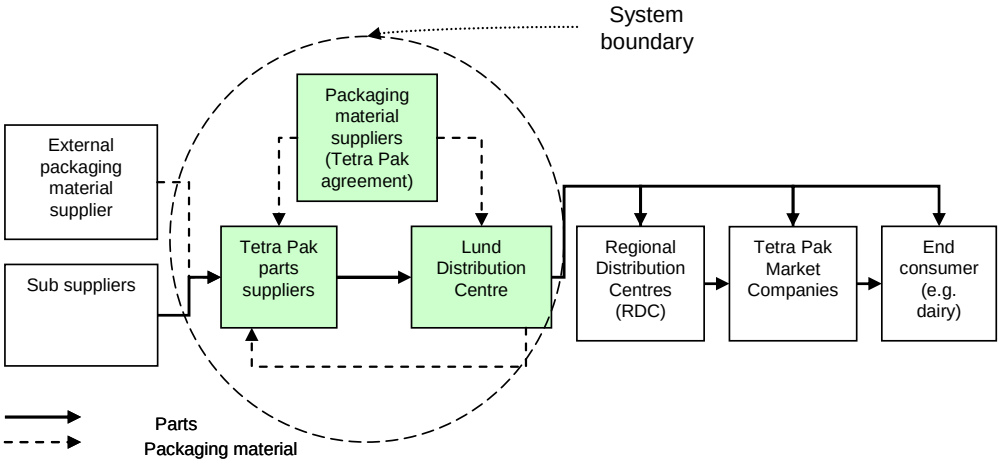

Figure 6: The system components and their mutual relationships

3.1.2 Our conceptions of knowledge and their relation to our research approach

According to the system theory, a system's outer boundaries are well defined both in terms of the physical content of it and also of its functions[24], a notion that suits our own approach, which therefore can be used to further describe and characterise it. A supply chain of any kind can very well be defined as a closed system in terms of its physical units. It is however apparent that information and material will flow in and out of this defined system. Our definition of the system of this study, where physical material and information pass through the boundaries is in line with the description of the system theory[25] that can be found in the literature.

Since one of Tetra Pak's motives for conducting this study is to get hard facts that can be used as a basis for decision making, everything we recommend Tetra Pak to do must be supported by logical reasoning and preferably measurements. Moreover, the units within the system previously defined have to be further analysed in order to understand why certain units behave in a certain way. These characteristics suit the positivistic viewpoint as the positivism is of a reductionistic character, which means that explanations to functions on a higher level are searched on a lower, more detailed

[24] Wallén, G. (1993), *Vetenskapsteori och forskningsmetodik*, p.26f
[25] Ibid, p.26f

scientific level[26]. However, we regard it difficult to find the answers to our questions only through the employment of this approach and we felt that the positivism cannot be used as our only research method since it does not suffice for helping us reach our objectives which to a large extent deal with the interaction between units. Additionally, according to the positivism, a totality is regarded as something that can be analysed element by element, where the sum of the components together form this totality[27] and that these elements are the same when examined one by one as when they are playing their part in the whole[28]. We do not think that this assumption is suitable in supply chain management research since the interactions between the units and their mutual relationships play such an important role to the overall system performance. Moreover, the followers of the positivistic approach believe in the laws of classic physics with its deterministic and causal relations[29]. We do not think this viewpoint being fitting to our system of research since we are studying organisations being built up by humans who do not act logically or follow causal laws at all times.

Nevertheless, since many of the ideals of the system theory actually are quite close to those within the positivism, we see no conflict in applying both when there is a necessity to do so. For instance the two research traditions both emphasise the requirements of rationality, measurability and comparability[30], all values that we share. We are however more attracted to the system theory's accent of synergy effects and we also share the notion that the mutual relationships between the units and the relation of units' contribution to the system features[31,32].On the other hand, we are sceptic to those descriptions of the system theory in our particular context that says that the components' actions can be understood from the qualities of the totality[33]. We think that the actors of the supply chain act as to optimise their own businesses and that the totality must be understood as being affected by elements that constitute it. We do however believe that their mutual relationships are of great importance to the system as a whole.

Most supply chain studies deals with the topic of optimising the totality as opposed to optimising the business of one actor. This matter can be addressed by the hermeneutics approach as one of its motives is to discover mismatches and oppositions between totalities and the units that together create such a totality[34]. We have however got the impression that the hermeneutics approach is best suited to studies of humans as opposed to studies of organisations and supply chains which is

[26] Ibid, p.35 & p.25
[27] Arbnor, I., Bjerke, B. (1994), *Företagsekonomisk metodlära,* p.65
[28] Checkland, P. (1981), *Systems Thinking, Systems Practice,* p. 59
[29] Arbnor, I., Bjerke, B. (1994), *Företagsekonomisk metodlära,* p.78
[30] Wallén, G. (1993), *Vetenskapsteori och forskningsmetodik*, p.28
[31] Arbnor, I., Bjerke, B. (1994), *Företagsekonomisk metodlära*, p.81
[32] Mazen, S. (2004), *A platform for Packaging Logistics Development – a systems approach,* p. 21
[33] Arbnor, I., Bjerke, B. (1994), *Företagsekonomisk metodlära,* p.67
[34] Wallén, G. (1993), *Vetenskapsteori och forskningsmetodik*, p.31

what we deal with in this study. That is why we have chosen not to apply this approach to any larger extent.

To conclude, our basic research approach can be likened to the system's approach. We will however also use positivistic influences, particularly in the cost analysis section.

3.2 Qualitative versus quantitative approach

There are two comprehensive approaches in research; qualitative and quantitative. It should however be noted that it often occurs that researchers who apply quantitative approaches often includes some sort of counting, i.e. quantitative elements. The qualitative method is typically used when the research emphasis is on the perspective of the individuals being studied and when the studied phenomena are immeasurable, such as feelings or opinions.[35] A quantitative study, on the other hand, could be used to structure and analyse great amounts of measurable data.[36] In this study we have chosen to apply a combination of qualitative and quantitative approaches. In the first part of the project, evaluate packaging solutions, we used primarily a qualitative approach. Nevertheless, this approach was supplemented with a more quantitative as we used statistical tools in order to get large amounts of data from Tetra Pak's ERP system in order to decide what parts to use when we developed new packaging solutions. This matter is explained more in detail in section 7.7.5.

In the second part of the project, where we analysed the supply chain in order to decide where to package the parts, the same manner of working had to be used, i.e. a combination of the two approaches. Due to the fact that we were to develop cost *estimations* regarding the future outcomes of a certain decision, a quantitative approach could not be used solely, but had to be supplemented with a qualitative ditto. It was also apparent that some estimates, particularly those concerning the potential benefits of a certain decision would be very vague, thus making a quantitative approach less meaningful. Finally, the nature of some of our estimates, particularly those concerning forecasts regarding future costs and possible wins forced us to check our estimates qualitatively in order to make sure that they were reasonable.

3.3 Data collection

In the following sections our three principal sources of information, i.e. primary sources, literature study and survey, are presented and the data collection methods used for each and every one of them are discussed.

[35] Bryman, A. (1989), *Research Methods and Organization studies*, p.24
[36] Svenning, C. (2003), *Metodboken*, p.72

3.3.1 Primary sources

The primary sources used in this report are co-workers at Tetra Pak Technical Service and Tetra Pak Carton Ambient as well as a number of unique parts suppliers and a packaging material supplier who were interviewed at a number of occasions. Moreover, we have conducted two minor benchmarking studies, one external with Volvo Cars, Torslanda, Sweden and one internal with Tetra Pak Hoyer in Aarhus, Denmark. We have also interviewed a Sony Ericsson representative.

To create an understanding of what we were doing and to make the purpose of our supplier visits clear we were careful to inform the supplier managers responsible for the suppliers we had decided to visit.

To all interviews we prepared questionnaires in advance which we tried to follow as much as possible during the meetings, but we also tried to stay open for other interesting input coming from the interviewees.

Semi-structured interviews with suppliers

Since the primary purpose of the supplier visits was to get the general picture and not perform a quantitative analysis covering certain aspects, an approach that requires standardisation and structure to be able to compare the answers, we decided to use semi-structured interviews. This technique implies that the interviewer in advance has decided what subject fields to cover and what kind of information he/she is looking for[37]. In the initial contact with the suppliers, which was usually done by phone, we explained our role as master thesis students and our relationship to Tetra Pak, i.e. not employed. From a methodological point of view, it is important to explain the purpose of a research study to the participants[38], which is why we were careful to clarify the objective of our visits and of our project to the suppliers, an aspect that is central also from an ethical perspective[39]. The initial contact was hereafter followed up by an e-mail where we once again explained our purpose and also included a questionnaire as to give them a chance of finding the answers before the actual interview. Since we were often asking for hard facts more than opinions we saw no great risk in using this approach. We used both short, closed questions such as ‘what kind of packaging material are you using’ and more open questions such as ‘Can you give us some general information regarding your company?’. Before the execution of the interviews we also met the planners from the procurement organisation and studied statistics regarding the supplier’s annual sales volume and its pre-packaging behaviour. This was done in order to be as prepared as possible and get an understanding of the supplier’s business in advance and hence obtain as useful and detailed information as possible during the visit. All interviews with the suppliers were performed by both of us together.

[37] Andersson, B-E. (1985), *Som man frågar får man svar*, p.77
[38] Ibid, p.127
[39] Ibid, p.127

A general questionnaire that was used during the supplier visits can be found in appendix 1. As previously mentioned, we adapted and added questions somewhat depending on the answers received from the interviewees during the interviews and also depending on the statistical foundation we had obtained in advance. The questionnaire in the appendix covers however the majority of the discussed questions.

Semi-structured interviews with Tetra Pak co-workers

During the meetings with the co-workers we used the same approach as with the suppliers, i.e. semi-structured interviews. We also used a lot of e-mail based communication in cases when we for instance needed a name or contact when we were searching for particular information. During most of the more formal interviews, we were both present, but some had to be conducted with only one representative from the project group.

We also arranged a workshop where we let the participants examine a number of chosen Tetra Pak unique parts in order to discover flaws in the packages of today. The workshop was arranged as to make the most of the competence in-house. We invited co-workers from Goods receipt, Pick and pack and warehouse managers as they deal with the packages in their day-to-day work.

Workshop with packaging material supplier

In order to obtain as much competence as possible regarding packaging development, we conducted a workshop with Tetra Pak TS's supplier of corrugated board packages. The objective was to decide what packaging design being the most suitable to Tetra Pak parts. The person who used to be administratively responsible for the pre-packaging from Tetra Pak TS did also participate.

In order to inform the supplier management department of the purpose of the workshop, a meeting with representatives from that department was conducted. Thereafter, they contacted the packaging material supplier and explained to him what we wanted to do in order to make clear to him the intentions with the meeting.

With the objective of being as prepared as possible during the actual workshop we sent a rough draft of a requirement specification of new packages to the corrugated board supplier. The requirement specification, which can be seen in Appendix 7, was then used as a basis for discussion during the workshop and conflicting requirements were highlighted. The output of the workshop was a conceptual design of new packages as well as a printing design and suitable number of printing colours. Moreover, we were able to obtain information regarding the cost of the different designs and printing options.

Internal and external benchmarking

To most companies, it is important to understand what constitutes good and poor performance within a particular business, and benchmarking can provide means for managers to increase this understanding. One type of benchmark is the historical comparison where the company evaluates its performance in comparison to historical data, i.e. it examines the performance in relation to previous years. Another benchmarking type can be performed within a business or industry, where the performance of a company is compared against a set of performance indicators agreed

upon within that particular industry. The third type is called best-in-class benchmarking. This means that the company's performance is compared to best-in-class performance, wherever that is found.[40] As will be explained below, we have performed benchmarking studies both as comparisons within a business as in the Tetra Pak Hoyer case, and against companies operating in other business than Tetra Pak as in the Volvo Cars and Sony Ericsson cases. Whether theses companies can be called best-in-class is not for us to decide, but at least they have a reputation of good brand management and a history of packaging development which we hoped could be useful to us.

The overall objective of the benchmarking studies performed in this project was to get new perspectives and find alternative solutions to present problems regarding the packaging of the parts. In other words, we have not performed a benchmarking study in its strictest definition. However, we have compared Tetra Pak's behaviour to the behaviour of the three chosen companies' and we think that the term 'benchmarking' is the best way of describing our method.

The benchmarking study of Tetra Pak Hoyer was executed during one day's visit when we interviewed the warehouse manager, and also were shown the storage and packing department. The reason why we wanted to visit Tetra Pak Hoyer is that the company was executing a project similar to ours where negotiations with suppliers to make them perform more of the pre-packaging activities were about to be initiated. Hoyer's reason of doing this is that its parts distribution shall be done via the distribution centre in Lund by the turn of the year 2005. We thought it to be useful to us in our development of the implementation plan phase to know how Hoyer managed to persuade the suppliers, if we should come to the conclusion that Tetra Pak should outsource all packaging activities to the parts suppliers. Moreover, Tetra Pak Hoyer has developed new branded packaging solutions to its parts, a fact that also makes the company interesting to study since we thought that it would be helpful in the evaluation of possible packaging solutions. We also wanted to know whether the Hoyer co-workers had seen any effects or opinions from their customers regarding the branded packages.

The benchmarking study with Volvo Cars was carried out as a telephone conference with one of its representatives. We chose Volvo Cars as we needed input regarding how the packaging responsibilities can be organised and also because we wanted to know whether Volvo Cars has measured the customer value of re-packing all parts into Volvo-marked boxes as they do today. Moreover, we considered Volvo Cars to be a good benchmarking candidate since the company operates in a different industry and still has a behaviour similar to Tetra Pak since Volvo Cars has outsourced a great deal of their manufacturing activities, just like Tetra Pak.

Lastly, we also interviewed a packaging responsible from Sony Ericsson regarding his decisions in packaging matters. We got in touch with him thanks to the fact that our Tetra Pak tutor used to work with him on his previous job. Additionally, we had a

[40] Johnson, G., Scholes, K. (2002), *Exploring corporate strategy*, p.171-174

rather clear idea regarding his working responsibilities which made it possible for us to prepare very specific questions regarding the development of new packages and packaging instructions and potential problems with such.

The questionnaires to these three benchmarking interviews can be found in appendix 2-4.

3.3.2 Literature studies

The theoretical framework of the study is based on secondary sources such as articles, books and web pages. Initially, books, master's theses and doctor's theses regarding packaging technology and packaging logistics were studied in order to get an understanding of the subject. Supplementary information was gathered from two databases, ELIN and PIRA, in addition to the sources mentioned above. The knowledge gained from a literature search can be used to create a theoretical framework that may function as model of interpretation or explanation, to define and delimit key concepts, to contribute to the specification of the purpose by demonstrating what is already known about the particular problems and to contribute to a well-founded choice of research method[41]. After our literature run-though, we understood that very few studies, if any, have been carried out with the purpose of measuring the effect of a changed package throughout the supply chain in monetary terms, a notion that was confirmed by researchers at Lund university[42,43].

3.3.3 Survey

The purpose of a survey investigation is to gather information that can be analysed in order to discover patterns and be able to make comparisons. Normally, the questions are sent to a number of selected representative respondents for the population the researcher aims to study. If the respondents are selected properly, their answers can be presented as being representative for the entire population. A typical example is an opinion poll.[44] We had the opportunity to include a couple of questions in a survey being sent to the market companies of Tetra Pak throughout the world. The survey was sent to 180 representatives from 59 market companies, and over 90 % of the respondents participated. (Tetra Pak Market Operations consist of 77 market companies[45].) The overall purpose of the survey was to assess the market companies' opinions regarding Tetra Pak Technical Service's service performance. Our questions concerned the market companies views on today's and the future's packaging solutions to the parts. The questions can be found in appendix 5.

[41] Winter, J. (1973), *Problemformulering, undersökning och rapport*, p.23
[42] Johnsson, M. (22/11/05)
[43] Bramklev, C. (14/11/05)
[44] Bell, J. (2000), *Introduktion till forskningsmetodik*, p.19
[45] Heinemyr, N., Order to fulfilment manager, (24/10/05)

3.4 Choices

One of our main issues in this project has been the various selections we have been forced to make due to the wide scope of the study.

Our first concern was how to handle the fact that Tetra Pak TS has a large assortment of unique Carton parts. Since if was impossible for us to examine all those parts, and not even desirable since some of them were clearly not suited to be packaged in corrugated board boxes, we were forced to make a selection. It is possible that another selection of parts would have given us other input regarding the packaging solution, which is why we tried to select the parts as carefully as possible. To delimit the range of products and to sharpen our focus, we applied various selection criteria.

Each criterion, except the unique parts criterion that was already discussed in section 1.5 will be further discussed in section 7.6

- Unique parts
- Frequently sold parts
- The value of the parts, i.e. the sales price
- The size of the parts, we have decided to focus on parts small enough to have room in the trays in the warehouse system
- The weight of the parts; in order to get rid of small parts such as screws and mutters, we examined parts that were heavier than 5 g and lighter than 10 kg.

Secondly, Tetra Pak TS has about 1000 suppliers and even if we were to examine those who Tetra Pak has chosen to work more actively with, it still gives us a range of some 200-250 suppliers[46], a number that was too large for us to investigate more closely. Therefore, we made a selection in cooperation with the procurement manager. The purpose of the supplier visits was to get the general picture regarding there packaging and their relationship to Tetra Pak, and it is possible that we would have gotten another impression if we would have visited some other suppliers. We do however believe that the selection was good enough for our purpose. The selection criteria we applied when we chose suppliers will be further described in section 5.3.1.

3.5 Method of analysis

Our overall method of analysis can be described as having *inductive*[47] features, i.e. we have used the 'reality' in the sense of the empirical evidence as our starting point and then compared it to theoretical models, as opposed to the *deductive* approach where theoretical propositions are verified or falsified through empirical observation. In other words, our approach has been to read the literature with the reality's spectacles i.e. always relating what we read to our specific case study.

[46] Widestadh, S., Procurement manager, (13/09/05)
[47] Lundahl, U., Skärvad, P-H. (1999), *Utredningsmetodik för samhällsvetare och ekonomer*, p.41

When we decided which co-workers and suppliers we needed to interview, we always used the objectives of the report as a guiding-star. Moreover, we tried to stay open from other relevant information coming from the interviewees that we thought could help us forward. In some specific areas such as customer value of a new package and packaging organisation, we have compared empirical evidence from Tetra Pak with the results from our benchmarking studies.

It is vital to have an overall analysis strategy in order to decide what techniques and methods to apply in the analysis.[48] In our supply chain analysis we have identified two main rival propositions to the question of where to pack the parts; in-house (at Tetra Pak TS) or at the suppliers'. The concept of rival propositions is described in the literature as one out of three overall analysis strategies[49]. We have however encountered a problem concerning the mutual exclusivity, i.e. that one proposition cannot exist at the same time as the another, which is recommended[50], since we also suspect that one possible answer to that particular research question is a combination of both the propositions, i.e. pack some parts in-house and some at the suppliers. Our starting point was nevertheless to treat the two assumptions as separately as possible, at least when we began the analysis.

A great issue regarding the analysis was our lack of theoretical propositions regarding our remaining research objectives, i.e. the evaluation of the packaging solutions, an aspect that forced us to apply an inductive approach. The analysis models we have encountered presuppose however the occurrence of theoretical propositions, i.e. that the researcher has some kind of theoretical hypothesis that he/she wants to verify/falsify through empirical studies. The suggested analysis techniques all starts out from those theoretical propositions which are used as a frame of reference against which the empirical evidence is compared.[51] We have been forced to work the opposite way around, i.e. start out from the empirical evidence and when possible compare it to the theory.

In order to decide the number of packaging sizes needed to package the selected unique Carton parts we used an algorithm in Microsoft Excel. The algorithm is described in connection to the analysis in section 7.7.5. The basic sources of errors are however identified and discussed here: We used an Excel file containing the measurements of all the unique Carton parts and used those measurements as a basis for the development of the new sizes. It is possible that the data regarding the measurements were not completely correct as they had been registered manually. The most apparent source of error is however the fact that we had to sort the data manually and that some data were registered in the wrong way, for instance where the width was longer than the length, which forced us to correct it manually. The fact that the Excel file contained so many parts also made it difficult to overlook, which in

[48] Yin, R.K. (2003) *Case Study Research,* p.111
[49] Ibid, p.111
[50] Ibid, p.118
[51] Ibid, p.118 & p.127

itself is a source of error. It is therefore very likely that some of our proposed sizes need to be adapted a little in order to fit the chosen parts.

Regarding the quantitative analysis dealing with the location of the packaging activities, we used a total cost approach where each cost first was examined on its own. Thereafter all identified cost components were collected in order to get the total sum. We were forced to make various assumptions and those have been stated explicitly in order to let the reader understand when our results are valid.

Finally we would like to comment that we are aware of the fact that it is normally beneficial to develop a conception regarding how the collected data shall be analysed in the early stages of the research design to avoid collecting irrelevant data and also prevent the situation where large amounts of evidence remains unanalysed as the researcher does not know how to analyse it[52]. This situation was however unavoidable in this particular study, as we were explicitly asked to document 'everything' since much information that we have come across, sometimes unintentionally, can be used in further improvement projects within the Tetra Pak organisation.

3.6 Determining the quality of our research design

Since we have used a combination of qualitative and quantitative approaches, there are different criteria to consider when determining the quality of our research design and execution.

3.6.1 Objectivity

The objectivity of the single Tetra Pak co-worker can of course be questioned since there is a possibility that some co-workers felt threatened by our approach and our project and therefore deliberately chose not to reveal all available information. To avoid such aspects to influence the results, we interviewed many co-workers from all parts of the organisation. We can of course not guarantee the objectivity of the single co-workers. Regarding our own objectivity, we have tried to examine the organisation and the supply chain as critically as possible. The fact that other students will act as opponents on this report before it is printed will hopefully work as means of highlighting sections where we are not completely objective if such sections occur.

When regarding the objectivity of the individual supplier representative, there was not much we could do to guarantee it. We interviewed several co-workers from the supplier companies when we had the opportunity to do so, which we did not have in all cases. We tried to ask some control questions when we received answers that surprised us and did not seem right, but this had to be done ad hoc which is why we have chosen to believe the representatives in the majority of the cases. We are however aware of the fact that some suppliers may have incentives not to be completely honest with us, for instance regarding their view of Tetra Pak and their

[52] Yin, R.K. (2003), *Case Study Research,* p.109

willingness to adapt to changes and sharpening of Tetra Pak's packaging requirements.

3.6.2 Validity and reliability

To ensure validity, i.e. measuring what is meant to be measured[53], meetings with the steering group were held once a month. During these meetings we reported what we had been doing so far and also what we were planning to do later on as the project proceeded. We also reported to our tutor at Tetra Pak on a weekly basis.

Before executing a run in Business Objects, a program that fetches statistics from SAP/R3, Tetra Pak'sf ERP system, we tried to establish a strategy regarding how to achieve the figures that were actually necessary. As the project went on, we noticed a need for such a strategy, since we tended to fetch all sorts of information from the ERP system just because it was available, information that was not always helpful.

To make sure we had interpreted the information from the interviewees correctly we had the initial ambition of recording the interviews in order to ensure a high reliability. After investigating how many interviews we were going to make, we decided however not to record those since it would have taken too much time to go through the recordings afterwards. We also feared that a recording would have an inhibitory effect on the interviewees, especially on the suppliers. Instead we sent the minutes back to the interviewees as to give them the opportunity of checking that we had not misunderstood them in central matters.

To largest possible extent we also double-checked all information concerning packaging and packaging material as we discovered that the answers differed a lot depending on which Tetra Pak co-worker we asked. This approach can be described as triangular, i.e. when the researcher collects different data treating the same phenomenon and it increases the both the validity and the reliability. The use of multiple sources of information is almost a prerequisite in case studies and the possibility to do so is one of the strengths about the method[54].

When regarding the reliability of our cost estimations we want to emphasise that all our calculations are merely estimations that cannot be dealt with as if they were absolutely correct. On the other hand, our purpose was more to develop estimations that were *good enough* as to provide basis for decision making, than to present absolutely correct figures, but we still had the ambition to present figures that were good enough in terms of reasonableness. Moreover, it would have been impossible to fulfil the rest of our objectives if all figures were to be absolutely correct. Due to the fact that our world is dynamic and in constant change, we cannot expect to achieve estimations that always will be correct, we always have to make on-the-spot accounts of the present situation. There are several sources of errors which we however tried to eliminate to largest possible extent.

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[53] Björklund, M., Paulsson, U. (2003), *Att skriva en rapport*, p.7
[54] Yin, R.K. (2003) *Case Study Research,*, p.97

First of all, we have, as mentioned previously, used the software application Business Objects in order to fetch information from Tetra Pak's ERP system. Due to the lack of user friendliness of this tool, the possibility of interpreting the numbers correctly at all times is quite small. As we were completely unfamiliar with this application from the start we have been forced to apply a trial and error technique, which was not always the most efficient manner of working. We have however got a lot of help from Tetra Pak personnel who explained the most common pitfalls of the program.

Business Objects is built up by several so-called universes such as Purchasing universe, Sales universe, and Material master universe. In all possible cases we executed runs in more than one universe to check that the results corresponded fairly. For instance, when we were looking for information of annual turnover measured in number of parts, we both used the purchasing universe to get the amount of purchased parts, and the sales universe to get the number of sold parts to be able to check that the amounts at least corresponded tolerably. In some cases, for instance when we calculated the consumption of packaging material at the distribution centre in Lund, we had to fetch the statistics manually from SAP/R3 for each type of packaging material since we did not manage to get any reliable information out of Business Objects.

Another issue is whether the information that Business Objects fetches is correct, i.e. whether the personnel working with SAP/R3 has entered data that correspond to the actual reality. It was little we could do to check this because of the large amounts of posts we had to go through, which is why we have chosen to believe that the information at least is good enough.

We have sent the calculated figures for control to at least one person who we believed had the possibility to know if the figures were in the right range.

Regarding the future, the cost estimations naturally become even vaguer. We were to estimate the costs associated with the alternative of outsourcing all activities regarding the primary packages and with the alternative of performing it in-house. Both alternatives imply new costs that are not present today, such as investment costs and costs associated with the packaging material as the packages are to change. Here we performed brainstorming sessions with chosen Tetra Pak co-workers who we believed have some input regarding this matter. We used mainly their guesses in combination with the results that we had achieved concerning the present situation when we made our estimations regarding the future alternatives at hand.

4 Theoretical framework

This chapter deals with the theory relevant for analysing the empirical findings of this project. Initially, we explain why the chosen theories are included as well as describing their mutual relationships. We hope this will make it clearer to the reader to understand the connections between the subject areas and why they are important in this particular context. We will treat the subject areas of packaging logistics, organisation and supply chain management.

4.1 Theory selection

The primary motive of the selected theory is to provide a means to analyse our empirical findings. The chapter is however structured in a way that aims to explain the interfaces and the connections between the different theories. The theoretical framework of this paper can be described as in Figure 7 below.

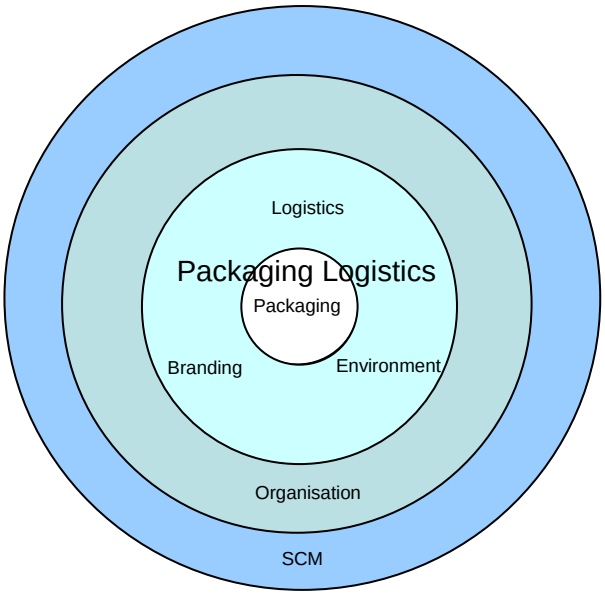

Figure 7: Theoretical framework[55]

Our point of departure of this chapter is the packaging itself, which can be seen in the centre of the figure above. There is a wide range of requirements being posed on the packaging and its design, depending on who you ask. The requirements will be

[55] Combination of Saghir, M. (2004), *A platform of Packaging Logistics Development – a systems approach*, p.61, and Klevås, J. (2005), *On opportunities of integrated packaging, logistics and product development*, p.7, our modifications and extensions

presented according to their origin, i.e. who is posing them, using the so-called function analysis model.

Outside the inner circle there are a number of secondary aspects being influenced by decisions concerning the design of the package. Here we have chosen to primarily deal with logistics and branding as these aspects reflect the objectives of the thesis. Furthermore, we have chosen to include environmental aspects, a matter that is rated highly from Tetra Pak in general and that therefore could not be disregarded even though it is not our main focus.

Packaging, environmental aspects, branding and logistics are treated in section 4.2 Packaging logistics.

The third circle describes organisational aspects. The organisation will affect decisions regarding branding, environmental matters and logistics, as well as being influenced in turn by the decisions made at those levels. In section 4.3 Organisation we are going to present theory regarding packaging organisation and the implementation of changes in organisations.

The forth and final circle describes supply chain management. In section 4.4 Supply chain management we present theory regarding interactions and relations between organisations. It is likely that the supply chain will be affected if the companies that constitute it changes, which is why the supply chain circle is placed outside the organisation circle in the figure. In this section we are going to present the concept of postponement and how it can be applied in packaging contexts. Moreover, we will also discuss relevant cost elements that can be used in the cost estimations in chapter 5 and 9.

4.2 Packaging logistics

The choice of package influences many functions within a company. Here we have decided to use the package itself as our starting point. We will thereafter move on to logistics, branding and environmental aspects. Finally, the requirements that arise when examining these aspects are presented in the so-called functional analysis model.

4.2.1 Packaging

In packaging literature there is a distinction made between *packaging* and *package*. *Packaging* can be defined as 'the art, science and technology of preparing goods for market and sale'. According to other writers, such as Paine, packaging can also be defined as: 'A coordinated system of preparing goods for transport, distribution, storage, retailing and end-use.'[56] According to these definitions, packaging is more than just a box. A *package*, on the other hand, has to do with the physical features of

[56] Johnsson, M. (1998), *Packaging Logistics – a value added approach*, p.36f

the packaging, i.e. the package is included in the concept of packaging.[57] The package has to live up to requirements being posed by the actors within the packaging system as well as actors outside it.

Since the protection of the product is one of the most important aspects to consider when designing a package, it will be treated separately below.

Product protection

Protection of the product is an important part of the package's purpose. The package shall protect the product from the distribution system and vice versa. Moreover, consumers often require some kind of guarantee that the package has not been open during the logistics chain, which can be provided through the use of special seals etc.[58] During the package's lifetime it is exposed to a number of stresses. Stresses can be divided into three groups; mechanic, climatic and biologic. Mechanic stresses occur as prods, pressure, falls and vibrations during warehousing, handling, and transportation.[59] Climatic stresses appear as temperature and atmospheric humidity[60], which can lead to corrosion. Biologic stresses are syndromes such as mould and animals.[61] The packaging material should in every case be selected to best protect the product. The most common material used in packaging is corrugated board, but other options are wood, plastic or metal.[62]

4.2.2 Logistics

Council of Logistics Management defines *logistics* as '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'.[63]

The impact of packaging in the logistics chain

The package has an important role within the logistics chain. It should be designed to suit all the actors so that an effective flow is possible. The package's purpose from a logistics point of view is to provide an interface between the product and the material handling system.[64] Furthermore, it shall facilitate handling, transportation and storage

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[57] Klevås, J. (2005), *On opportunities of integrated packaging, logistics and product development*, p.33
[58] Johansson, K., et al. (1996), *Förpackningslogistik*, p.44
[59] Andersson, L. (2003), *Vad styr kundens val av emballage och vilka faktorer påverkar kundens emballagekostnad*, p.32
[60] *Kurskompendium Internationell Distributionsteknik MTT045* (2004), Lund Institute of Technology, chapter 9 p.17
[61] Andersson, L. (2003), *Vad styr kundens val av emballage och vilka faktorer påverkar kundens emballagekostnad*, p.33
[62] *Kurskompendium Internationell Distributionsteknik MTT045* (2004), Lund Institute of Technology, chapter 9 p. 19
[63] Johnsson, M. (1998), *Packaging Logistics – a value added approach*, p.47
[64] Ibid,, p.43

and it shall protect it from stresses it might be exposed to during these activities, which were described earlier in section 4.2.1. When regarding transportation, the volume utilisation, i.e. how well the available volume is utilised throughout the logistics chain, is a common measure.

The package is also an important interface between subsystems along the logistic channel. This requires that the selection of packages is done with an understanding as well as knowledge of the environment where the packages will be used and handled throughout the logistics chain.[65] The different actors within the logistics channel will need different kinds of information on the package such as content, weight, quantity, handling directions, producers name and country of origin.[66] The information aspect is also important from a working environment perspective.[67]

4.2.3 Branding

According to the American Market Association, *marketing* can be defined as: 'The process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services to create exchanges that satisfy individual and organisational objectives.'[68]

Branding can be defined as 'A group of attributes by which a consumer relates to a specific product, service, or organisation.'[69]

A *brand* can be defined as 'a collection of perceptions in the mind of the customer'.[70] For many products and companies, branding is an essential part of marketing.[71] Hence, branding is a part of the marketing, but the marketing contains much more than the building of brand name.

In the following sections we will confine ourselves to branding since the purpose of the thesis has more to do with branding than marketing. It is however likely that people who deal with branding activities are marketers, a fact that might cause confusion.

Price and other tangible features are often quite similar between companies in competitive markets. Therefore companies need to differentiate from the competitors, for instance through the strengthening of their brands and/or provide a higher service. Moreover, research shows that intangible attributes as the brand image can influence the purchasing decisions not only on consumer markets, but also in industrial markets.[72] Other studies show that a company's overall reputation was more

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[65] Johnsson M. (1998), *Packaging Logistics – a value added approach*, p.42f
[66] Livsmedelsverkets webpage, (01/11/05)
[67] Johansson, K., et al. (1996), *Förpackningslogistik*, p.83
[68] Website marketing plans' webpage, (23/01/06)
[69] Bitpipe's webpage, (23/01/06)
[70] Buildingbrands' webpage, (23/01/06)
[71] Investorwords' webpage, (23/01/06)
[72] Mudambi, S. (2002), 'Branding importance in business-to-business markets Three buyer clusters'

important in buying decisions than the sales presentation[73]. To purchasers, one important issue is to reduce risks attached to the supply of products. Buying top brands from highly regarded companies is one way of handling and decreasing this risk.[74]

Brand equity can be described as buyers' willingness to pay a price premium for a favoured brand over a generic or unknown brand, and to give special consideration to another product with the same company brand name.[75] Brand equity can also be defined as brand loyalty, brand awareness, perceived quality, and brand associations.[76] The study made by Bendixen et al shows that perceived quality is the main brand equity generating variable, and that there exists brand equity in the form of buyers' willingness to pay a price premium in industrial markets. This implies that industrial marketers have something to gain from building a strong positive brand image among the stakeholders. Since quality is the main brand-equity-generating variable, it is important to emphasise that quality can only be declared if there is substance to the declaration, i.e. marketers have to make sure that their efforts to strengthen a brand are not undermined by poor quality. The opposite is however equally important; it is not enough to create a high quality product unless the quality is translated into customer perceived quality. Moreover, an aspect that distinguishes industrial markets from consumer markets is the difficulty to know who is making the purchasing decisions. This fact makes it even more important to companies operating on the industrial market to create a positive brand image to all stakeholders that come into contact with the company. To achieve this, the selling company must develop a total corporate communication program in order to build up and strengthen the company brand.[77]

The impact of packaging on the company brand and the marketing performance

In the case of packaging, it is important for the marketer to regard the packaging as an investment, not a cost[78] as packaging is considered an interface activity between the marketing and the logistics. Moreover, the physical properties of a product and its package have a direct influence on marketing.[79] Despite this, many companies still primarily look at the price for packaging development rather than the value of the work. According to several case studies of best practice, the payback time of the design investment can be measured in days through the increased sales performance

[73] Bendixen, M., Bukasa, K.A., Abratt, R. (2004), 'Brand equity in business-to-business markets'
[74] Hutton, J. G. (1997), 'A study of brand equity in an organizational-buying context'
[75] Mudambi, S. (2002), 'Branding importance in business-to-business markets'
[76] Aaker, D., A. (1996), 'Measuring brand equity across products and markets'
[77] Bendixen, M., Bukasa, K.A., Abratt, R. (2004), 'Brand equity in the business-to-business markets'
[78] Sands, J., *About: packaging design*, Design Council's webpage, (01/11/05)
[79] Saghir, M. (2004), *A platform for Packaging Logistics Development – a systems approach*, p.44

achieved through the better package. It shall be noted though, that the case studies referred to in this publication are all conducted within the business-to-consumers area. It is however important to acknowledge the need of preserving and strengthening the brand and hence the package as the package becomes the incarnation of the brand. Moreover, a strong package can defend the company's competitive position and also provide means to increase the margins.[80]

The packaging design will almost always have an effect on a company's results. If treated as nothing more than a cost, it is likely that the design will influence the results negatively, but treated as an investment there is potential to use it as a strategic weapon and in turn increase profits.[81] Gateway, a strategic branding and design firm states that 'Packaging is literally a hands-on opportunity for companies to communicate with their customers.' Moreover, Gateway declares that the packaging design provides an opportunity to transform brand investment into increased sales.[82]

Swedish bearing manufacturer SKF, conducted a packaging development project for larger bearings during 2000-2001. The primary motives were to develop a package that met demands of robustness, safety and recycling, and would reflect the high quality of the contents. SKF was of the opinion that the packaging needed to support SKF branding by reinforcing the group image. Moreover, it was a requirement that the package could create a clear visual identity of its content and in addition be difficult for the competitors to copy. SKF considers the project being a success and has performed a survey that showed that the customers are very positive about the new packaging system.[83]

4.2.4 Environmental aspects

It is important to consider the environmental aspect during the package designing process. Basic environmental requirements are[84,85]:

- Minimise utilisation of resources
- Minimise the usage of harmful substances
- Minimise the amount of waste

Moreover, the designer has to consider how the package can be recycled which requires knowledge in recycling systems. If the possibility to perform the recycling activities in an efficient manner is overlooked, the working environment might be

[80] Sands, J. *About: packaging design*, Design Council's webpage, (01/11/05)
[81] Sands, J. *About: packaging design*, Design Council's webpage, (01/11/05)
[82] Gateway's webpage, (01/11/05)
[83] Sahlgren, A. (2005), 'Packaging solutions benefit from sophisticated design approach'
[84] Petterson, M. (2003), *Determining Criteria for Choosing Packages in the British Food-service Supply Chain*, p.33
[85] Jahre, M., Hatteland, C.J. (2004), 'Packages and physical distribution'

affected negatively, for instance through worse working postures, increased risk of accidents, lacking hygienic properties, and monotonous work. [86]

The packaging designer must take also take aspects as reusability, reducibility, recovery, and disposal into consideration in the development of a new package.[87]

4.2.5 Direct requirements to consider in packaging development

The functional analysis model, presented in Table 1, is to be considered as a means of assistance in packaging development. It groups the requirements according to the actors throughout the packaging supply chain. The model shows that there are several stakeholders posing requirements on the packaging, even within a company. Moreover, the logistical responsibility and the logistical requirements might be shared between several positions within a company. For instance, the transport purchaser demands a tight, modular package that can be stacked when full and nested when empty. The purchasing function requires normally a package that provides flexibility when choosing suppliers and production personnel demand a package that is efficient to fill. Due to the fact that there are so many stakeholders within the organisation, it is often difficult to measure and survey all elements being influenced by the choice of package.[88]

[86] Johansson, K., et al. (1996), *Förpackningslogistik,* p.85
[87] Saghir, M. (2004), *A platform for Packaging Logistics Development – a systems approach*, p.61
[88] Johansson, K., et al. (1996), *Förpackningslogistik,* p.47 & p.55

Stakeholder	Requirements
Packaging material producer	Effective production
Carrier of empty packages	High volume utilization Low weight
Packer	Flexible size Rational raising Rational closing Rational packing
Handler of full packages	Few re-packing operations Adaptation to handling equipment Information Waste preventive
Carrier of full packages	High volume utilisation Weight adaptation Protection against transport damage Information Waste prevention
Retailer	Adapted to interior fittings Rational handling in retailers Informative, self-selling package
End consumer	Manageability User friendliness Information
Resource recycling	Material savings Energy savings Reusability Produced in returnable material
Marketers	Promote sales Communicate value Branding of the company

Table 1: The functional analysis model[89]

[89] Johansson, K., et al. (1996), *Förpackningslogistik*, p.54, our modification and extension

4.3 Organisation

In this section, theories regarding organisation aspects in general as well as packaging organisation in particular are presented and elaborated on.

4.3.1 Organising packaging

Van Weele presents four types of organisational structures on how to organise purchasing; Centralised, Decentralised, Centralised/Decentralised, and pooling structure. The first three are presented in Figure 8 below since they are the only ones being interesting in this study. The purpose of this thesis has however little to do with purchasing organisation but we still think that the overall ideas can be used to describe other functions than purchasing, e.g. packaging.

In the centralised structure, the company is divided into business units but has specialists, for instance in the packaging area, operating on a strategic and tactic level which is illustrated by the highlighted square in the figure to the left. When regarding the decentralised structure, a typical feature is that every business unit manager is responsible for his/her own financial results. Therefore, the manager of the business unit is responsible for the packaging activities performed within his/her business unit which explain why the three squares in the bottom are highlighted in the figure in the middle. In the centralised/decentralised structure, the packaging activities are organised both on a corporate level and on individual business unit level. Strategic and tactic packaging activities can be performed both centralised and decentralised, which is illustrated in the figure to the right.[90]

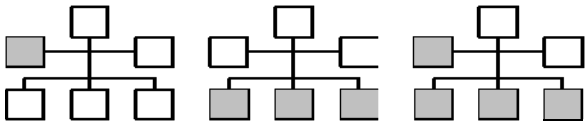

Figure 8: Organisational structures; Centralised, Decentralised and Centralised/Decentralised[91]

Klevås's research covers Swedish furniture retailer IKEA's packaging organisation transformation from Centralised via Decentralised to Centralised/Decentralised. The different models have had various advantages and drawbacks as they have been applied in the IKEA organisation. The models are described in chronological order according to when they were applied. In the centralised organisation (-1985), there was a high packaging competence, a high packaging authority and a strong connection to logistics. A negative side effect was that there was a long lead-time for product and packaging development. In the decentralised structure (1985-1999), there was a close connection to product development. The drawbacks were that IKEA experienced insufficient communication, control and coordination, that there was no obvious link to logistics and that there was a loss of packaging competence and

[90] Van Weele, A. J. (2002), *Purchasing and supply chain management*, p.239-241
[91] Ibid, p.239-241

authority. In the centralised/decentralised structure (1999-) IKEA experiences control and coordination of packaging activities, close connection to product development and logistics as well as high packaging authority. The negative side effect is the risk of a bureaucratic organisation.[92]

4.3.2 Change management

Normally, people react to change with a positive attitude as long as the change does not concern them.[93] On the other hand, those affected by a change are often offering resistance but the grade of resistance varies from case to case and from person to person. The first reaction to an organisational change is often concern. Thereafter, there are two different patterns of reaction; either the change stimulates the person to self reflection and activity, which means that he/she gets through the change successfully. The other extreme reaction is that the person cannot handle the change and therefore leaves the organisation, or stays but cannot work as supposed to in his/her new role.[94]

As organisations are built up by the people working in it, one can expect that in organisations there will be a sluggishness to implement changes due to the above described resistance among the individual co-workers. Bruzelius and Skärvad describe two types of sluggishness in organisations; understanding and manoeuvre sluggishness. The understanding sluggishness derives from forces that prevent or make it more difficult for the members of the organisation to understand why the change is necessary. Examples of such forces are: lack in education and knowledge, too strict manuals of handling, or too short-term goals. The manoeuvre sluggishness is caused by bindings and locking of resources such as physical equipment and knowledge within the company.[95]

4.4 Supply chain management

The supply chain is the network of organisations being involved, through upstream and downstream linkage[96], in the process of providing products and services to the ultimate consumer. This means that the management of the supply chain extends across organisational boundaries, which in turn implies that a common information system accessible to the involved parties is needed in order to coordinate them.[97]

The supply chain is both a network and a system. The network properties involve the sequence of connections among organisational units for product flow and information; the systematic properties are the interdependence of activities, organisations and processes. Actions in one part of the system affect other parts and

[92] Klevås, J. (2005), 'Organization of packaging resources at a product developing company'
[93] Ljungberg, A., Larsson, E. (2001), *Processbaserad verksamhetsutveckling*, p. 309
[94] Bruzelius, L., Skärvad, P-H. (2000), *Integrerad organisationslära*, p..370-373
[95] Ibid, p. 371
[96] Christopher, M. (2005), *Logistics and Supply Chain Management*, p. 17
[97] Schary, P.B., Skjött-Larsen, T. (2001), *Managing the Global Supply Chain*, p. .29

the objectives of supply chain management are holistic since they relate to the system as whole rather than to its individual members. Consequently, the purpose of supply chain management is to control and direct the interactions between the member organisations.[98]

In the following sections we are going to present theories that can help us analyse the decision regarding the location of the packaging activities for Tetra Pak parts. We will start with the concepts of packaging postponement, and will thereafter move on to supply chain relations and outsourcing. The chapter is finalised with a presentation of the costs that might be affected if the location of the packaging activities is changed.

4.4.1 Postponement

Postponement and speculation are two extreme answers to the question when to add value in distribution channels in order to reduce cost and risk. Postponement is the concept of not doing today what can be done tomorrow as nobody knows what then will happen.[99] Speculation on the other hand says that manufacturing and for instance packaging shall take place as early as possible in the value chain in order to achieve economies of scale. Consequently, speculation relies on forecasts which are not always correct.[100] Since one of our objectives is to determine whether the packaging activities shall take place in-house or at the suppliers, we will in the following chapter present factors determining when to postpone packaging.

An important factor regarding the location of the packaging activities is the ability to achieve economies of scale in the packaging operation.

Packaging is typically postponed for *global standard products customised for local markets*. Even if the product inside is the same, the package's language, structure and for instance product manuals vary for geographical regional markets. Another important factor having impact on postponement decisions is *how much volume or weight the product gain during packaging*.[101] Almost all products gain volume and weight when they are packaged which is why packaging postponement is considered a forceful way of reducing transportation costs.[102] A third important aspect is the *product's value profile*; if much of the product's total value is added in the final operations, postponement might be reasonable.[103] When demand is unpredictable the risk of speculation is high, which is why postponement might be reasonable. Moreover, *when a product is sold in several package sizes or brands*, it is a good candidate for postponement. For instance, there are wines that are transported in bulk

[98] Schary, P.B., Skjött-Larsen, T. (2001), *Managing the Global Supply Chain,* p.29-33
[99] Ibid,, p.422
[100] Twede, D., et al (2000), 'Packaging Postponement: A Global Packaging Strategy'
[101] Ibid
[102] Ibid
[103] Ibid

and bottled under several brands at regional distribution centres. It is cheaper to transport the wine in bulk as the bottles add too much weight.[104]

Four types of postponement can be identified; full speculation, logistics postponement, manufacturing/packaging postponement, and full postponement.[105]

Full speculation

According to the full speculation strategy, finished inventory is shipped to the end of the distribution channel in order to stay close to the end consumers expecting demand. The cost of inventory rises as each stock keeping unit requires its own safety stock in several locations. On the other hand, there is a possibility to achieve economies of scale in production and in distribution as full truckloads can be used due to an even capacity utilisation.[106]

Logistics postponement

In this strategy, finished inventory is kept at a central location and products are shipped directly only on demand. The upside of such a strategy is lower inventory costs as the safety stock decreases, but normally a higher distribution cost will follow. The strategy requires packages to have standardised dimensions so that they are easy to sort quickly. Due to the fact that it is difficult to use full truckloads as the demand is shifting, premium transportation, e.g. less than truckload service and air freight, is often used which implies the packages to be small in order to minimise transportation costs. Moreover, the package needs to be robust since it must resist frequent handling, conveyors and mixed-load stacking.[107]

Manufacturing/packaging postponement

According to the manufacturing/packaging postponement strategy, semi-finished products are shipped in bulk to a point near the market where they are packaged. An example is coffee beans that are packed at a retail shop. The Swedish retailer IKEA has postponed the assembly of their furniture to largest possible extent, as they sell the furniture unassembled, in order to reduce transportation costs through flat packages. Moreover, this strategy reduces the damage caused by manual handling.[108]

Full postponement

In the full postponement strategy, order triggers the process of producing a customised product and the product is thereafter shipped directly to the customer. The products are stocked and customised at a single central location. This option might be fitting when customisation has a high value to customers. One example is labelling which is normally done centrally due to economies of scale through the use of highly automated equipment. As labelling does not affect the weight or the volume and hence not the transportation costs it might as well be done centrally. With the

[104] Twede, D., et al (2000), 'Packaging Postponement: A Global Packaging Strategy'
[105] Ibid
[106] Ibid
[107] Ibid
[108] Ibid

possibility to label a product differently depending on the market the product is going to a flexible supply chain is achieved. In other words, the strategy is fitting when customisation has a high value to customers, when there is a good reason to keep such operations centrally and when customers are ready to wait for the products.[109]

4.4.2 Supply chain relations

In this section we are going to present two extremes when it comes to supply chain relations. In reality, these two extremes are often mixed and many buying companies apply both of them depending on the product and/or supplier in question.

Traditional customer/supplier relationship

The most common relationship is the traditional customer/supplier relationship which can be characterised as:[110]

- Customer and supplier have a competitive relation, fighting over the profit margin of the supply chain. The companies act according to the following principle 'if the supplier's profit margin increases thanks to the higher prices we pay him, our own profit margin is threatened'.
- It is a winning/losing game for both parts.
- Both parts tries to eliminate the opponent's position of strength.

Using this attitude both parts are characterised with a behaviour that tries to avoid dependence on the other. Both parts try to avoid linkage in the value chain that is to a disadvantage. For the buying company this implies for instance a wish to have several suppliers and a striving to avoid long-term contracts. The supplier tries to delimit its dependence on the buying companies and also tries to lock-in the customers it already has through long-term contracts. [111]

The risks with this kind of relationship are that the supplier market could be too fragmentised and destitute since the suppliers loose the ability to develop their products and their technological competence. The suppliers are experiencing price-reducing measures constantly, which threaten their ability to develop and strengthen their competitiveness. Moreover, it is difficult for both parties to render activities that require cooperation more efficient since such measures presuppose linkages and dependencies between the companies.[112]

Partnership

Another type of customer/supplier relationship is partnership. According to this strategy, the buying company should focus on developing close and intimate

[109] Twede, D., et al. (2000), 'Packaging Postponement: A Global Packaging Strategy'
[110] Mattsson, S-A. (1999), *Effektivisering av materialflöden i supply chains*, p.85
[111] Ibid, p.85
[112] Ibid, p.86

relationship with a limited number of suppliers. This attitude can be characterised by:[113]

- It is a win/win situation for both parties.
- The partners try together to increase the supply chains force of competition with the aim of increasing both companies' profit margins.

This kind of relationship does however occur rarely. According to research made by Ellram and Hendrick, less than 1% of the examined supplier relations in their study could be defined as partnership relationships.[114] According to this approach both parts' behaviour is a way of creating close collaboration and increase the relation of dependence. Moreover, it is desirable for both to have long agreements. In other words, both parts strive to increase the dependence on the other as opposed to the traditional relationship when dependence is regarded as a risk.[115]

The risk with partnership is that the dependence gets too strong, and as a consequence, one part cannot survive without the other. If the wrong partner has been chosen the company risks its own existence due to the strong linkages. The risk is however dependent on the areas where the partners have chosen to collaborate. For instance, it is generally more risky if the cooperation includes product development and marketing as opposed to adapting production technologies to each other.[116]

Finally, since many measures to render the supply chain more efficient assume cooperation between the members of the supply chain, the chances of succeeding in efficiency projects are higher in a partnership relation compared to a traditional relationship.[117]

4.4.3 Outsourcing

Most companies' competitive advantages arise from relatively few internal activities and resources[118]. Therefore it might be wise to consider focusing on these core activities and outsource activities that do not contribute to the company's competitive advantage[119]. An outsourcing process might be difficult to manage though since it is often difficult to identify the core activities. If the identification is properly done, there is potential wins to gain such as higher efficiency, less bureaucracy, stronger market position and stronger strategic focus.[120] Typical examples of non-core activities in producing companies are security, catering, cleaning services, and maintenance activities.[121] However, leaving a critical asset in the hands of suppliers

[113] Mattsson, S-A. (1999), *Effektivisering av materialflöden i supply chains*, p.86
[114] Van Weele, A. J. (2002), *Purchasing and supply chain management*, p.166
[115] Mattsson, S-A. (1999), *Effektivisering av materialflöden i supply chains*, p.87
[116] Ibid, p.87
[117] Ibid, p.87
[118] Bruzelius, L., Skärvad, P-H. (2000), *Integrerad organisationslära*, p.218
[119] Van Weele, A. J. (2002), *Purchasing and supply chain management*, p.143
[120] Bruzelius, L., Skärvad, P-H. (2000), *Integrerad organisationslära*, p.217
[121] Van Weele, A. J. (2002), *Purchasing and supply chain managements*, p.324

causes a risk. Outsourcing is therefore unlikely to occur in situations where companies want to reduce risk. Moreover, it is less likely to happen when the buyer can achieve economies of scale.[122] To be able to outsource successfully, excellent suppliers and hence excellent purchasers are needed.[123]

From a strict economic perspective, outsourcing is recommended when the sum of the external costs of production plus the costs of transaction is less than the internal costs of production. Cost of transaction is the extra costs that arise when activities are outsourced, such as costs of negotiation, contracts, transports, communications, and control of the supplier's performance.[124] Cost reduction is in virtually every case the main objective when companies decide to outsource[125]. Research shows however that many companies lack a strategic view in their make-or-buy decisions, which implies that they decide to buy rather than make for short-term reasons of cost reduction. In the short term, buying gives the company the opportunity to use the skills and technology from the best suppliers in each product area. In the longer term, buying rather than making might imply that the company becomes increasingly dependent on the goodwill and support of the supplier. Finally, a buy decision naturally leads to the loss of in-house competence within the outsourced area, and it might also decrease the number of employees.[126] Ellram and Maltz argue that job elimination should be regarded as a saving in these decisions since if jobs are not eliminated and people redeployed, there are no savings[127].

4.4.4 Total cost approach

The total cost is an important conception in logistics contexts. It is central to collect all costs associated with a certain decision in a certain situation in order to avoid sub optimisation. Usually, some costs components will decrease and others will increase as an effect of a decision and when choosing among several alternatives the decision makers must be aware of the total difference in cost between the decision alternatives at hand.[128]

The cost components relevant to this study are presented in Figure 9. The figure aims at describing the costs' mutual relationships as well as whether they are directly or indirectly influenced by packaging decisions. It is important to understand that few, if any, of the cost components previously described are independent from each other.

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[122] Ellram, L., M., Maltz, A., B. (1995), 'The use of total cost of ownership to model the outsourcing decision'
[123] Van Weele, A. J. (2002), *Purchasing and supply chain management*, p.10
[124] Bruzelius, L., Skärvard, P-H. (2000), *Integrerad organisationslära*, p.218
[125] Ellram, L., M., Maltz, A., B. (1995), 'The use of total cost of ownership to model the outsourcing decision'
[126] Ford, D., et al (1993), 'Make-or-buy Decisions and their Implications'
[127] Ellram, L., M., Maltz, A., B. (1995) 'The use of total cost of ownership to model the outsourcing decision'
[128] Aronsson, H., et al (2003) *Modern logistik*, p.31

On the other hand, a change in one component affects more or less all the others, which is why a holistic approach is so important.

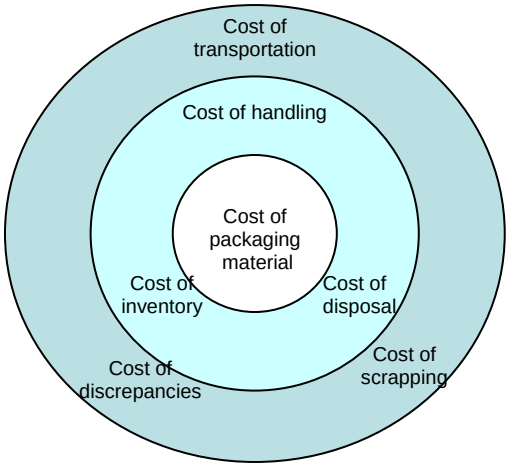

Figure 9: Cost components affected by the choice of package and the location of the packaging activities[129]

Cost of packaging material

The packaging material cost includes the direct costs for the package, e.g. the cost for developing and buying the packaging material.[130]

One parameter that affects the cost of packaging material is to what extent the packaging material selection is standardised. If the packaging design is basic, the lead time to develop new packages can be shorter and less advanced tools are needed. A shorter development lead time and less advanced tools normally decrease packaging material costs. Moreover, a smaller number of sizes decrease the average conversion time per variant change. A small selection also means that the purchasing volumes get bigger per size whereas the price per piece reduces. The drawback with a standardised selection is that the package's internal volume utilisation reduces. Standardised packages also need to be constructed in such a way that they can handle strong pressures, which means that some product gets more packaging than necessary.[131]

Other factors influencing packaging cost (and distribution cost) are product fragility, size, shape, and weight. The product fragility was in the past something that was considered given; if the product could not survive the distribution activities it had to be better packaged. Nowadays, some companies try to consider the product's own ability to withstand the stresses it is exposed to during distribution. If a product is considered to be too fragile it has to be redesigned, which is a notion previously

[129] Own development
[130] Johansson, K., et al. (1996), *Förpackningslogistik*, p.28
[131] Andersson, L. (2003), *Vad styr kundens val av emballage och vilka faktorer påverkar kundens emballagekostnad*, p.42

unimaginable. To determine the acceptable level of fragility one might consider the following three relationships;[132]

- The relationship between product fragility and manufacturing cost.
- The relationship between product fragility and packaging cost.
- The relationship between the size, weight, and shape of the product/package systems and the transportation, material handling, and warehousing cost.

Cost of handling

The cost of handling consists of the costs associated with personnel and equipment to pack the products. The choice of packaging affects the possibility to perform the packaging activities rationally and efficiently.[133]

Cost of inventory

The cost associated with inventory can be divided into inventory carrying cost and warehousing cost.

Inventory carrying cost

The inventory cost includes costs for capital tied up in inventory[134], and the costs associated with the risk of stock-keeping. The risk costs are for instance risk for obsolescence, waste, cassation and costs for insurance premiums.[135] The inventory costs are affected by the grade of packaging postponement employed in the supply chain, an aspect that was treated previously in section 4.4.1. It is also affected by the number of variants kept in stock. If there are fewer variants, less capital is tied up in inventory since the total safety stock decreases.[136]

Warehousing cost

The warehousing costs are constituted by the costs associated with the daily operation of a warehouse, e.g. costs for the ownership and management of the warehouse building, salaries, costs for inventory and handling equipment, and transportation within the plant.[137]

Cost of disposal

When the product is taken out of the package, the package stops being a support of the product and becomes a product on its own and needs to be treated as such. The cost of collection and recycling has a direct component as it measures the cost of taking care of the used packages. It is also affected indirectly by the choice of

[132] Maezawa, E., (1995) *Product Modification to Reduce Distribution Costs*, extract from Distribution Packaging Technology, Fiedler, R. (ed), p.83
[133] Johansson, K., et al. (1996), *Förpackningslogistik*, p.28
[134] Schary, P.B., Skjött-Larsen, T. (2001), *Managing the Global Supply Chain*, p.120
[135] Aronsson, H., et al. (2003), *Modern logistik*, p.32f
[136] Johansson, K., et al. (1996), *Förpackningslogistik*, p.30
[137] Aronsson, H., et al. (2003), *Modern logistik*, p.33

packaging material as the cost might vary depending on for instance type of material.[138]

Cost of transportation

Transportation cost includes all costs associated with the administration and execution of transports.[139] The transportation cost is indirectly influenced by the choice of package.[140]

Cost of scrapping and cost of discrepancies

The cost of damaged products, which for instance can be registered as discrepancies or scrapping, is affected by a changed package provided that the package's protective abilities are changed. Therefore, when deciding on packaging material it is important to find a package that gives protection to a reasonable price. One way of showing the factors that reflects the choice of packaging can be seen in Figure 10. As the figure shows, the cost of packaging increases with the package's protective abilities. The cost of damaged parts decreases on the other hand with a more protective package. Therefore, the company shall try to minimise the sum of the cost of damaged products and the cost of packaging.

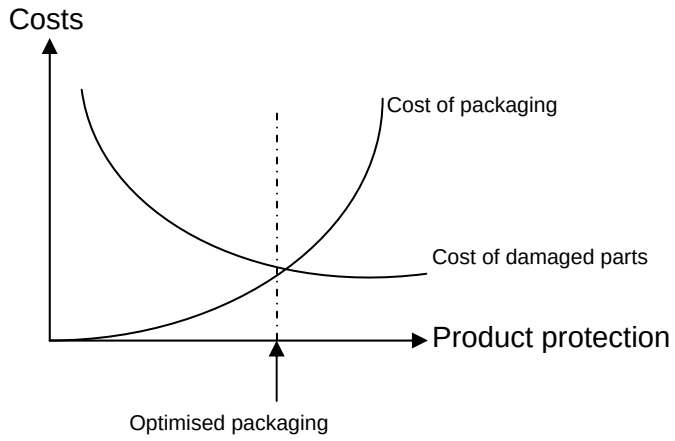

Figure 10: The relationship between packaging costs and costs of damaged parts[141, 142]

[138] Johansson, K., et al. (1996), *Förpackningslogistik*, p.29
[139] Aronsson, H., et al. (2003), *Modern logistik*, p.33
[140] Johansson, K., et al. (1996), *Förpackningslogistik*, p.28
[141] Andersson, L. (2003), *Vad styr kundens val av emballage och vilka faktorer påverkar kundens emballagekostna*d, p.34
[142] Johansson, K., et al. (1996), *Förpackningslogistik*, p.44

5 Present packaging of Tetra Pak parts

Since this is a packaging logistics thesis, we thought it fitting to structure this chapter according to the supply chain for Tetra Pak parts and packaging material. We will present the empirical findings originating from the different actors within our pre-defined system of study, see chapter 3, i.e. Tetra Pak Distribution Centre, Tetra Pak parts suppliers, and packaging material suppliers. Hereafter, the packaging responsibilities throughout the internal supply chain will be presented. After this, other packaging projects and matters concerning product responsibilities are included as those areas were explicitly asked for from our assigner. Finally today's costs affected by packaging activities are presented. First, we will however present today's primary packages.

5.1 Today's corrugated board primary package

In the following section, a brief description of today's primary corrugated board package is presented.

5.1.1 Packaging design

The corrugated board boxes being used for pre-packaging, i.e. primary packaging, today are all brown and unmarked, i.e. they are not printed with the Tetra Pak logotype. The packages are of a number of different designs. A sample of today's primary packages can be seen in Figure 11.

Figure 11: Sample of today's packaging solutions

5.1.2 The perception of today's corrugated board package

A survey measuring Tetra Pak Market Companies' views on the service provided by Technical Service was conducted simultaneously as this project. We had the opportunity to include a few questions regarding packaging. The survey showed that the representatives from the market companies rated the primary packages 3.6 on a scale from 1 to 5 where 3 meant ok, 4 good and 5 very good. They were also positive to the idea of using a more commercial package for the parts (grade 3.9) provided that the customer price is not affected. The questions can be found in Appendix 5.

5.2 Overall presentation of the supply chain

The three actors previously defined as being inside our system of study, see section 3.1.1 are presented more thoroughly in the following sub sections. As seen in Figure 12 below, the packaging material used to package the parts can either be distributed to

the parts suppliers from the packaging material suppliers, or from Lund Distribution Centre. Some packaging material is also used in Lund. This will be further explained in coming sections.

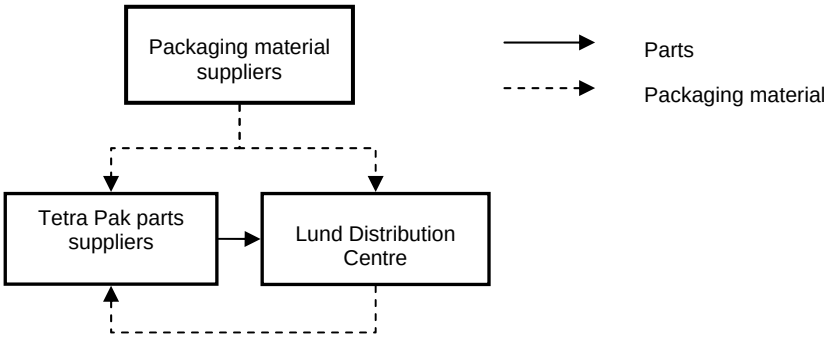

Figure 12: Tetra Pak parts supply chain including the flow of information and packaging material

5.3 Parts suppliers

The supplier visits were performed in order to understand the current situation for the parts suppliers in terms of packaging activities and packaging quality.

In this section, we are going to present the empirical findings from the parts supplier visits. We will also describe how we selected the suppliers since the selection influences the results. As described in section 5.2, the parts suppliers represent one of the defined system units, see Figure 13 below.

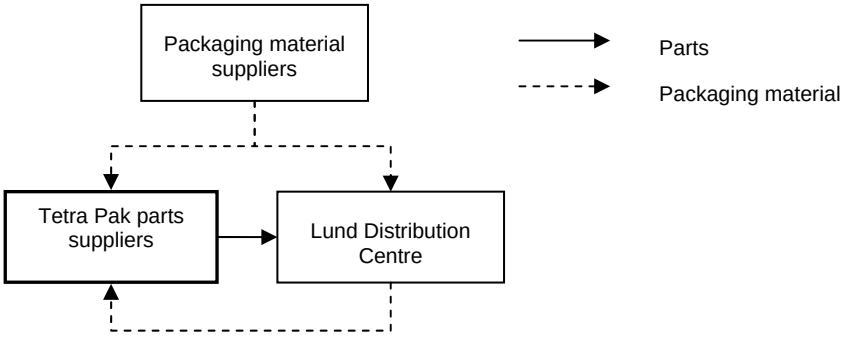

Figure 13: System unit Tetra Pak parts suppliers

5.3.1 Selection of suppliers

To find out which suppliers to visit we consulted the procurement manager together with whom we selected a number of suppliers. When we chose suppliers we used a number of criteria:

- Unique parts: The majority of the suppliers that we visited produced unique Carton parts, i.e. parts to the Carton Ambient and Carton Chilled assortment, but we also visited a supplier of standard components to Processing to see if there was any difference.

- Turnover: We chose both suppliers who had a large turnover to Tetra Pak TS and smaller ones as well.
- Packaging behaviour: We selected suppliers with different packaging behaviours, both in terms of what packaging material they use and whether they order it from Tetra Pak or not.
- Nationality: We wanted to examine both Swedish and non Swedish suppliers, therefore, we picked two Italian suppliers since they were large in terms of turnover to Tetra Pak TS, and we also chose one Danish supplier.
- Cooperativeness: We picked suppliers with a reputation of cooperativeness as well as less cooperative suppliers.

5.3.2 Supplier types

There are several types of suppliers delivering parts to Tetra Pak TS. The most important ones will be listed and briefly described below;

- System suppliers
- Parts suppliers
- Kit suppliers
- Various combinations of the three types

The supplier types and their mutual relationships as well as their relationships to Tetra Pak and Tetra Pak TS are given in the Figure 14 below.

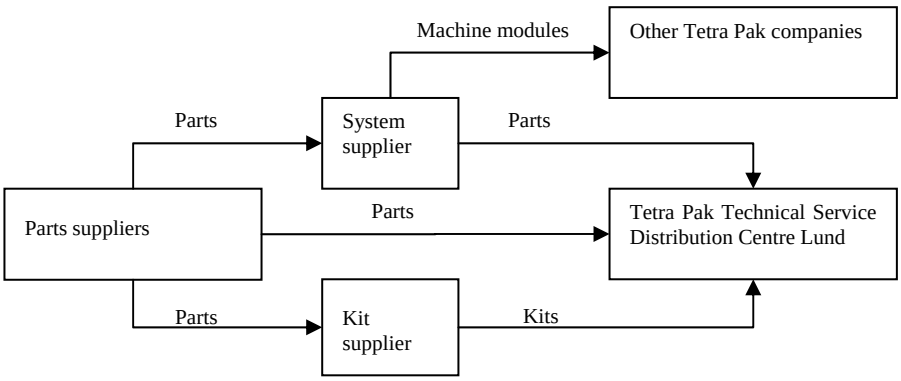

Figure 14: Different types of suppliers and their mutual relationships

The system suppliers deliver mainly complete machine modules to other Tetra Pak companies than Tetra Pak TS. These machines are however in need of parts, which means that some system suppliers both supply TS with parts and supply other Tetra Pak companies with complete machine modules. Moreover, the system suppliers need parts in order to be able to assemble the machines. Normally, they order these parts from so-called parts suppliers. In other words, the suppliers of freestanding parts normally deliver those both to TS and to TS's system suppliers.

The kit suppliers order components from parts suppliers, often using Tetra Pak's contracts. In most cases, they produce some of the included components by themselves. Finally they assemble the purchased components and the in-house manufactured components in a Tetra Pak branded box and deliver it to TS as a kit.

The difference between a kit delivery and a system delivery is that a system delivery normally is a complete module that can be put in operation at a dairy almost immediately, while a kit is a box with a number of parts needed to upgrade a machine module.

The suppliers we visited who produce unique parts were mostly small mechanical workshops that concentrate on cutting work like turning, milling, drilling, welding and grinding. Most of these suppliers produce a lot of different parts to TS. The suppliers who have a large part of their production to TS often produce small batches with special parts when Tetra Pak TS demands it. The fact that the parts are Tetra Pak unique implies that Tetra Pak owns the drawings and holds the patent if there is any.

The majority of the suppliers we visited deliver both to Technical Service's distribution centre in Lund and to Tetra Pak's system suppliers. Among the Swedish ones, all had between 40-100% of their turnover to Tetra Pak. There was however a difference between the Swedish and the foreign companies; the foreign companies were not as depending on the Tetra Pak Group as the Swedish i.e. they had not so large share of their turnover to Tetra Pak.

Even though most of the companies had a large part of their production to the Tetra Pak Group, there was a great difference in volume to Tetra Pak Technical Service. Some delivered almost all their Tetra Pak production to TS while others had less then 1% of their Tetra Pak volume to TS.

5.3.3 Packaging activities

In the following sections, matters concerning packaging and packaging activities will be dealt with.

Packaging instructions

According to the suppliers that we visited there are no specific instructions regarding how they should pack the parts to TS, apart from the re-building kits that have detailed instructions. There are however a general packaging instruction that the suppliers have received. If the part has a pre-packaging demand and there is a pre-packaging agreement with the supplier, there is a reference to a packaging material number on the order. For instance, there can be a reference to a specific plastic bag, corrugated board box or other packaging material that should be used to package the part. The majority of the parts have no pre-packaging demand and no pre-packaging agreement and as a consequence no specific packaging instructions, a fact that implies that the parts are packed on intuition and common sense.

There is in most cases no difference in terms of packaging requirements depending on whether the suppliers deliver to a Tetra Pak company, or to a system supplier contracted by Tetra Pak. In other words, the suppliers use the same packaging department and the same packaging personnel independently of the destination of the goods; Lund or a system supplier's plant. There are however often a difference between the suppliers' customers, e.g. Tetra Pak Group or Volvo Group, and the way they pack to them. Most of the suppliers pack after the customers' demands.

All the suppliers we visited and interviewed performed their packaging activities manually.

Supply of packaging material

About 65 suppliers (other Tetra Pak companies not included) received primary packaging material, i.e. pre-packaging material, free of charge from Tetra Pak TS during 2004.[143] This packaging material is related to specific parts on which Tetra Pak TS has pre-packaging demand. This implies that only suppliers who produce parts with pre-packaging demand are provided with packaging material by Tetra Pak TS. For the rest of the parts, they use their own packaging material, i.e. packaging material which they buy from their own packaging material suppliers.

The reason why the parts suppliers receive packaging material free of charge originates from a decision where Tetra Pak wanted to locate more of the pre-packaging activities at the suppliers. Tetra Pak already pre-packaged some parts in-house, and had therefore to pay for the packaging material used to those parts, and it was practically no difference in cost to distribute the packaging material to the suppliers of those parts instead, provided that the suppliers performed the pre-packaging activities for free. Moreover, the cost of packaging material is not burdening the price of the part; instead it is accounted for under Cost of sales, a post that nonetheless decreases Tetra Pak's margin.[144]

When parts suppliers need packaging material they order it from Tetra Pak TS who submits an internal order for picking and then the packaging material is shipped to the parts suppliers in the same way as a normal shipment.[145] The Tetra Pak packaging material distributed via Lund DC only shall be used to Tetra Pak TS parts. It does however occur that some suppliers order packaging material from Lund in order to use it in deliveries to other Tetra Pak companies than Tetra Pak TS.[146]

Branded boxes

Tetra Pak had never discussed pre-packing in Tetra Pak branded boxes with the suppliers that we visited. The suppliers would generally not mind packing the parts in Tetra Pak branded packages, even though they mention that it might be an issue with the wider assortment of packaging material that they would need to store and the administration of it. They also mention that it is a matter of negotiation and prices if they were to pack more parts singularly as it requires extra handling. Some were also concerned if Tetra Pak was going to implement a standard range of sizes, that those boxes would not fit their products and that they therefore would have to ship more air.[147]

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[143] Business Objects (05/01/06)
[144] Ivarsson, M., former Manager CC and CQ, (25/10/06)
[145] Pettersson, Å., (2002) *Pre-packaging pre-study*, p.7
[146] Wåhlander, P., Sales coordinator, (04/01/06)
[147] Suppliers (12/10/05-21/10/05)

For the supplier of standard components we visited there were almost the same conditions as for the unique parts suppliers. A fact worth mentioning is that this supplier uses less packaging material to Tetra Pak than to its other customers. The company also has its own brand on all the packages that reach the end customer. Its suppliers buy the branded packaging material from packaging material suppliers. [148]

Other findings

During our supplier visits, we also understood that Tetra Pak has had a problem of living up to its forecasts. For the period of year 2005, the order intake of machines was in general lower than what was forecasted, a fact that affects the suppliers' capacity utilisation negatively. Moreover, another problem for the mechanical workshops in Sweden is that there is a lack of educated fitters to work in the production. The visits also showed that the workforce of the mechanical workshops has a high average age.[149]

5.3.4 Key findings Parts suppliers

The key findings concerning Parts suppliers are listed bellow:

- The suppliers produce small batches of unique products
- Especially the Swedish suppliers are very Tetra Pak dependent
- Different handling ways for parts and kits in spite of the fact that they belong to the same company
- Different agreements with the suppliers regarding packaging and supply of packaging material due to the fact that not all parts have pre-packaging demand
- The suppliers perform the packaging activities manually
- Packaging not included in the contracts
- Packaging material given to the suppliers free of charge

5.4 Packaging material suppliers

In this section we are going to present the empirical findings regarding the packaging material suppliers. The packaging material suppliers are defined as one of the system units, see Figure 15 below.

[148] Suppliers (12/10/05-21/10/05)
[149] Suppliers (12/10/05-21/10/05)

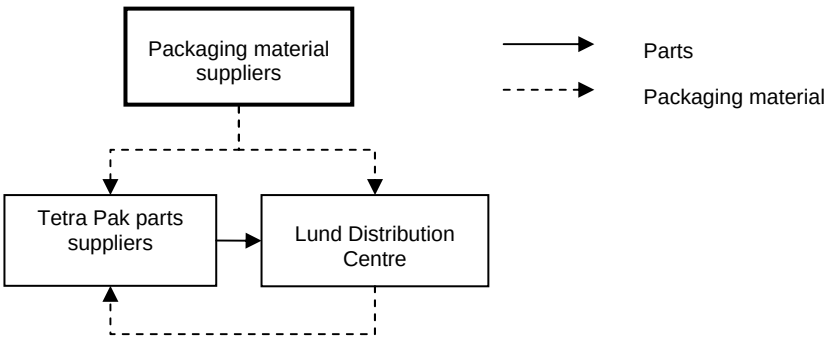

Figure 15: System unit Packaging material suppliers

Tetra Pak TS uses a number of different packaging material suppliers but normally it employs the concept of single sourcing, i.e. there is only one supplier for each type of packaging material.[150] In this report, we are primarily focusing on packages made of corrugated board. Consequently, we visited a corrugated board supplier to get an understanding of its relation to Tetra Pak TS, its working conditions and its preconditions for providing suitable packaging designs as well as providing competitive prices.

The packaging material supplier delivers the majority of the packaging material which is to be consumed by Tetra Pak TS or one of Tetra Pak TS's suppliers to the distribution centre in Lund.[151] From there, the packaging material is shipped to the parts suppliers needing it. The reason for this is that the price per package increases if the batches are too small, then it is considered better if Tetra Pak consolidates the orders with the purpose of achieving a more efficient production and hence lower price per package.[152]

The packaging material supplier representative explains that Tetra Pak Technical Service has approx. 90 active article numbers being delivered to Lund DC. These 90 boxes are used for approximately 2000 parts.[153] The cost for the transportation of the packaging material to Lund DC is included in the prices for the packaging material. The parts suppliers, who order packaging material directly from the packaging material supplier, are charged for the transportation separately.

The packaging material supplier does not keep any Tetra Pak material in stock, except for the export packages that are produced in considerably higher volumes, instead it produces when ordered.[154]

[150] Internal material from Wåhlander, P., Sales coordinator, (27/09/05)
[151] Packaging material supplier (09/11/05)
[152] Wåhlander, P., Sales coordinator, (27/09/05)
[153] Business Objects (13/01/16)
[154] Packaging material supplier (09/11/05)

5.4.1 Packaging design alternatives

The packaging material supplier presented a number of packaging solutions that could be used to package Tetra Pak parts. All of them except FEFCO 427 are used by Tetra Pak TS today.[155]

Slit box: The slit box is simple to raise but it requires tape in order to seal it, both on the upper and under side, see Figure 16.

Figure 16: Corrugated board box with slit

Multi box: The multi box is often constructed as a slit box but it has different folding possibilities so that the box can be used to parts with different sizes. The drawback of multi boxes is that they get unstable in the highest position. As the slit boxes, they need tape to seal the top and the bottom.

Cross cover box: The cross cover box has a whole bottom, and consequently it only needs to be taped from the upper side, see Figure 17.

Figure 17: Corrugated board box with cross cover

Speed bottom box: The speed bottom box is designed to facilitate handling. The bottom is pushed down, see Figure 18 and will therefore save handling time. In order to reach economy in production, the order quantity should be at least 20 000 pieces/batch.

Figure 18: Corrugated board box with speed bottom

[155] Packaging material supplier (04/01/06)

FEFCO 421: FEFCO 421 is a box with closable lid. It is one of the most common packaging solutions at Tetra Pak TS today. The box is folded so that tape only is necessary in order to close the lid, see Figure 19 below.

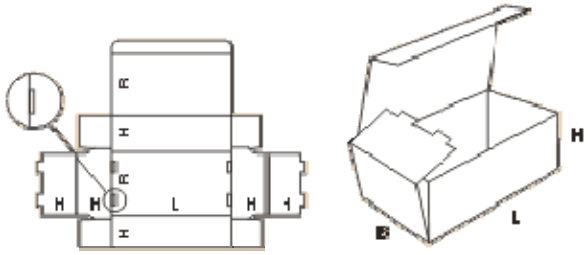

Figure 19: FEFCO 421; today's most common packaging solution used to package Tetra Pak parts

FEFCO 427: The FEFCO 427 design is not used today by Tetra Pak TS. The box is almost the same as FEFCO 421 except that it has flaps on the lid to lock it in place without using tape, see Figure 20.

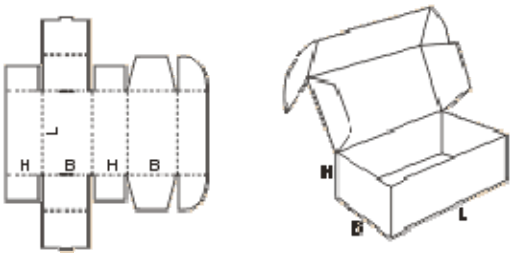

Figure 20: FEFCO 427, corrugated board box with locking mechanism

FEFCO 427 has the same handling time as FEFCO 421.[156] If Tetra Pak still wants to seal the box using adhesive tape in order to make sure that nobody has opened the packaging during the transportation from Lund DC, there is a suggestion to use the label as a sealing mechanism. This might require a bigger label though.[157]

The packaging material used in all these boxes is re-used corrugated board. The thickness of the material are between 1-4 mm were 2-3 mm is most common.[158]

It is important to stress that a package that does not need much packaging material is not necessarily environmental friendly, partly because a less complex package might need tape in order to hold together, partly because there might be more material waste in the production of the package if it is impossible to place the template on the sheet in an efficient manner.[159]

[156] Packaging material supplier (04/01/06)
[157] Wåhlander, P., Sales coordinator, (04/01/06)
[158] Packaging material supplier (04/01/06)
[159] Ibid

Inserts

In order to educe the number of boxes one possible option is to use inserts. Tetra Pak TS does not use any inserts today. An insert is a paper that fixes the part in a box that is too large to fit the product perfectly. To secure the product properly, the insert needs to have at least two centimetres extra margin around the product. Every insert is specific to one box size, and they also need their own punching tool. If inserts are used there are two parts to handle, i.e. the box and the insert, which can be a disadvantage.[160]

Colour and printing

The most common colours of corrugated board are white or brown. The box could be brown or white on both the sides or white on the outside and brown on the inside. There is also the possibility to get the inside of the boxes covered with foam rubber or other material to better protect the product. There is no difference in environmental friendliness between using white (bleached) or brown (un-bleached) corrugated board in the boxes thanks to the fact that the bleaching processes have developed a lot lately.[161]

There are two available printing techniques that can be used on corrugated board boxes: the first is to have one standard design that is used on all the packages, scaled by the size of the box, see Figure 21 below. This method demands a specific printing plate to all the different box sizes.

Figure 21: Export package with print

The other printing alternative is wallpaper print seen in Figure 22. This printing type has same printing plate whether or not it is the same box size.

[160] Packaging material supplier (04/01/06)
[161] Ibid

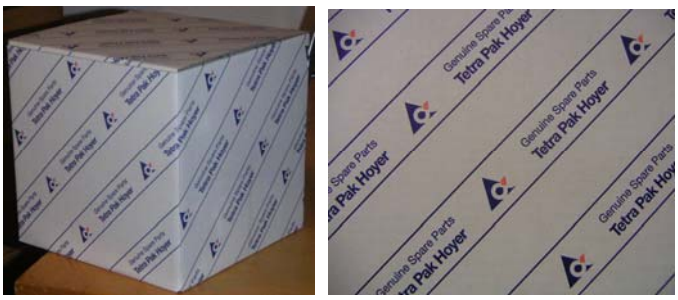

Figure 22: Wallpaper print

One can use one, two or four colours when printing. There is no big difference in cost between using one or two colours but four-colour printing is much more expensive. The colour of the corrugated box determines what colours that can be used when printing, red can for instance not be printed on brown corrugated board.[162]

According to the packaging material supplier wallpaper print is the only economical option for Tetra Pak TS since it has so many different sizes of packages.[163]

5.4.2 Tetra Pak instructions

The representative from the packaging material supplier expressed the opinion that Tetra Pak is behind in the usage of the most modern packaging solutions. Instead, Tetra Pak orders packages that were constructed in the early 1980's, a behaviour that is questionable from the packaging material supplier's point of view as the packaging technology has developed tremendously since then. Another aspect is that Tetra Pak developed those solutions themselves and did not employ the expertise of the packaging material supplier.[164]

5.4.3 Key findings Packaging material supplier

The key findings concerning Packaging material supplier are listed bellow:

- Tetra Pak has 90 active primary packages of corrugated board
- Tetra Pak uses old packaging models from the 80's
- No difference between bleached and non bleached paper in terms of environmental friendliness
- Wallpaper print is the most economical option

5.5 Lund Distribution Centre

In this section we are going to present the internal supply chain within Lund Distribution Centre. As described in section 5.2, Lund Distribution Centre is one of our system units, see Figure 23 below.

[162] Packaging material supplier (04/01/06)
[163] Ibid
[164] Ibid, (09/11/05)

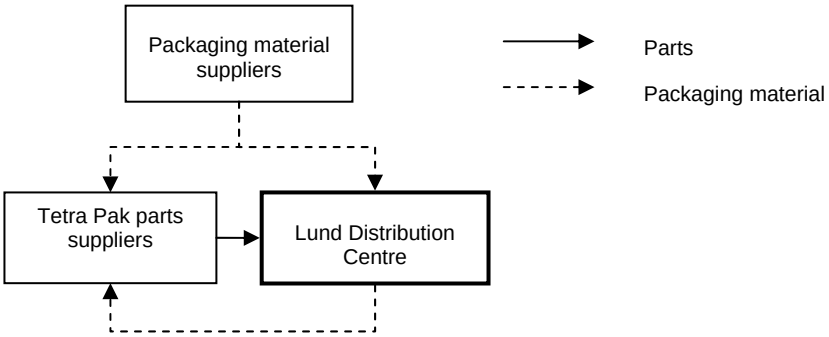

Figure 23: System unit Lund Distribution Centre

This system unit can in turn be divided into a number of subunits according to Figure 24 below. The sub units handling the physical flow of products are Goods receipt, Storing, Pick and pack, Consolidation, and Loading. Moreover, there is a shipping department handling the documentation regarding the outbound transportation. The subunits will be described in coming subsections where we first will present a short description of what activities being performed at each location. Thereafter, the implications on the packages and the packaging activities are presented for each subunit.

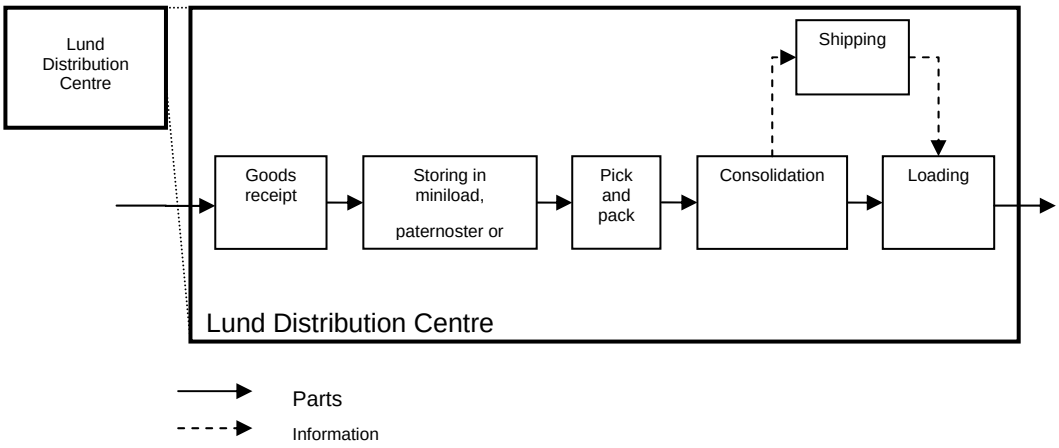

Figure 24: System unit Lund Distribution Centre and its sub units

5.5.1 Goods receipt

The Goods receipt department is responsible for the receiving and unpacking of the goods arriving from the parts suppliers and for entering them into the warehouse system. There is a wide range of goods arriving to Goods receipt, and they are classified as large goods, dangerous goods or normal goods[165]. It often occurs that the goods arrive bulked, i.e. not pre-packaged good enough to pass right through the storage and to the end consumer without being primary packaged somewhere in the

[165] Björk, R., Goods receipt manager, (18/01/06)

internal chain.[166,167] This does however not imply that the goods arrive damaged, since they are normally packaged good enough to withstand the transportation strains they risk being exposed to during the transportation from the supplier to the distribution centre in Lund. In other words, the quality of the incoming parts usually meets the pre-defined standards stated in the contracts[168] even though the majority of the unique parts are not singularly packaged[169]. It is stated in the contracts that the supplier shall package the parts in such a way that they can withstand the strains they might be exposed to during the transportation to the DC in Lund[170,171]. In those cases where parts arrive damaged, they are sent back to the suppliers[172].

In the past, the storage was organised with stationary storage locations, a fact that facilitated the discovery of supplier packaging errors as those who packed up the goods and entered it in the storage could compare the incoming goods and their packages to the goods that was already stored at that specific location.[173]

In the case where the co-workers at Goods receipt pack the parts they order the packaging material as if it was a normal order which means that it will have to be fetched at Pick and pack. In other words, the packaging material is stored within the warehouse system and not in connection to the pack stations at Goods receipt. It happens that some packaging material are kept at Goods receipt due to the fact that the co-workers sometimes fetch a few more boxes than necessary which means that there is a buffer storage at Goods receipt.[174] A picture of a working station at Goods receipt with buffer storage of packaging material can be seen in Figure 25.

Figure 25: Working station Goods receipt

[166] Björk, R., Goods receipt manager, Andersson, K., Goods receipt, (21/11/05)
[167] Johansson, J., Production support, (22/11/05)
[168] Sahlström, L., Quality investigation, (11/10/05)
[169] Björk, R., Goods receipt manager, Andersson, K., Goods receipt, (21/11/05)
[170] Simonsson, P., Supplier manager, (03/10/05)
[171] Tetra Pak suppliers (12/10/05-11/11/05)
[172] Björk, R., Goods receipt manager, (21/11/05)
[173] Sahlström, L., Quality investigation, (11/10/05)
[174] Björk, R., Goods receipt manager, (21/11/05)

The Goods receipt manager estimates that the personnel at his department pre-packages about ten purchasing order lines per day. The goal defined from warehouse management is that Goods receipt shall enter totally 585 order lines into the storage per day.[175] In other words, Goods receipt pre-packages about 2 % of the daily order lines.

This pre-packaging of parts in corrugated board boxes is performed manually. The personnel at Goods receipt receive information if a part should be pre-packed before entering the WCS (Warehouse Control System), but they cannot directly see whether it is the supplier or themselves who should perform the pre-packaging activities. Hence, if a part with a pre-packaging instruction arrives unpackaged, it is always packaged at Goods receipt since it would take too much time for the Goods receipt personnel to investigate whether the supplier did not live up to the pre-packaging agreement. Sometimes, the Goods receipt personnel express a wish to the pre-packaging responsible that a certain part should be pre-packaged by the supplier instead. In those cases, the pre-packaging responsible discovers whether it was the supplier who should have performed the pre-packaging from the start. [176]

Out of the ten purchasing order lines being pre-packaged at Goods receipt, about five have pre-packaging instructions in SAP/R3 and the remaining five are pre-packaged anyway since the personnel judge it necessary in order to secure that the parts arrive safely to the picking stations.[177] The personnel can only manage to pre-pack those parts that have pre-packaging instructions in SAP/R3 and those parts being absolutely necessary to pre-package since there is no time to pre-package everything they think should be pre-packaged. Hence, approx. 575 out of 585 order lines enter the storage without being pre-packaged by Goods receipt.

A picture of the pre-packaging department can be seen in Figure 26 below.

Figure 26: Pre-packaging department

The Goods receipt manager roughly estimates that the personnel at Goods receipt altogether devote approximately 30 hours a week to pre-packaging activities.[178]

[175] Björk, R., Goods receipt manager, (30/11/05)
[176] Ibid, (10/11/06)
[177] Ibid, (30/11/05)
[178] Björk, R., Goods receipt manager, (30/11/05)

During 1995-2001, there were more goods being pre-packaged at Goods receipt and the pre-packaging activities were included in the daily work there. The warehouse manager at the time wanted the goods to arrive pre-packaged from the suppliers since the lead time from when the goods arrived until it was available to sell was critical. There was however not a separate pre-packaging department but the personnel pre-packaged when they had the time. The warehouse manager did however experience that it was difficult to persuade the suppliers to perform a larger part of the pre-packaging activities. Moreover, such activities were not prioritised by the purchasing department. The warehouse manager mentioned that this lack of interest might have originated from Tetra Pak's lack in focusing on the parts; something he believes has changed to the better over the last years.[179]

5.5.2 Key findings Goods receipt

The key findings concerning Goods receipt are listed bellow:

- No time to package everything the co-workers think should be packaged
- In most cases there are no pre-packaging instructions
- Not possible to compare the packaging quality between deliveries due to the floating inventory locations
- All packaging in corrugated board boxes performed manually

5.5.3 Storage

When the normal goods, i.e. all goods except dangerous goods and large goods, have been loaded into plastic trays by the personnel at Goods receipt, they enter the storage through a conveyor belt, see Figure 27.

Figure 27: Trays on the conveyor belt

The normal goods can either be stored in the miniload system, in the paternoster system or on pallets. The location is decided by the goods' size and frequency[180]. A picture of the paternoster system can be seen in Figure 28 below. The paternoster is a computer controlled storage system adapted for many and small parts. The paternoster moves the parts vertically and delivers the wanted parts to a picking

[179] Mile, J., former Store operations manager, (21/12/05)
[180] Sahlström, L., Quality investigation, (11/10/05)

station. [181] The paternoster is loaded with smaller boxes than the miniload section and is therefore used for small goods such as screws and mutters. It is also slower than the miniload which is why it should be used for low frequent goods.

Figure 28: Paternoster

The miniload section is generally used for high-frequent normal goods since it is much faster than the paternoster.[182] Heavy goods are stored on pallets that are accessible through the usage of two fork-lift trucks. The majority of the goods are however stored in the miniload system. The miniload system is a highly automated application that is set up with floating inventory locations and has room for approx. 33 000 plastic trays.[183] The trays have the dimensions 565x365x145 mm or 565x365x245 mm.[184]

The miniload system and the conveyor belts have been operational since 2001 and were big investments for Tetra Pak TS.[185] The combination of the miniload system and the conveyor belts is called WCS, Warehouse Control System.[186]

The miniload system has the consequence that the products are clashing into each other due to the high speed of the system and that the boxes not only move vertically but also horizontally[187], a fact that has created a need for a better package. Moreover, it occurs that the products fall out of their packages due to the increased amount of movements in the storage[188]. Moreover, a lot of parts get damaged during their journey on the conveyor belt, a fact that implies that also parts being stored in the paternoster system risk getting damaged on their way to their storing locations[189].

Another problem that has arisen after the introduction of the new system is that if parts are bulked in larger plastic bags, it happens that the bags protrude over the top of the trays and cause disturbances in the system. The problem arises after the picking

[181] Knudsen, D. (2002), *Litteratur för kursen materialhantering VT-02*, p.55
[182] Björk, R., Goods receipt manager, (051130)
[183] Johansson, J., Production support, (10/01/06)
[184] Björk, R., Goods receipt manager, (11/01/06)
[185] Berkström, D., Store operations manager, (13/09/05)
[186] Johansson, J., Production support, (10/01/06)
[187] Workshop (31/10/05)
[188] Sahlström, L., Quality investigation, (11/10/05)
[189] Björk, R., Goods receipt manager, (30/11/05)

stations if the personnel there are not careful to fold the bags with the remaining parts after having picked a certain quantity.[190]

Key findings Storage

There are new demands on the packaging after introducing the WCS:

- Parts fall out of their packages
- Parts clash into each other
- All parts risk being damaged due to the vibrations on the conveyor belt, not only those entering the high speed miniload section
- Bags protrude over the top of the trays which causes disturbances

5.5.4 Pick and pack

There are eleven picking/packing stations for picking of the normal goods, out of which nine are dedicated to pick parts from the miniload section and two from the paternoster section. It does however occur that the nine miniload stations receives picking orders from the paternoster section if a delivery activated on a particular picking station contains picks from the paternoster. Then the picker at the paternoster section picks the part from there, puts it in a package if necessary, and places it in a tray on the conveyor belt. Thereafter the tray continues to the miniload picking station using the conveyor belt. A schematic picture of the working operations at the miniload sections can be seen in Figure 29 below.

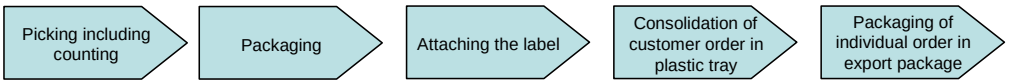

Figure 29: Working operations at the miniload stations

The pick and pack operations are triggered by customer orders coming either from the market companies, the other distribution centres or the end consumers. Some goods are directly delivered to the end consumers, some are delivered to the market companies where they are unpacked and stored to be used as buffer storages, and some to the distribution centres in Singapore and Dubai before delivered to the end consumers.

The co-workers pick the part that is indicated on a screen in front of them and the trays with the parts arrive automatically on the conveyor belt.[191] A picking station can be seen in Figure 30.

[190] Workshop (31/10/05)
[191] Johansson, J., Production support, (17/01/06)

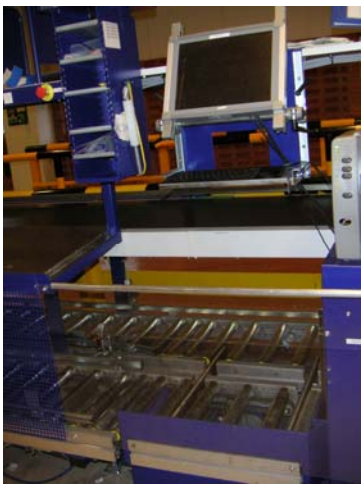

Figure 30: Picking station

When the tray arrives to the picking station, a barcode that is placed on the outside of the plastic tray is automatically scanned by a scanner placed under the picking table. The scanning triggers the printing of a label that is to be put on the part's primary package. There is one label for each order line which means that if one order line contains several parts, just one of the parts will be labelled and the remaining will not. On the screen there is information regarding what cell in the plastic tray to pick from and also how many parts to pick.[192] See Figure 31 for blue tray with cells.

Figure 31: Blue tray with cells seen from above at a picking station

For about 50 % of the order lines, the pickers need to put the part in a primary package in order to fasten the label. If a part arrives to the picking station packed in a net, the picker has to put the part in a plastic bag or a corrugated board box to be able to attach the label. Alternatively, the label can be attached using a string.[193]

There are no instructions saying if the picker shall use a plastic bag or a box made of corrugated board in order to package the parts. If the co-worker is to pick several pieces of one product, he/she normally puts them in a plastic bag and attaches the

[192] Popova Lundberg, S., Stocktaking, (26/10/05)
[193] Johansson, J., Production support, (15/12/05)

label. Therefore, it is not a label per part, but a label per picking order line, which means that if an order line for instance contains three parts, there is still only one label. In connection to the picking stations, there are buffer storages of packaging material, mainly plastic bags and approx. 10 sizes of corrugated board boxes, the so-called export packages, see Figure 32.

Figure 32: Buffer storage of export packages

A problem concerning pre-packaging is that 68 % of the picks are so called counting picks, i.e. the picker picks more than one product.[194] Over the years there have been discussions regarding how the amount of counting picks can be decreased. One way of solving this is through the usage of multiple quantities for some parts. Hence, those parts can only be ordered in fixed, multiple quantities. If so, the parts could be packaged in such quantities already when arriving from the supplier or from Goods receipt thus decreasing the workload significantly at Pick and pack. Moreover, the amount of discrepancies due to miscalculations, that represent a large share of the number of discrepancies, could also be decreased.[195]

After having fastened the label, the picker puts the part in another type of plastic tray where it waits for the next part in that customer order to arrive.[196] The second tray works thus as an assembly station for the individual orders, see Figure 33.

Figure 33: Plastic tray, order assembly station

The picking orders appear on the screen sequentially which means that the pickers never know what is to be put next in the tray. There is nothing hindering the situation

[194] Berkström, D., Store operations manager, (12/12/05)
[195] Ibid, (13/09/05)
[196] Employee at Pick and pack (30/11/05)

where a light detail is placed under a heavier.[197] Some co-workers express however the opinion that the personnel at the picking stations by themselves should be able to understand the risk of placing a light detail under a heavier.[198]

When the entire order is assembled in the second tray, the picker packs the order into an export package which is a corrugated board box, marked with the Tetra Pak logotype, see Figure 34.

Figure 34: Export package containing a part of a delivery

Several co-workers express that the pickers are under a lot of stress, particularly in the afternoons when the direct delivery shipments are picked.[199] Moreover, since Tetra Pak TS has such a short lead time to its customers, almost no orders are pre-planned which makes it hard to dimension the capacity in the warehouse as management know little of the workload in advance.[200]

5.5.5 Key findings Pick and pack

The key findings concerning Pick and pack are listed bellow:

- Double handling of parts, e.g. parts already pre-packaged in nets need to be packaged in a plastic bag or corrugated board box.
- The system does not take the fragility of the products into account which means that a fragile part can be packed under a heavier part thus arriving crushed or damaged to the customer.

5.5.6 Consolidation

In the consolidation department, the individual orders coming from the picking department are assembled to larger shipments. Here, Tetra Pak uses plywood boxes that comply with restrictions regarding heat-treated wood.[201]

[197] Svensson, A-K., Quality investigation, (06/12/05), Sander, L., Warehouse manager, Tetra Pak Hoyer, (03/11/05)
[198] Samberg, P., Svensson, A-K., Quality investigation, (06/12/05)
[199] Johansson, J., Production support, (22/11/05)
[200] Månsson, J., Project manager, (16/11/05)
[201] Berkström J., Pick and pack, (16/12/05)

5.5.7 Shipping

The shipping department handles the shipping to the individual TS customer. The department is responsible for the production of documents needed to comply with customs requirements, requirements that differ depending on country of destination and the type of customer. The shipping department enters the chain of activities when the personnel receive a shipping instruction. The instruction is printed automatically when a packer from the consolidation department has entered information into the system that the goods are ready to be loaded.[202]

Global Transport and Travel (GT&T) handles the global transport purchasing. Shipping uses the contracts that GT&T has developed with the carriers and the forwarding agents. The shipping department is relatively free to decide on the best transport solutions using the different contracts that GT&T provides with the carriers, for instance it is the shipping department that knows if it is for example price or delivery time that is the most important factor to a particular customer.[203] However, it is up to the customer, i.e. market companies, distribution centres or dairy to decide what type of delivery he/she wants using the different kinds of transportation modes that Tetra Pak has contracted on a particular distance.[204]

5.5.8 Loading

When the proper documentation is issued by the shipping personnel, the loading personnel match the documentation with the packages that was previously prepared for transportation by the pickers and consolidation personnel.[205]

5.6 Packaging responsibilities throughout the internal supply chain

The responsibility for the packaging activities is spread across the Tetra Pak organisation. The packages used for pre-packaging are handled by the Quality investigation group within Tetra Pak TS and the export packages are handled by a co-worker from Production support, also within Tetra Pak TS. Moreover, the commercial responsibility for the packaging material suppliers of corrugated board and plastic bags is located under a supplier manager from Tetra Pak Carton Ambient, i.e. another Tetra Pak company than Tetra Pak TS.

Despite the presumably clear split of responsibilities between the pre-packaging responsible and the export packaging responsible, it has occurred that the export packaging responsible has been involved in pre-packaging projects initiated by co-workers at Goods receipt.[206]

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[202] Lundgren, G., Shipping, (16/12/05)
[203] Malm, K., Transport purchaser, (12/12/05)
[204] Gyllander, M., Shipping manager, (14/12/05)
[205] Lundgren, G., Shipping, (16/12/05)
[206] Johansson, J., Production support, (22/11/05)

5.6.1 Pre-packaging

A Quality investigation group is from December 2005 dealing with pre-packaging issues. The manager of the group has appointed two persons who will be responsible for trouble-shooting regarding pre-packaging activities. These two co-workers will receive complaints regarding the pre-packaging and shall thereafter send them forward to the one responsible. The responsible might for instance be a supplier manager for a supplier who did not deliver according to pre-packaging requirements.[207] The two responsible will also handle the administration of supplying the parts suppliers with pre-packaging material.[208]

Earlier, before the introduction of the Quality investigation group, there was one person who had the operational responsibility for the pre-packaging activities. This was however not a fulltime responsibility, but took some 10 % of his working time. He was responsible for updating SAP/R3 with pre-packaging instructions, so that such are included in the orders to the parts suppliers when pre-packaging is agreed upon.[209]

Due to the fact that pre-packaging is not included in the contracts, the need of pre-packaging is often not discovered until the supplier starts delivering the particular part. Then the pre-packaging responsible must 'negotiate' with the suppliers once again and try to persuade them to pre-package the parts. The suppliers normally ask why this matter was not mentioned before they signed the contract. It is however not a negotiation in its strictest definition since there is already a contract when the pre-packaging responsible comes into the picture. Rather it is a way of making things work in practice. The pre-packaging responsible does not have the authority to negotiate with the suppliers, only the supplier managers do.[210]

Ordering of packaging material

The packaging material used for pre-packaging is ordered by a co-worker at the Procurement department. Tetra Pak TS uses an automatic ordering system, Syncron, and the size of the order is based on forecasts. However, when packaging material is used internally, the forecasts are not updated, which implies that those are not correct. The inventory balance is updated when there is internal consumption of packaging material, but the forecasts are not. As a consequence, packaging material being used only in-house and not at the suppliers is sometimes scrapped as the personnel responsible for the scrapping do not notice that the packaging material has been consumed in-house; they believe that it has not moved for a long time due to the fact that the forecasts have not been updated. If this is discovered too late it is impossible for the Goods receipt personnel to get the packaging material in time since the lead time from the packaging material supplier is about three weeks. Therefore, the Goods receipt personnel cannot pre-package some parts in the right corrugated board boxes.

[207] Nordgren, L., Quality investigation manager, (30/11/05)
[208] Svensson, A-K., Quality investigation, (18/01/06)
[209] Wåhlander, P., Sales coordinator, (27/09/05)
[210] Ibid

Due to this system error, it has even occurred that packaging material being bought one week was scrapped the next.[211]

In the past, before the introduction of Syncron, the internal consumption of packaging material did not trigger the forecasts either and consequently the procurement personnel had to order the packaging material manually. The former system was easier to overlook though and it was designed to be handled manually. The purpose of Syncron is however to automate the ordering as much as possible.[212]

5.6.2 Export packaging

The export packaging responsibility includes the export packages, i.e. the packages used at Pick and pack, and Consolidation.[213]

5.6.3 Supplier management

Supplier management's main responsibility is to serve Tetra Pak's business areas (Tetra Pak Carton Ambient, Tetra Pak Processing, and Tetra Pak Carton Chilled) with components. There are two supplier management functions and the responsibility is split according to which business they are to serve. The supplier management at Carton Ambient handles the supply of components to Carton Ambient and Carton Chilled, and the one within Processing handles the supply to Processing accordingly.[214] The supplier management function has the commercial responsibility, including contracts, for the suppliers contracted by that particular business area. In other words, there are two separate supplier management departments handling the purchasing to their business area respectively.[215]

Normally, there is no difference in the supplier contracts depending on whether the components are going to be used in production or distributed as parts. Instead, the supplier management departments negotiate about a price that can be used by all Tetra Pak companies, including Tetra Pak system supplier, that need the part.[216] Sometimes, the system suppliers are not interested in receiving the parts pre-packaged as it requires extra work to unpack the parts[217]. Today, it is not stated explicitly in the contracts how the suppliers shall pack the parts. Supplier managers express that it should be possible to include the packaging requirements in the contracts, but that it might require two contracts and two pricelists, one for the components that are to be used in production and one for the parts. Supplier managers at Carton Ambient mean that two pricelists would increase their administrative workload. Moreover, they are

[211] Månsson, L., Procurement, (17/01/06)
[212] Ibid
[213] Johansson, J., Production support , (22/11/05)
[214] Nilsson, S. G., Supplier management, (19/12/05)
[215] Ibid
[216] Simonsson, P., Supplier manager, (03/10/05)
[217] Supplier (17/10/05)

of the opinion that TS should pay for that extra workload if TS wants to introduce double contracts and double pricelists.[218]

Up till one year ago, there was a supplier management function that was located within Tetra Pak Technical Service.[219] The reason for the movement of it to Carton Ambient was that there was a general wish to centralise purchasing activities. In the past, those activities were widespread throughout the organisation, a manner of working that was regarded ineffective.[220] Moreover, the movement has also implied that the supplier management's focus has become more global which in turn means that the supplier managers are not focusing as much on Technical Service as they used to do since they now do not have the time.[221]

The technical responsibility of the components is normally handled by product managers. They develop all the necessary information that the supplier managers need in order to pick a supplier. There is no product manager for packaging material used to package Tetra Pak parts.[222]

The supplier management at Carton Ambient has the commercial responsibility for the suppliers of packaging material used to package Tetra Pak parts. There are ideas of moving the responsibility to either Business Support[223], who already is responsible for another large packaging material supplier, or to Technical Service who is the main user of the material.[224]

Since the supplier managers at Carton Ambient do not know whether they are going to keep the responsibility of these suppliers, they are at the moment not putting a great effort into the management of them[225]. The motive to move these suppliers is that the management of them lies outside the supplier management's core responsibility, namely to settle agreements on the *components* used in the machines sold by Tetra Pak.[226]

With some suppliers of packaging material to Tetra Pak parts, Tetra Pak does not have a contract, which means that the supply relies on mutual agreements[227] and pricelists[228]. For instance, there is a supplier who would like to have a contract as to be safer with volumes and being able to trust that Tetra Pak is committed to the

[218] Simonsson, P., Supplier manager, (03/10/05)
[219] Nilsson, S. G., Supplier management, (10/01/06)
[220] Widestadh, S., Procurement manager, (13/09/05)
[221] André, L., Supplier manager, (11/01/06)
[222] Nilsson, S. G., Supplier management, (19/12/05)
[223] Business support is a Tetra Pak company that specialises in assisting Tetra Pak co-workers in a wide range of matters lying outside their core competence, such as car rental, purchasing of office supplies, and the administration of salaries (Tetra Pak's internal webpage)
[224] André, L., Supplier manager, (05/10/05)
[225] Ibid
[226] Nilsson, S. G., Supplier management, (11/01/06)
[227] Johansson, J., Production support, (22/11/05)
[228] André, L., Supplier manager, (05/10/05)

relationship. The responsible supplier manager has however experienced that every time an eventual contract is brought up to discussion, this particular supplier want to increase the prices. As a consequence, the negotiations have always stranded which means that there is no contract.[229]

In SAP/R3 it is documented whether a specific part needs to be pre-packaged, if it has a pre-packaging *demand*. Since not all parts have such a demand, there are only pre-packaging *agreements* with some parts suppliers. If a part has a pre-packaging demand but if there is no pre-packaging agreement with the supplier producing the particular part, the part is packaged at Goods receipt as described in section 5.5.1. When the supplier managers want to switch suppliers of parts with a pre-packaging demand, they need to change a parameter in SAP/R3 manually, namely the one telling if there is a pre-packaging agreement with this particular supplier. If they do not, or if there is no such agreement, parts that used to arrive pre-packaged will arrive unpackaged since the information regarding the pre-packaging demand is not accompanying the order being sent to the supplier.[230]

There is a general opinion within TS that the supplier managers are measured mostly on price.[231] It has occurred that suppliers who were known to deliver goods with a high quality were kicked out because they were considered too expensive and were thereafter taken back as the new ones could not live up to the delivery requirements. This is however not a new problem, but occurred also in the past when the supplier management was located within TS.[232]

5.6.4 Key findings Packaging responsibilities

The key findings concerning Packaging responsibilities are listed bellow:

- Lack of interest and priority from supplier managers regarding pre-packaging
- There is a general opinion within TS that the supplier managers are measured on price, not on quality
- No contracts with packaging material suppliers
- Possible solution: two pricelists, one with pre-packaging specification to TS and one without to system suppliers

5.7 Other packaging projects

In the following sections, other projects concerning parts packaging relevant to our objectives are briefly presented.

[229] André, L., Supplier manager, (05/10/05)
[230] Simonsson, P., Supplier manager, (03/10/05)
[231] Nordgren, L., Quality investigation manager, (04/10/05), Ivarsson, M., former Manager CC and QC, (25/10/05), Sahlström, L., Quality investigation, (11/10/05)
[232] Ivarsson, M., former Manager CC and QC, (25/10/05)

5.7.1 Modular packages

There is an on-going project where Jonas Johansson, export packaging responsible, in cooperation with a packaging material supplier have developed five new modular boxes that are planned to replace 7-8 of today's export packages[233]. The project was initiated as a panic measure since the consumption of tape had increased significantly and Johansson also thought it was time to do something about the handling efficiency which was very poor using the previous packages[234].

The measurements of the boxes originate from the measurements of the EUR-pallet and the boxes shall be possible to nest into each other.

The new boxes are developed to minimize the packing time, to decrease repetitive strain injuries and decrease the usage of tape. Furthermore, the objective is to decrease the amount of transported air. Thanks to the fact that there are now fewer variants of packages, the volumes increases which will decrease the price per package.[235] Johansson did not calculate the volumes, but informed the supplier that Tetra Pak was going to change the packages and that the supplier could count on the same volumes as the replaced packages. [236]

Johansson specified the measurements of the boxes and how much weight the boxes were supposed to stand and the above mentioned requirements to the packaging material supplier, who developed a packaging solution according to these requirements. The supplier already had a standard package, but adapted it a little to suit Tetra Pak's requirements.[237]

Tetra Pak TS did not commit to pay any of the packaging supplier's costs for packaging development, the only thing TS has agreed to pay is the cost for tools that were needed to produce the package samples, which is a single payment that will not affect the price per package.[238] The packaging material supplier was informed that Tetra Pak wanted to change today's assortment of export packages. The supplier did what was asked for with no further obligations from Tetra Pak's side as the supplier is aware of the fierce competition within the corrugated board industry.

Johansson carried out this project with no intervention from the supplier managers. He agreed with the supplier manager who was responsible at the time that she would do the pricing negotiation when the time was ready. The supplier manager has however left this position and the price negotiation has not yet taken place. Until the negotiation has taken place, the supply relies on an oral agreement regarding the prices between Jonas Johansson and the corrugated board supplier.

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[233] Johansson, J., Production support, (22/11/05)
[234] Ibid, (07/12/05)
[235] Ibid, (22/11/05)
[236] Ibid, (07/12/05)
[237] Ibid, (07/12/05)
[238] Ibid, (06/12/05)

5.7.2 Former pre-packaging project

In the pre-packaging project conducted by Åke Pettersson 2002, it was recommended that the parts suppliers should use their own packaging material to package Tetra Pak parts.[239] According to the report, it will be relatively easy to standardise the packages although not too much since a lot of standardisation already has taken place.[240]

Previous recommendations

The pre-packaging project conducted during 2002 came up with the recommendation to establish a position, a so called pre-packaging officer/manager, who would be responsible for all activities and issues regarding the pre-packaging, including exerting an influence on suppliers to improve their packaging. This should be done through collecting knowledge, experience, and complaints from the floor and hereafter contact the supplier to work the issues out. However, after the introduction of the quality investigation group, the introduction of a pre-packaging manager position is no longer of immediate importance.

A selection of other recommendations produced in this project is presented below[241]:

- All parts which today are documented to be pre-packaged have to be gone through and documented with reason for pre-packaging; *this has not been done.*
- Goods receipt will always check that goods ordered to be pre-packaged are packed in a correct way; this is not done due to the fact that the Goods receipt personnel do not have immediate access to information telling whether the goods shall be pre-packaging at the suppliers or at Goods receipt. They can only see whether the part is supposed to be pre-packaged.
- Goods receipt will document all goods received that are being pre-packaged by Goods receipt. This information will be compelled by the person responsible for the packaging activities; *this has not been done.*
- Supplier managers will, when suitable from economic point of view, outsource all pre-packaging activities to the parts suppliers; *this has not been done*.
- Supplier managers will properly document all pre-packaging details that have been agreed upon with the parts suppliers; *this has not been done.*
- Guiding principles regarding outsourcing/insourcing of pre-packaging activities have to be established; *there are no such guidelines.*
- When pre-packaging is supposed to be performed by the supplier, information about these details has to be included in the purchase order.
- Standardisation of packaging material has to be seen as an on-going activity and based on gradually changed consumption pattern of Tetra Pak packaging material, it will be possible to decrease the range of packaging material.

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[239] Pettersson, Å. (2002), *Pre-packaging pre-study,* p.3
[240] Ibid, p.6
[241] Pettersson, Å., Wåhlander, P. (2002), *Pre-packaging,* p.19

- Software has to be modified to make it possible to have pre-packaging information transferred properly when a part is moved from one supplier to another; *the problem still exists.*
- The pre-packaging aspects has to be considered when new parts are added to the product range and first purchase has to include the need for pre-packaging when this is relevant ; *this has not been done.*
- Input regarding claims and damages during transport that are seen as emanating from inadequate pre-packaging will have to be dealt with by the person responsible for pre-packaging; *there is no such person.*
- The matter of increased use of Tetra Pak logo on packages/products is proposed to be dealt with in a separate project; *our project.*

5.7.3 Key findings previous packaging projects

The key findings concerning previous projects are listed bellow:

- The majority of the recommendations have not been realised and the problems they were aiming to solve are still present.

5.8 Product responsibility

Since Tetra Pak particularly asked for an investigation regarding whether the product responsibility and the liability to damages are affected if Tetra Pak should decide to repack parts at the storage in Lund, information regarding the product responsibility law is therefore included.

In the Swedish judicial system, the product responsibility is controlled by the product responsibility law. If a person or property gets injured due to the fact that a purchased product in some way does not live up to agreed standards, the injured party can sue either party that has been in contact with the particular product. The product responsibility law is joint and several, which means that the actors in a supply chain (seller, producer, marketer, carrier etc.) together share the product responsibility. Moreover, the law is imperative which means that the selling parts are responsible for injuries caused by the product even if they have not acted carelessly. It is probable that the injured party sues the richest party and the sued part can very well be liable to damages without having done something wrong. If the sued party so to say is innocent, he has to settle this with for instance the supplier, if it is possible to prove that the supplier caused the injury. If there are no contracts between these parties, they have to sue each other, a process that can take several years.[242,243]

The injured party has no obligations to investigate which part of the supply chain that caused the injury, but can sue anyone he/she knows has been in contact with the product. If a party receives a writ of summons, he/she has to settle this with the other

[242] Hellström, A., Tetra Pak Legal Affairs, (24/11/05)
[243] Ledendal, J., Doctoral candidate, Department of Business law, School of economics and management, Lund university (23/11/05)

parties throughout the supply chain.[244,245] Normally, Tetra Pak controls this in its contracts with the suppliers and lets them be completely responsible for injuries caused by a product they have manufactured up to a part of or multiple of his annual sales volume to Tetra Pak. The sum that the supplier guarantees to pay has to do with his confidence in his own quality system and the price Tetra Pak is charged to pay.[246]

According to Anders Hellström[247], the re-packaging has no relevant impact on the product responsibility as Tetra Pak has the same likelihood of getting sued anyway as the customers normally know that they have bought the parts from Tetra Pak. However, if the product has a lack of security due to the packaging or packaging activities, it is possible that the manufacturer of the part walks free if Tetra Pak has meddled with the package. [248]

5.9 Discrepancies

A discrepancy is an error originating from handling etc. throughout the supply chain. It has nothing to do with defects arising from manufacturing since such errors are classified as claims and the responsibility of those are located within the Business areas, i.e. Tetra Pak Carton and Tetra Pak Processing. The discrepancies arise after the products have entered the storage. Normally, errors on the products are not discovered by the pickers but by the customers and they return as discrepancies[249].The most common damages of the products are scratches etc. due to punches that for instance may occur if the products clash into each other within the miniload system.[250]

5.9.1 Key finding Discrepancies

The key finding concerning Discrepancies is listed bellow:

- The most common damages are scratches etc. due to punches in the warehouse handling system

5.10 Costs

The costs that are affected by the packaging material and the packaging activities can be grouped into three levels seen in Figure 35 below.

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[244] Hellström, A., Tetra Pak Legal Affairs, (24/11/05)
[245] Ledendal, J., Doctoral candidate, Department of Business law, School of economics and management, Lund university (23/11/05)
[246] Hellström, A., Tetra Pak Legal Affairs, (24/11/05)
[247] Ibid
[248] Ledendal, J. Doctoral candidate, Department of Business law, School of Economics and Management, Lund University (23/11/05)
[249] Sahlström, L., Quality investigation, (11/10/05)
[250] Ibid

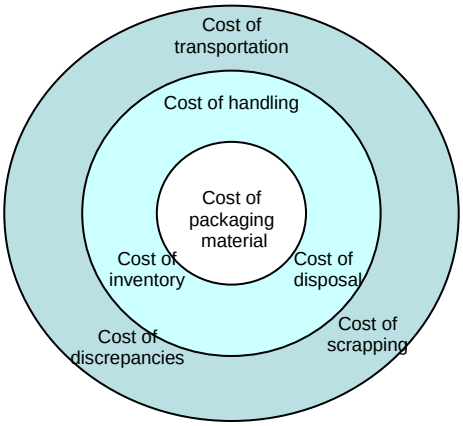

Figure 35: Costs and their mutual relationships

In the inner circle we have placed the direct packaging material cost. Thereafter we have placed costs that are directly depending on the choice of packaging material and packaging design, such as handling, cost of inventory and cost of disposal. The third group of cost are indirectly affected by the package, such as cost of transportation, discrepancies, and scrapping.

We will also present cost of investments that are interesting later during our analysis.

5.10.1 Cost of packaging material

Tetra Pak uses packaging material for three different purposes; the company uses it in-house for packaging activities, it sells packaging material to the parts suppliers, and it gives away pre-packaging material to suppliers, free of charge.[251]

The total consumption (sold, given away and used in-house) of pre-packaging material during 2004 was approx. 1.6 million SEK distributed as can be seen in Table 2 below.[252] Of the 90 000 corrugated board boxes, the suppliers used 83 000 and the storage in Lund used 7000.

[251] Wåhlander, P., Sales coordinator, (27/09/05), Johansson J., Production support (22/11/05)
[252] SAP R/3 and Business Objects (05/12/05)

Packaging material	Packaging material passing by Lund or used in Lund (pieces)	Cost (SEK)	Share (consumption)	Share (Cost)
Small corrugated board boxes	90 000	550 000	5,7%	53,8%
Tubes	14 000	8 000	0,86%	0,81%
Net (rolls)	300	40 000	0,02%	4,1%
Plastic bags	1 500 000	420 000	93,5%	41,3%
Sum	**1 604 300**	**1 018 000**	**100%**	**100%**

Table 2: Estimated total consumption of packaging material

From this table we can see that the average price for a corrugated box are 5.90 SEK/piece (550 000 SEK/92 000pcs).

During 2004 Tetra Pak gave away packaging material (except for lace) to suppliers for an approximate value of 600 000 SEK free of charge. [253]

Distribution of costs for corrugated board box manufacturing[254]

According to the packaging material supplier the cost of corrugated board material is based on square metre, in other words the buyer pays not only for the material used in the box, but for all material needed to produce a box. The cost drivers for manufacturing corrugated board boxes can be divided as in Table 3. This is however just an example on a specific size.

Batch size	Material cost (SEK/pc)	Adjustment and start up cost (SEK/pc)	Production (SEK/pc)	Total (SEK/pc)
100 pcs	2	8	0.5	10.5
500 pcs	2	2	0.5	4.5
1000 pcs	2	0.8	0.5	3.3
5000 pcs	2	0.2	0.5	2.7
10 000 pcs	2	0.1	0.5	2.6

Table 3: Example of cost distribution for manufacture of corrugated board boxes

[253] Summation of invoices coming from Wåhlander, P., Sales coordinator, (02/11/05)
[254] Packaging material supplier (12/01/05)

If the box is going to be marked with the Tetra Pak logotype there is also a cost for printing, see Table 4:

Batch size	Material cost (SEK/pc)	Adjustment and print of material cost (SEK/pc)	Adjustment and start up cost (SEK/pc)	Production cost (SEK/pc)	Total cost (SEK/pc)
100 pcs	2	5,5	8	0,5	16
500 pcs	2	1,5	2	0,5	6
1000 pcs	2	1	0,8	0,5	4,3
5000 pcs	2	0,6	0,2	0,5	3,3
10 000 pcs	2	0,5	0,1	0,5	3,1

Table 4: Example of cost distribution for manufacture of corrugated board boxes with printing

The packaging supplier bases the price on Tetra Pak's forecasts. The supplier still indicates that Tetra Pak's forecasts are not reliable but over the year the ups and downs seem to even themselves out.

Apart from the cost for the packaging material there is also a cost of investments in tools for punching and printing plates. A tool for punching costs about 3000 SEK, and a printing plate for two-colour printing costs about 10 000 SEK. For every box model there is a need for an individual punching tool. There is also a need for different printing plates, but those are related to the size of the sheet that is used. Based on today's number of sizes (90 sizes) the packaging material supplier roughly estimates that there is a need of 5-10 printing plates if wallpaper print is used.[255]

5.10.2 Cost of handling

By handling cost we mean the costs of raising, filling and closing the package.

The cost of handling arises everywhere in the supply chain where packaging activities takes place, i.e. at the suppliers, at Goods receipt and at pick and pick.

Internal

The salary cost for one employee is estimated to 400 000 SEK/year.[256]

5.10.3 Cost of inventory

All costs related to the inventory of packaging material to the parts, such as the cost of tied-up capital, cost of storage, cost of handling and handling equipment, insurance, stocktaking and scrapping are placed under this element.

[255] Packaging material supplier, (18/01/06)
[256] Berkström D., Store operations manager, (16/01/06)

This means that the cost of inventory includes the cost of warehousing as it is defined in the theoretical framework, see section 4.4.4.

The average inventory value during the week 20-53 year 2004 (this period of time was used because the software was installed at week 20, 2004, this does however not affect the cost because we use an average value) was 520 000 SEK divided as follows in Table 5:

Packaging material	**Average inventory value (SEK)**	**Share (of value)**
Small corrugated board boxes	280 000	54%
Tubes	31 000	6%
Net	18 000	3,5%
Plastic bags	190 000	36,5%
Sum	**520 000**	**100%**

Table 5: Average inventory value of various packaging material

According to the Parts supply operations manager, the cost of inventory and the cost of warehousing can roughly be estimated to 15 % of the average inventory value. [257] Then, the cost of inventory for the packaging material mentioned in the table above is 78 000 SEK/year totally.

5.10.4 Cost of disposal

The cost of disposal is calculated as the handling costs for waste material. The Goods receipt manager roughly estimates that his personnel altogether devote 8 hours/day for disposal of packaging material, i.e. one fulltime post.[258] The cost for disposal of packaging material in Lund can then be estimated as the annual salary cost for one employee, i.e. 400 000[259] SEK/year.

5.10.5 Cost of transportation

There are three main groups of transportation modes that Tetra Pak TS applies for the outbound transportation: air express, airfreight and road express.[260] Additionally, TS also sends some shipments with regular trucks. The conversion factors and the division factors for some modes of transports can be seen in Table 6:[261]

[257] Persson U. H., Parts Supply Lund operations manager, (20/12/05)
[258] Björk, R., Goods receipt manager, (21/12/05)
[259] Berkström, D., Store operations manager, (09/01/06)
[260] Gyllander, M., Shipping manager, (14/12/05), (22/12/05)
[261] Malm, K., Transport purchaser, (12/12/05)

Mode of transport	Conversion factor	Division factor
Air express	200 or 167 kg/m^3	5000 or 6000
Road express	250 or 167 kg/m^3	4000 or 6000
Airfreight	167 kg/m^3	6000
Regular truck	333 kg/m^3	3000

Table 6: Modes of transport and their conversion factors respectively

The conversion factor is used to determine whether a shipment shall be invoiced on volume weight or real weight. A conversion factor of 333 kg/m^3 means that the transportation cost of a package of 1 m^3 will be invoiced on real weight if the package weighs more than 333 kg; else it will be invoiced on volume weight.

The transportation costs are based on the weight or the volume weight. These are always to the forwarders advantage, which means that Tetra Pak pays for the highest weight, may it be volume weight or real weight. The volume weight can be calculated as follows:

$\frac{Length \times Width \times Height}{Divisionfactor}$, (Length, width and height are given in centimetres)

For instance, if you are going to transport a EUR-pallet by airfreight with the volume of $120 \times 80 \times 100$ cm^3, and the real weight 120 kg, the volume weight becomes:

$\frac{120 \times 80 \times 100}{6000}$ =160. Since 160 is bigger than 120, Tetra Pak would have to pay for the transportation of 160 kg, i.e. the volume weight.

The registration of the weights is done by Shipping personnel. There are two alternatives: either the freight cost is counted automatically and enters SAP/R3 or the shipping personnel calculate the weights manually and then enter the sum in SAP/R3. Today it is not possible to trace whether a shipment cost was based on real weight or volume weight as this is not registered in SAP/R3. As the transportation costs are built up in intervals, they will not be affected as long as no interval limit is crossed.

Since it is impossible to trace within SAP/R3 whether TS's transports were invoiced on weight or volume weight, we will below present figures from Alfa Laval's distribution centre just to get a feeling for the transportation costs. The figures were calculated 2001 as a part of a master thesis project. According to this paper, about 52 % of Alfa Laval's shipments on airfreight and express (conversion factor 167 kg/m^3)

were invoiced on real weight. When regular trucks were used (conversion factor 333 kg/m^3), about 23 % of the freights was invoiced on real weight.[262]

Inbound

About 80-90 % of the inbound transportation is performed using Tetra Pak's contracts and the majority of these transports are performed using regular truck, i.e. conversion factor 333 kg/m^3[263].

Outbound

Tetra Pak TS's outbound transportation cost is approx. 5 times the inbound cost[264]. For the outbound transportation, the distribution of transportation modes based on number of shipments during 2004, can be seen in Table 7 below.

Mode of transport	Share of shipments 2004	Comment
Air express	61 %	Mostly parcels
Airfreight	15 %	Larger shipments, e.g. pallets
Road express	13 %	
Regular truck	6 %	
Other	5 %	

Table 7: TS's mode of transport and their shares respectively. "Other" includes Tetra Pak's internal truck, boat, and train as well as shipments picked up by the customers.

5.10.6 Cost of discrepancies

The number of discrepancies directly deriving from poor packaging is approximately 1 percent of the total amount of discrepancies.[265].

However, if we instead measure the cost for discrepancies the cost deriving from poor packaging is 7 %.

5.10.7 Cost of scrapping

Tetra Pak TS scraps parts due to obsolescence, low turnover, and damage. There is however no statistics or possibility to see the reasons why a part is scrapped since all scrapped parts are collected under the same item in the account system.[266] Neither were there any personnel who could estimate the different factors' (obsolescence, low turnover, and damaged parts) shares of the total scrapping sum.

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[262] Lindahl, B., Wallette, J. (2002), *Emballagets ekonomiska betydelse i logistiksystemet – Alfa Lavals reservdelslager*, p.55f
[263] Widestadh, S., Procurement manager, (19/12/05)
[264] Gyllander, M., Shipping manager, (05/01/06)
[265] Svensson A-K., Quality investigation, discrepancy list (07/12/05)
[266] Nyberg, K., Administrator repurchasing, (22/12/05)

5.10.8 Cost of investments

A packaging table with shelves costs about 7000-8000 SEK.[267]

5.11 Concluding key findings

In this chapter we will collect the key findings identified in the previous sections and establish what we want to analyse further. We have collected the findings according to which aspect they affect and where they will be analysed later on: packaging logistics, organisation or supply chain management

5.11.1 Packaging logistics

Findings regarding packaging

There are new demands on the packaging after introducing the WCS:

- All parts risk being damaged due to the vibrations on the conveyor belt, not only those entering the high speed miniload section
- Parts fall out of their packages
- Parts clash into each other
- The system does not take the fragility of the parts into account which means that a fragile part can be packed under a heavier part thus arriving crushed or damaged to the customer if the package is not robust enough

Findings regarding logistics

- All packaging performed manually, both in-house and at the suppliers
- No time to package everything the co-workers think should be packaged
- Tetra Pak uses packaging models from the 80's
- Not possible to compare the packaging quality between deliveries due to the floating inventory locations
- In most cases there are no packaging instructions
- Bags protrude over the top of the trays thus causing disturbances in the system

Findings regarding environmental aspects

- No difference between bleached and non bleached paper in terms of cost or environmental influence

Findings regarding packaging design

- Tetra Pak has 90 active primary packages of corrugated board
- Packaging material that is not printed with the Tetra Pak logotype is given to suppliers free of charge
- Wallpaper print is the most economical option

[267] AJ Produkter's official webpage (18/01/06)

5.11.2 Findings regarding organisation

- There is a general opinion within TS that the supplier managers are measured on price, not on quality
- Lack of interest and priority from supplier managers regarding pre-packaging
- Possible solution: two pricelists, one with pre-packaging specification to TS and one without to system suppliers
- Failure to implement recommendations produced in previous projects

5.11.3 Findings regarding supply chain management

- Especially the Swedish suppliers are very depending on Tetra Pak
- Suppliers produce small batches of many products
- Kits are treated differently in terms of packaging instructions
- Different agreements with the suppliers regarding packaging material, for some it is free of charge, some need to pay for it. Some included in their prices
- No contracts with packaging material suppliers

6 Results from benchmarking studies

In this chapter, we are going to present information regarding Tetra Pak Hoyer, Volvo Cars, Sony Ericsson and their packaging activities. All these companies have chosen to brand their packages and we were curious about their motives to do that. We also wondered how they have organised the packaging practically.

6.1 Tetra Pak Hoyer

The information from Tetra Pak Hoyer was collected during one day's visit at the office in Aarhus, Denmark.

Tetra Pak Hoyer is a single-source manufacturer and supplier of complete solutions, equipment and consumables for processing and packaging ice cream.[268] The company has belonged to the Tetra Pak Group for 15 years. Hoyer became fully integrated into Tetra Pak five years ago and it was then decided to move Hoyer's parts distribution centre from Hoyer to the distribution centre in Lund. The transfer of the parts occurs simultaneously as this paper is being written.[269]

Before the relocation of parts, Hoyer had about 6700 parts in its storage and that is approximately 50 % of the assortment.[270]

For about three years ago Hoyer began a genuine parts project with the purpose of launching the Hoyer products in branded packages. The new packaging solutions were developed in cooperation with a packaging material supplier and the result became seven smaller white boxes and three brown larger boxes made of corrugated board, all marked with 'Tetra Pak Hoyer genuine spare parts', see Figure 36 below.[271]

Figure 36: Tetra Pak Hoyer's branded packaging solution

[268] Tetra Pak Hoyer's official webpage (05/12/05)
[269] Sander, L., Warehouse manager Tetra Pak Hoyer, (03/11/05)
[270] Ibid
[271] Ibid

Hoyer also developed plastic bags in different sizes, marked with the Tetra Pak Hoyer brand. The boxes and bags are not specified to a single part so the same box can be used to a wide range of parts. The approximated cost for the boxes is 5 DKK for the smaller and 15 DKK for the larger and more robust one.[272]

6.1.1 Motives to the branding decision[273]

Hoyer's motives for introducing the new packages were to create packages that looked professional, and provided better protection both in the internal and in the external handling. Moreover, the Hoyer co-workers felt a need to promote the brand and they wanted their products to look better on the shelf at the customers which might stimulate the sales. The Hoyer branded package lying on the customer's shelf constantly reminds the customer where he bought it, and Hoyer wanted the customers to think 'perhaps Hoyer also has what we are in need of right now'.

The packaging of the parts in Hoyer branded packages has until now been performed in-house. The decision to re-pack everything in-house, at Aarhus, was made without any thorough calculations. However, most of Hoyer's suppliers are small companies with three or four employees. Therefore, Hoyer presupposed that the suppliers would not be able to perform the packaging activities in the way that was required and Hoyer also thought that there would be economics of scale to gain if the packaging was performed in-house. At the warehouse in Aarhus there is one person handling the packaging of the parts.

The new packaging solutions are suitable for about 5 % of Hoyer's article numbers. The factors that were considered when Hoyer decided which parts to package in those packages were value, sensitivity, manageability, weight, and if the part is unique or a core product. One of the reasons for branding the packages was also to protect themselves from pirates and to create a value. Hoyer saw a risk that customers that were not satisfied with the parts from Hoyer, would use a pirate's parts next time.

6.1.2 Results[274]

The result of the change to Tetra Pak Hoyer branded package has not been analysed specifically. The market companies say however that the response from the customers has been positive and so is the feedback that their service technicians have received from customers. According to the market companies, the customers' perception of the new package is that it looks professional and that some customers show a higher acceptance of the price level. Hoyer did however not increase the price to the customers after implementing the new packages.

During the first year after the new packages were introduced, the sales increased by 40 %. This was however during the time as Hoyer was integrated into Tetra Pak, which makes it difficult to calculate how much of the sales increase that derived from

[272] Sander, L., Warehouse manager Tetra Pak Hoyer, (03/11/05)
[273] Ibid
[274] Ibid

the new package versus the integration. The general picture from the last five years is that the growth due to integration was little the first three years – and by that they assume the 40% growth is caused by the new packaging solution.

To sum up, Hoyer co-workers are of the opinion that the pay-back time was short since the sales increased, but then again they do not know if it was the package or the Tetra Pak integration that made it happen.

Today, the parts that Hoyer buys get delivered to different addresses depending on if they are going to be used in production or as spare parts. They also have different invoice addresses, and there are two different contracts.

6.1.3 After the movement of Hoyer's parts[275]

The warehouse manager estimates that today about 150 of Hoyer's parts needs to be singularly packaged, but after the movement of the distribution centre to Lund, he has identified approximately 1000 parts that need a better package. The increase derives from the fact that the warehouse manager is worried about what will happen to the Hoyer parts passing through Lund DC since he is of the opinion that the parts are exposed to a greater risk of being damaged.

After the takeover, the parts suppliers will have to perform the singular packaging. At our visit Hoyer did not know exactly how to persuade them, but thanks to the fact that the responsibility for the contracts is going to be kept at Hoyer, Hoyer will still have the possibility to include packaging issues into the contracts. The Hoyer co-workers are however expecting higher prices.

The supply of packaging material is another issue that has to be solved; it is likely that many of the suppliers are too small to order packaging material directly from the suppliers as they have minimum quantities.

6.2 Volvo Cars[276]

The input from Volvo Cars was collected during a telephone interview with a packaging specialist. The interview was followed up with e-mail based questions for clarifications and when further explanations were needed.

6.2.1 Number of packaging solutions

Volvo Cars has about 700 variants of packages to the parts, including corrugated board boxes and plastic bags in various sizes. In addition, there are so-called consumer packages which if counted increases the number more even if the package has the same measurements and is made of the same material. They are differentiated concerning printing, pictures and texts in different languages.

[275] Sander, L., Warehouse manager Tetra Pak Hoyer, (03/11/05)
[276] Svantesson, L-G., Packaging specialist Volvo Cars, (25/10/05)

Even though 700 packages might seem like a lot, Volvo can still achieve economies of scale as the volume of each part is so high.

6.2.2 Packaging in-house as opposed to packaging at suppliers'

The suppliers are treated separately depending on whether they deliver to Volvo Cars' production or to Volvo Cars' parts distribution. Moreover, these differences are regulated in the contracts. The parts are handled by a special company, called Volvo Cars Customer Service.

Volvo uses different packages depending on whether the parts are going to be used in production or distributed as spare parts. The question of whether to pack at the supplier's or in-house is addressed in every single case. Some suppliers think that the extra packaging required for to the spare parts causes too much extra work for them, and in some cases it might therefore be too expensive to force the supplier to perform the packaging. If it is judged to be the best from a commercial, logistical and environmental viewpoint, the packaging activities are performed at the supplier's. If not, the packaging activities of that particular part are performed at the plant in Torslanda.

In storage in Torslanda, there are approx. 120 000 unique article numbers of which approx. 80 000 are considered as active. The annual turnover is about 80 millions articles of which 50 % is being packaged at the supplier's and the rest at the plant in Torslanda.

6.2.3 Value of a branded package

Everything Volvo Cars sells is branded with the Volvo logotype, including standard components, which means that all packaging material is branded, at least the outer packages. Filling material, such as bubble plastics is however not branded. Volvo Cars sees several benefits from using a branded package, for instance within its line of business pirate business is quite common and the branded package sends a signal to the customer that the part is safe to buy. The pirate market has a large turn-over and Volvo needs to profile itself towards the pirate companies.

Moreover, Volvo Cars wants to profile itself as premium class. To mark all spare parts with Volvo Cars' logotype enables the possibility of increasing the end-consumer price as the brand in itself implies some guarantees, such as a certain quality which the customer must be prepared to pay for.

The Volvo representative did not know whether Volvo Cars has seen any effect in sales deriving from the branded package, but he says that compared to other car manufacturers that have decided to outsource the entire spare parts business, Volvo has a better business performance.

6.3 Sony Ericsson[277]

The benchmarking study with Sony Ericsson was conducted as an interview with a packaging specialist at the Sony Ericsson office in Lund, Sweden.

Sony Ericsson has employed packaging specialists that deals with the development of packages on a professional basis, a fact that enables them to perform most of the packaging development in-house. Sony Ericsson's packages for the mobile phones are usually made of corrugated board and they contain a fibre insert in order to make sure that the different accessories are fixed during transportation and handling. For the construction of the fibre inserts Sony Ericsson uses external consultants coming from a firm with which Sony Ericsson has had a long-term relationship.

Since the size of the Sony Ericsson's products vary relatively little, Sony Ericsson has a limited number of packages of corrugated board which can be used to the majority of the mobile phones.

6.3.1 Adjustment of packaging solutions

The development of a packaging to a mobile phone is done within the frames of the development project of that particular phone. There are normally no formal package specifications since the only thing changing from project to project is the shape of the insert. Instead, the constructors are given a free rain to develop the fibre insert as long as the insert fits into the packaging, and the telephone and its accessories have enough room. Normally, the constructors get the phone and the accessories sent to them when they are to develop a new insert. In other words, they adjust the fibre inserts according to the accessories and according to the box of corrugated board. Sony Ericsson does not order a new insert for each telephone if it already has one that suits the new phone. Time to market is essential to Sony Ericsson's success and the development time of a new insert is about ten weeks, which is considered quite a long time in this line of business.

6.3.2 Packaging activities

The manufacturing and the packaging of the mobile phones are usually performed in the same factory. Sony Ericsson has outsourced most of its production and packaging activities to low-cost countries such as China and Malaysia. This implies that Sony Ericsson does not see the need of implementing any automated packaging lines. Instead, everything is performed manually, even the sticking of the labels. In the past, when there was still manufacturing activities in Sweden, they had an automated raising machine. When Sony Ericsson developed the packaging solutions that they today still usually use, marketing, logistical and environmental aspects were taken into consideration.

The measurements of the packages originated from the measurements of the EUR-pallet in order to secure an effective logistical performance. The company also tries to avoid the use of plastics in order to comply with rules in the environmental area.

[277] Orremo, F., Packaging specialist, Sony Ericsson, (30/11/05)

When designing the packages, the handling aspect was considered and through that they got a package with rational raising abilities. How easy it is to fill depends on the packaging instruction and the design of the insert.

6.3.3 The value of the packaging

Sony Ericsson hopes that the packages can work as a means to stimulate the sales, but that aspect is very difficult to measure and estimate. One thing can be said though; the packaging budget grows with the budget of the telephone project. In other words, if the price of the telephone is intended to be relatively high, there might be opportunities to develop a new catchy package. This has for instance been done with the development of the package to Sony Ericsson's first walkman phone. It is a plastic tube which was developed since the telephone project wanted to do something bold that would draw attention to the new product.

7 Analysis of Tetra Pak parts packaging logistics

This chapter gives the analysis of our empirical findings regarding Tetra Pak parts packaging and packaging logistics. As described in the methodology chapter, we are going to apply an inductive approach, i.e. we will use the empirical findings as our starting point. We will identify the parts we think should be primary packaged in corrugated board boxes and finally, we will present a packaging design proposal and the number of sizes needed to package the selected parts.

7.1 Outline

Chapter 7 – Analysis of Tetra Pak parts packaging logistics, deals with the two inner circles in Figure 37 below, see also section 4.1. First, we will present our packaging analysis and we will thereafter move on to logistics, branding and environmental aspects.

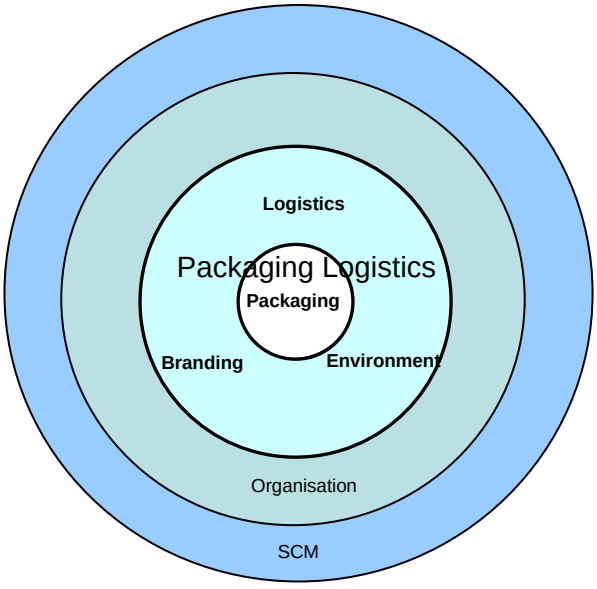

Figure 37: Chapter 7's connection to the theoretical framework

7.2 Packaging

In this section we will analyse the requirements being posed on a package made of corrugated board as well as the key findings regarding packaging that were listed in section 5.11.1:

- All parts risk being damaged due to the vibrations of the conveyor belt, not only those entering the miniload section

- Products fall out of their packages
- Products clash into each other
- The system does not take into account the fragility of the parts

7.2.1 Stresses

As described in the theoretical framework, see section 4.2.1, the package shall protect the product from climatic, biologic and mechanic stresses. It occurs that Tetra Pak parts are exposed to climatic stresses, for instance in the form of atmospheric humidity. Some Tetra Pak parts are especially sensitive against rust, and such parts needs an adapted package, for instance through the use of rust preventive paper. Other Tetra Pak parts are made of light sensitive rubber and therefore require a package that is not pervious to light.

Regarding the biologic stresses, Tetra Pak parts are not exposed to such to any larger extent. The majority of Tetra Pak's parts are produced of metal or plastic, materials that do not mould and are usually not affected by animals.

When considering the mechanic stresses, there are new demands on the packaging after introducing the miniload section and the conveyor belts, see section 5.5.3. The mechanic stresses and their origin will be treated separately depending on the location where they arise.

Conveyor belt

It occurs that parts fall out of their packages due to the vibrations on the conveyor belt. Therefore, there is a need of a package with a good sealing mechanism or that more adhesive tape is used in order to seal the packages. It is especially important to emphasise that all parts riding the conveyor belt risk being damaged, not only those entering the high speed miniload section since those with the destination of the paternoster, that moves smother, also use the conveyor belt in order to get to their storage locations.

Furthermore, the parts that enter the system un-packed risk getting dirty during the time they spend in the blue trays. Therefore, the parts need to be better packaged so that thoose with sensitive surfaces do not get damaged.

Miniload section

Regarding the miniload section, where the majority of the parts are stored, the package needs to withstand that parts clash into each other without getting damaged due to the high speed of the system and the fact that the trays move both vertically and horizontally. Alternatively, one could investigate the possibility of decreasing the speed of the miniload section in order to reduce the forces the parts are exposed to. However, we do not believe this to be a realistic alternative since time is emphasised as an important factor by several employees. If the speed is reduced, much of the aim and advantage with the system disappears. Therefore, there is a need of a robust package that withstands the mechanical strains. We are of the opinion that today's packages made of corrugated board can cope with these stresses, but the problem is that there are lots of parts that are not packaged in such boxes even though they need

it from a product protection point of view. We do however not know to what extent this occurs.

Pick and pack

Since the computer system at Pick and pack does not provide any information regarding the fragility of the parts, a fragile part can be packed in an export package under a heavier part thus arriving crushed or damaged to the customer if the primary package is not robust enough. In this case, the same goes as for the above mentioned issue, namely that a corrugated board box normally can withstand these stresses; the problem is that not all parts are packaged in corrugated board boxes. We mean that plastic bags can still be used to insensitive parts if they are not placed under heavier parts. Given that the system of today is not showing what is to be packed after a certain product in an order, the picker must make sure that no sensitive parts are being placed under heavier parts. Due to the fact that the pickers are experiencing a lot of time pressure, particularly in the afternoons when the direct deliveries are to be packed, this might be difficult to accomplish.

Another option is to investigate the possibility of reprogramming the system so that the heaviest parts in a customer order always arrive first or that the most fragile ones always arrive last. Then the pickers would know what to put in the bottom. On the other hand, the miniload section is programmed to be as efficient as possible. If the system also has to take the fragility aspect into account it is likely that the system will be slower. As a consequence, we believe that the pickers should be able to make these judgements using their common sense.

Based on the discussion above, we have come to the conclusion that a change of conduct at the Pick and pack stations is needed. We have identified two possible causes as to why fragile parts are being placed under heavier parts:

- The pickers are experiencing a high time pressure, an aspect that affects how careful they are when handling the parts. We therefore firstly question whether the time pressure the pickers are experiencing is well-founded. If so, the warehouse management must emphasise that careful handling of the goods is still necessary. The customer will not be satisfied if the part arrives on time if it is damaged. Moreover, we do not think that the required extra carefulness will claim so much extra time.
- The pickers do not realise that a fragile part is fragile. Such parts are ideal candidates for pre-packaging in corrugated board boxes so that they are not damaged during transportation. Moreover, we suggest that guidelines are established telling what types of products usually being fragile so that the pickers can be extra attentive when picking and packing such parts. Then again, this requires further investigation which lies outside the scope of this project. We do however believe that it might be difficult to establish more than general guidelines due to the wide range of product types passing through the distribution centre.

7.2.2 Conclusions packaging

- Mechanic stresses are the key issues when protecting Tetra Pak parts
- Vibrations and collisions are the most important mechanical stresses

- Today's corrugated board box can cope with the stresses, provided that it is taped so that the parts do not fall out
- Change of conduct at Pick and pack needed; cannot put fragile parts under heavy parts

7.3 Logistics

The primary purposes of the package from a logistics viewpoint are to facilitate handling, transportation and storage of the product, see section 4.2.2. We will however structure our analysis according to our findings and their origin, i.e. suppliers, Goods receipt, WCS, and Pick and pack. The following findings will be dealt with in our logistics analysis:

- All packaging is performed manually
- Goods receipt personnel do not have the time to pre-pack everything they think should be pre-packaged
- Tetra Pak uses packaging models from the 80's
- Difficult to compare the packaging quality between shipments due to floating inventory locations
- In most cases there are no packaging instructions
- Bags protrude over the top of the trays, thus causing disturbances in the system

7.3.1 Suppliers

All suppliers we interviewed performed their packaging activities manually. This implies that there is a need of a package design that is efficient to handle manually, if the pre-packaging is going to be performed at the suppliers. Even though we may come to the conclusion that the packaging activities are to be performed in-house, where it might be possible to automate the packaging to some extent, we still think that a package that is efficient to handle manually must be our starting point.

7.3.2 Goods receipt

The co-workers at Goods receipt do not have the time to pre-package everything they think should be pre-packaged. Therefore, there is a need of a package that is more efficient to handle, i.e. raise, fill and close. As mentioned in section 5.4.2 some of Tetra Pak's packages were developed in the 80's a fact that might explain why package designs being inefficient to handle still exist.

For the majority of the parts entering Goods receipt, there are no pre-packaging instructions. This implies that the packaging quality might differ depending on the individual co-worker. Then again, as Goods receipt personnel are not supposed to package parts without pre-packaging instructions, the problem occurs only when they package parts with no instructions which is actually not their working assignment.

In the past, the personnel at Goods receipt had the possibility to investigate whether the quality of the incoming goods corresponded to the already stored goods. Today, the introduction of the floating inventory locations i.e. the same parts are not stored at the same locations, has made it difficult to compare the packaging quality between

deliveries. This implies that it is more difficult to notice if a supplier does not live up to the packaging requirements agreed upon. We see no particular solution to this issue, but are of the opinion that Tetra Pak TS should be able to trust their suppliers. If the information in the computer system about *where* the part should be pre-packed was visible to the personnel at Goods receipt, they could check when the part arrived how it was supposed to be packed, or if they should pre-pack the part.

7.3.3 WCS

A problem that occurs in the warehouse system is that bags protrude over the top of the trays which causes disturbances and sometimes make the system stop. This could be solved if only corrugated board boxes were used. This is not a realistic solution though, partly since the space in the trays is limited and filled boxes require more space than filled plastic bags, partly because of the amount of bags that are used today. The only way of solving this problem is through better handling routines when bags are put back in the trays after Pick and pack. The co-workers at Pick and pack have to make sure that the bags are folded so that the trays do not get stuck, causing the system to stop.

7.3.4 Pick and pack

At Pick and pack, there are no packaging instructions. This implies that the packaging of one part can be performed differently depending on the individual co-worker. A possible consequence is that the packaging quality might differ between shipments and that the packaging sometimes is performed unnecessarily inefficient as the co-workers do not know what packaging material to use, e.g. the size of the corrugated board box or whether a corrugated board box or a plastic bag should be used, for a particular part. As it is today, this information is stored on individual co-worker level, and they use their common sense deciding what packaging material and size to use. If this was documented it would be easier to introduce new employees at Pick and pack, as well as achieving a uniform packaging procedure.

Based on the discussion above, we want to emphasise the need of a person to whom the co-workers can turn when they do not know what packaging material to use to a particular part. As it is today, there is no such person. We do however believe that the introduction of the Quality Investigation group, see section 5.6.1, is a step in the right direction as it among else contains two persons being responsible for troubleshooting and administration regarding pre-packaging.

7.3.5 Packaging in the internal supply chain

There are no clear guidelines regarding where to pack the parts in the internal supply chain, i.e. when parts that are not pre-packaged arrive from the suppliers it is not obvious who should perform the packaging; Goods receipt or Pick and pack. If there are pre-packaging instructions the parts are pre-packaged at Goods receipt. As mentioned previously, it occurs however that Goods receipt co-workers package parts without pre-packaging instructions because they judge it necessary.

As it is today, most parts are packaged at Pick and pack but the fact that the co-workers there are under a lot of time pressure implies that this might not be the best solution. About 50 % of the picks require packaging activities at Pick and pack, i.e.

not only attaching the label. In order to shorten the lead times at Pick and pack, it would be effective if the packaging activities at Pick and pack could be minimised. Additionally, what speaks against packaging activities, i.e. primary packaging, at Pick and pack are the mechanical stresses the parts are exposed to during warehouse transportation on conveyors and in the miniload section, as previously discussed in section 7.2.1.

We also suspect that the Goods receipt co-workers are more inclined to report parts that they think should be pre-packaged since they used to work in closer connection to the person being responsible for pre-packaging issues. We believe that if the part enters the conveyor belt without being pre-packaged it is more likely to be sent to the customer damaged since the personnel at Pick and pack trust that the personnel at Goods receipt have packaged the parts good enough to withstand strains in the warehouse. They might therefore not react on a damaged part if it arrives to the picking stations unpackaged, since a part arriving unpackaged signals that it is not fragile and if it for instance is scratched it might not be noticed.

Based on the discussion above, we suggest that all parts that are to be primary packaged in corrugated board boxes shall be packaged before they enter the picking stations. In other words, the pre-packaging activities can take place either at Goods receipt or at the suppliers. The decision regarding the location of the packaging activities will be elaborated on later in section 9.4.

7.3.6 Conclusions logistics

- There is a need of a package that is efficient to handle manually
- The majority of today's corrugated board packages are not good enough from a handling point of view
- There is a need of pre-packaging instructions in order to establish uniform packaging
- The pre-packaging of parts in corrugated board boxes shall take place either at the suppliers or at Goods receipt
- All parts that risk being damaged during warehouse transportation must be pre-packaged before they enter the storage, i.e. at the suppliers or at Goods receipt

7.4 Branding

Tetra Pak's business model consists of three legs; Packaging Material, Capital Equipment and Technical Service. In the past, the main focus was on packaging material and the remaining businesses' main objective was to support the packaging material business. As a consequence, Tetra Pak TS provided the customers with spare parts practically free of charge. With the introduction of the new business model, all three legs must be profitable. Therefore, Tetra Pak TS is now charging its customers for the spare parts, a fact that naturally increases the customers' demands. Furthermore, we have come to understand that Tetra Pak TS is pricing its spare parts relatively high, particularly the unique ones, and must hence provide a product that lives up to the value expectations raised by their prices. In order to offer a product whose price reflects its value, there are two ways; either the prices are adjusted to

better reflect the customer value of the product, or are the products improved in order to reflect the price.

The theoretical framework describes that brand equity exists on industrial markets in the form of buyers' willingness to pay a price premium for a product from a company with a strong company brand name and that the main brand equity generating variable is perceived quality. In order to increase the perceived quality it is therefore important to make sure that the quality of the product lives up to, and preferably exceeds, the customers' expectations and as Tetra Pak is trying to position the company in the premium segment, the quality of the product is of utmost importance. This is however not enough; Tetra Pak also has to make sure that the customers *understand* the high quality of the parts they receive. In other words, Tetra Pak has to translate the quality into perceived quality.

7.4.1 How packaging can influence the perception of the Tetra Pak brand

As described in the theoretical framework, see section 4.2.3, it is important to create a positive brand image to every stakeholder in contact with the company, especially for companies which, like Tetra Pak, are operating on the industrial market. Tetra Pak has a high competence on packaging material and we see a risk that the perception of Tetra Pak as a high quality packaging material company is undermined by the fact that the packages to the spare parts are of a lower quality. Hence, if the packages to the spare parts are improved, we see a great improvement potential in terms of corporate branding for the Tetra Pak Group in general and particularly for Tetra Pak Technical Service.

A well designed package improves quality as it protects the products better and professional looking packaging design also provides means as to improving customer perceived quality. The design works as a tool to creating a positive brand image for the people handling the part throughout the supply chain and at the shelves at the customers. These are the primary motives to package Tetra Pak parts in commercial packages printed with the Tetra Pak logotype.

Tetra Pak TS vs. Volvo Cars regarding branded packages

The main difference between Volvo Cars, see section 6.2, and Tetra Pak TS when it comes to spare parts and branding is that Volvo Cars' business is directed towards consumers while Tetra Pak TS is operating in an industry with Business-to-business marketing. On the other hand, the products are quite alike; they are both spare parts that are to be put into a machine, e.g. a car or a filling machine. Moreover, there is a strong trend in the automotive industry that the end customers should not do repair work on their cars by themselves, instead they are to turn to garages. Therefore, Volvo Cars must also direct their marketing efforts to the garages, i.e. business-to-business marketing since Volvo Cars spare parts profit depends on that the responsible purchasers of the garages buy Volvo Cars products. We believe that the decision of branding all Volvo Car's packages is made to stimulate the purchasers of the garages to buy Volvo Cars spare parts. It is likely that the purchasers are interested in reducing the risk attached to the purchasing of unbranded products, see

section 4.2.3, and the branding of the product provide means for Volvo Cars to ensure that the parts are genuine.

Volvo Cars is operating in an industry where the competition is fierce, and furthermore it is not the market leader as opposed to Tetra Pak that has a very strong market position worldwide. Volvo Cars' greater need to position itself may be one explanation as to why the company has chosen to print practically all its packaging material with the Volvo logotype. Another difference is that the pirate market in the car automotive industry is a common problem, probably a bigger issue than in the industry where Tetra Pak operates.

Nonetheless, the two companies both want to profile themselves as premium class. With Tetra Pak TS upcoming pricing project where the pricing model is going to be value based instead of cost-plus based, see section 1.7.2, Tetra Pak now has the possibility of adjusting its prices on unique parts. According to the Volvo Cars representative, one of the company's main motives of branding all its packages was to increase the prices as the brand implies certain quality guarantees that the customer must be prepared to pay for. Even if the risk of pirates is higher within Volvo Cars' branch of business, we are of the opinion that Tetra Pak TS has potential wins of protecting and branding its parts as we believe that the threats of pirates are likely to grow in the future.

Branded packages as means to improve customer value

Volvo Cars has seen an improved customer satisfaction after improving its packages, even though the representative we interviewed did not know any numbers or means of measuring it quantitatively. The same goes for Sony Ericsson that has not been able to relate changes in sales to the packages even though they have received positive opinions from their customers regarding the packages. Also SKF, see section 4.2.3, and Tetra Pak Hoyer, see section 6.1.2, have received positive opinions from their customers regarding their branded packages. Tetra Pak Hoyer has also received positive feedback from its market companies and according to them the customers show a higher acceptance of the price level thanks to the improved package. Tetra Pak Hoyer has not been able to measure the improvements quantitatively, for instance in terms of increased sales.

The difficulty of measuring such values is confirmed by the survey described in section 5.1.2. It is noteworthy that today's primary packages received so high marks as 3.6 since it is just a brown box, without logotype and that often not even fit the product. The research described in the theoretical framework show nonetheless that the value in terms of improved perceived quality has potential of increasing.

Based on the research regarding perceived quality as the main brand equity generating variable and the fact that all the companies we talked to that have introduced branded packages have seen improved customer satisfaction, we mean that one way of increasing the perceived quality and hence the perceived value, is through a more commercial package. Furthermore, an improved package does not only increase the perceived value but also the actual quality.

7.4.2 Conclusions branding

- Volvo Cars and Hoyer see a connection between branding and the price; Volvo Cars uses the package in order to increase the prices, and Hoyer uses it to maintain and defend its price level
- Hoyer has seen a higher acceptance of the price level thanks to the introduction of the new package
- Non of the above mention companies have been to able to measurer the value of a branded package quantitative
- Commercial, improved packages, work as means to increase perceived value and actual quality of the parts

7.5 Environmental aspects

When changing packaging design it is important to consider the environmental aspects. We will discuss the environmental effects of increasing the number of parts packaged in corrugated board and also the finding we identified in section 5.4.1 namely:

- No difference between bleached and unbleached paper in terms of cost or environmental friendliness

Since there is no difference in terms of environmental friendliness between bleached and unbleached corrugated board, Tetra Pak might very well use bleached corrugated board to the primary packages without increasing the environmental influence.

The outbound transportations will apparently increase if Tetra Pak decides to pre-package more parts in corrugated board boxes. We know however little about the average outbound transport efficiency, i.e. the volume utilisation. If it has improvement potential, the use of corrugated board boxes should not affect the outbound transportation greatly.

Since one of our objectives included the matter of deciding an optimal number of sizes needed to package the parts that we will select later on, we also need to discuss the environmental effects of such a decision. If too few sizes are introduced there will be a lot of transported air which is not desirable from an environmental viewpoint, neither from a transport cost perspective. On the other hand, an improved package that protects the product better implies fewer damaged parts which in turn lead to fewer double transports, which is desirable from an environmental viewpoint.

Other environmental aspects to consider are the disposal of used packages and the efficient use of resources. It is however difficult to say something about the disposal of material and how it is affected if more parts are primary packaged in corrugated board boxes since it might imply that less filling material is required during transportation. Moreover, as mentioned in section 5.4.1, there is no direct connection between a more complicated design, which in itself requires more material, and a greater environmental impact since one also has to consider the material that is wasted when the packages are produced.

7.5.1 Conclusions environmental aspects

- Tetra Pak can use white corrugated board without affecting its environmental influence
- The amount of transportation will increase if more parts are packaged in corrugated board boxes, on the other hand the return transportations due to damaged parts will decrease
- We see no direct connection between increased use of primary corrugated board packages and more material waste
- A more complex package that requires more packaging material does not have to be less environmental friendly

7.6 New packaging design

In this section we will analyse the packaging designs being proposed by the packaging material supplier. Moreover, we will also discuss the following key findings:

- Tetra Pak has 90 active packages
- Packaging material that is not printed with the Tetra Pak logotype is given to suppliers free of charge

7.6.1 Packaging types

When we started to investigate the available packaging designs, our point of departure was to examine whether it would be possible to develop boxes that would fit into the boxes that were developed during the Modular Project, see section 5.7.1. Due to the variety in size of Tetra Pak's parts that was however not a possible option. As described in section 5.4.1 the available corrugated board packaging designs proposed by Tetra Pak TS's corrugated board supplier are:

- Slit box
- Multi box
- Cross-cover box
- Speed bottom
- FEFCO 421
- FEFCO 427

The *slit box* is the simplest one, and it is also quite inexpensive to produce, but as it requires tape both in the bottom and on the top in order to stay closed it is not very handling efficient. In addition, the cost of tape needs to be included into the packaging material cost. As the handling efficiency is such an important factor in the warehouse, this design is not desirable from a handling perspective.

The *multi box* is a slit box that is flexible in size since it can be folded at different heights so that it can be used for different products. Tetra Pak has however a lot of parts with different sizes in all dimensions and such parts are not suitable to package in multi boxes. The fact that the multi box is a type of slit box and that it gets unstable in its highest position are other important drawbacks. We are therefore excluding it as an alternative as a standard design.

The box with *cross cover* has the advantage in relation to the slit box that it only needs tape to seal the box on the upper side. On the other hand, it is difficult to handle and as said it needs tape to be sealed. We therefore exclude the box with cross cover as an alternative as a standard design.

The design with the *speed bottom* is desirable from a handling perspective. However, in order to achieve economy in production, larger volumes of every packaging size per batch than Tetra Pak consumes are needed. This design is therefore excluded.

There is no difference in production cost, between using *FEFCO 427* (with sealing mechanism) and *FEFCO 421* (needs tape in order to stay closed), see section 5.4.1, which is why it is better to use *FEFCO 427* in order to reduce the number of working operations when closing the packages.

On the other hand, there might be a need of attaching a label or tape on top of the seam in order to make sure that nobody opens the package unnoticed. Nonetheless, since there is no difference in cost, we are of the opinion that it is safer for the part if it is packed in a package with a stronger sealing mechanism. If the part is packed at Goods receipt or at the supplier using a FEFCO 427 without tape, it is likely not to open up during the inbound transportation and warehouse transportation. Then, as mentioned in section 5.4.1 the pickers can attach the label on top of the joint and through that provide the guarantee that the package is not opened until it reaches the end consumer. In the case where there is no tape the risk of the part falling out of the package, provided that it is not meddled with, is minimised. This might however require a bigger label than today.

To conclude, **FEFCO 427** is the corrugated board packaging design that best lives up to the requirements being posed from the internal supply chain. In the case where the packages are too big, i.e. where the height exceeds the 160 mm limit, see section 5.4.1 the slit box is the only economically defensible option. Pictures of the two conceptual designs can be seen in Figure 38 below.

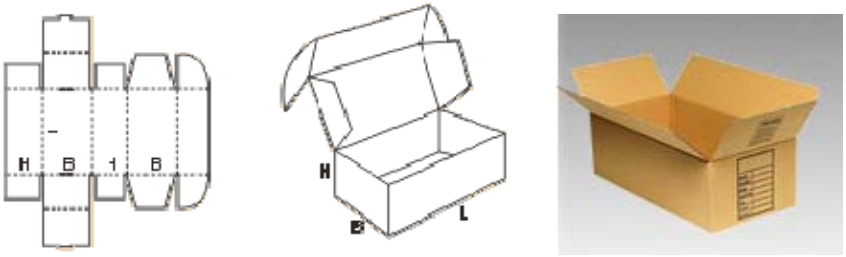

Figure 38: Our main primary packaging design proposals. To the left: FEFCO 427 for boxes with maximum 160 mm in height, to the right: slit box for the larger ones

7.6.2 Colour and printing

The fact that packaging material that are not marked with the Tetra Pak logotype is given to suppliers free of charge implies that the packaging material can be used to package parts to other customers than Tetra Pak. To print the packages with Tetra Pak's logotype would probably decrease the suppliers' consumption of packaging material since they can only use it to package Tetra Pak products.

Since Tetra Pak's logotype includes the colour red, which is impossible to print on brown corrugated board, we suggest that Tetra Pak should use boxes that are white on the outside and brown on the inside to their corrugated board primary packages. White has the advantage that any printing colour can be used on top of it and it is also in line with our general perception of the dairy industry where Tetra Pak operates. We are of the opinion that the package looks better with two-colour printing and since Tetra Pak only has two colours in its logotype, blue and red, there needs to be a white base if the red colour shall be visible.

Regarding the printing pattern, we suggest Tetra Pak TS to use wallpaper printing. Wallpaper printing has the advantage that the sheet can be printed before the punching of the boxes and therefore the printing does not have to be adapted to the box. Wallpaper printing is the most economic alternative.

When considering the text to be printed on the boxes, we suggest the use of the Tetra Pak logotype, including the house mark. In order to be consistent with the on-going Genuine Parts On-time project, see section 1.7.2, we suggest that 'Genuine Parts On-time' is printed under it, see Figure 39.

Genuine Parts On-time

Figure 39: Logotype and text

7.6.3 Conclusions packaging design

- We suggest that FEFCO 427 is chosen to be the standard design for packaging Tetra Pak parts in corrugated board boxes.
- If the heigt of the box are over 160 mm we suggest that the slit box is used
- We also suggest the use of wallpaper print in two colours.
- Genuine Parts On-time is written under the logotype, including the house mark.

7.7 Number of packaging solutions

In this section we will come up with a suggestion regarding the number of packaging sizes needed in order to package a limited number of Tetra Pak unique parts.

7.7.1 Tetra Pak vs. Tetra Pak Hoyer regarding number of packaging solutions

Tetra Pak Hoyer has 10 different corrugated board boxes, seven white and three brown, to cover 5% of their assortment. It means that for every box size there are 335 different parts in average. Hoyer has however chosen the parts to be packaged in the boxes carefully, which means that those 5% are the core products and/or the more expensive products that Hoyer markets. Since Hoyer's customers are satisfied, we can see that the choice of the right products to package in branded, quite expensive, boxes

can provide a great customer impact and still be economically reasonable in a total cost/benefit perspective.

7.7.2 Tetra Pak vs. Volvo Cars regarding number of packaging solutions

As mentioned in section 6.2.1 Volvo Cars has about 700 primary packaging solutions compared to Tetra Pak TS Parts that has approx. 150 primary packaging solutions (both corrugated board boxes and plastic bags).

The basic difference between the two companies is that Volvo Cars has a much greater turnover per article compared to Tetra Pak TS and can therefore introduce a larger number of packaging solutions. This also means that Volvo Cars can achieve significant volumes and through that probably achieve competitive prices per package from its packaging material suppliers.

7.7.3 Tetra Pak TS vs. Sony Ericsson regarding number of packaging solutions

Sony Ericsson has a very limited number of primary packages since the sizes of its products do not vary to any larger extent, a feature that distinguishes it from Tetra Pak TS's situation. Sony Ericsson has decided to use different inserts to adapt the standard corrugated board boxes to different mobile phones and different accessories.

The fact that Sony Ericsson uses a limited number of boxes and inserts is however nothing we think is transmittable to Tetra Pak TS. As mentioned above, Sony Ericsson's products are similar in terms of size. Moreover, every box contains a lot of different articles, such as phone, manual and charger. An insert is a good alternative to fix a lot of different articles in the same box. In Tetra Pak's case the use of inserts could be an option for the kits, but when it comes to the singular spare parts we suspect that this alternative is not the best, based on the nature of Tetra Pak's parts, i.e. very varying in terms of size, shape and demands. We also assume that Sony Ericsson has a much greater volume on every box size and insert size and therefore get a higher volume per sort, which explains the more complex design with inserts and printing.

7.7.4 Inserts vs. large number of box sizes

As described in section 5.4.1 the package can either be designed to suit the product inside it perfectly in terms of size or one can use inserts in order to fix the product. The use of inserts has certain drawbacks though, for instance it requires stock-keeping of two units per package. If the insert shall fulfil its purpose there is a need of one insert per product which in Tetra Pak TS's case would require many more inserts than packaging sizes, and the production of them would be much less efficient than the production of a limited number of packages, even though a relatively large number of package sizes are required.

In view of the fact that that Tetra Pak is striving to minimise its environmental influence, it is not defensible to introduce a large number of inserts since the use of inserts means that the package must be too big in order to make sure that the insert is

really fastening the product as supposed to. We do therefore exclude the use of inserts as means of reducing the number of packages.

7.7.5 Number of packaging sizes needed to selected Carton parts

In order to decide how many packaging solutions made of corrugated board that is feasible we applied the following method. The method can be automated in order to find a more optimal solution, but in this stage we will only use the methodology and manually find a number that we think is good enough. We also want to highlight that the method is functional but it is not mathematically optimal.

Delimit the selection

Since the cost of corrugated board is so much higher per piece compared to the cost of plastic bags, we do not think that it is economically feasible to replace all plastic bags with corrugated board boxes. Moreover, since the plastic bags has such a high consumption, see section 5.10.1, the transportation costs and hence the environmental impact would increase significantly if they were replaced with boxes. We do not believe that the customers will be very happy with such an increased transportation cost and we mean that the aim of increasing the perceived value would sooner be undermined if the customers would receive screws and mutters singularly packaged in corrugated board boxes.

We are of the opinion that increased use of corrugated board boxes to a carefully selected range of parts will have a greater positive impact on the customers' minds since a smaller selection makes it possible to keep transportation costs and storage costs at a reasonable level. Lastly, the amount of parts passing through the distribution centre in Lund is not likely to decrease, rather increase. This implies that there is not enough room in the storage if the plastic bags are replaced with corrugated board boxes, at least if the pre-packaging takes place before the parts enter the conveyor belts, in the same manner as today.

Deriving from the discussion above we needed to delimit the selection. We started with the unique Carton parts, i.e. parts coming from Carton Chilled and Carton Ambient. Processing components were in other words excluded, since there was no available data regarding their measurements.

The criteria can be seen in Table 8.

Firstly, we excluded all the parts that lacked the required information, such as number of sold parts the last twelve months (R12), or information regarding their measurements. Secondly, we removed parts that were too big to be placed in the blue trays in the conveyor system. Thirdly, we eliminated parts being too light in order to exclude small parts such as screws and mutters that usually do not require a corrugated board package and that therefore generally can be packaged in plastic bags.

Thereafter, we removed parts with a higher weight than 10 kg, because we assumed that parts weighing more than 10 kg require a more robust package. In order to focus on parts having the biggest impact on Tetra Pak's customers, we used price and sold quantity as the last two conditions. We chose price as a criterion because we wanted

the packaging to reflect the value of the part. Therefore we chose parts with a customer price over 200 SEK, (L1). Furthermore, we kept parts that had a turnover of more than five parts every year, since we are of the opinion that the more often a product is sold, the greater the impact onto customers' minds regarding their perception of Tetra Pak as a company.

Criteria	Condition	Comment
Lack of information		N/A in the statistics
Too long	Length >560 mm	The trays are 565 mm long
Too high	Height>240mm	The trays are 240 mm high
Too big diameter	Diameter> 360 mm	The trays are 360 mm wide
Too light	Net weight<0,05 kg	If the part is too light, the package will be heavier than the part
Too heavy	Net weight>10 kg	Needs a more robust package
Too cheap	L1<200 SEK	Eliminate counting picks Make sure that the part can bear the cost of the packaging
Too seldom sold	R12<5	In order to decrease the range. Not economical to develop a package to parts being sold so seldom

Table 8: Criteria to delimit the number of parts that need a package of corrugated board

Now we have 5186 parts that are qualified for being packaged in a corrugated board box using our criteria.

If we compare the parts we have left with the parts that have a pre-packaging instruction that says corrugated board box (totally 698 in this data range), we see that about 300 of those were excluded somewhere in the sorting. Most of them disappeared since they were sold too seldom.

Algorithm

A basic assumption of a package is that Length>Width>Height, which was correct for the majority of Tetra Pak's unique Carton parts.

The algorithm aims at decreasing the difference between the volume of the box and the volume of the part thus minimising the amount of air within the box. In this context, the volume of the parts is measured as the widest measurements in all three dimensions. The idea of the algorithm was given to us by our tutor from Lund University, but we adapted it a little so that it would fit our context.

We plotted the lengths of the parts to get an understanding of what lengths being the most common. Then, the basic idea is to study the derivative, i.e. the slope of the length curve, and adapt the intervals accordingly. The intervals shall be wide when the derivative is small and narrow when the derivative is large. A large derivative means that the lengths are changing fast and a small derivative means that the lengths are changing slowly. If the lengths change slowly, fewer lengths are needed in order to find packages that suit the products' lengths. A plot of the lengths and the sold quantity for the selected parts can be seen in Figure 40 below.

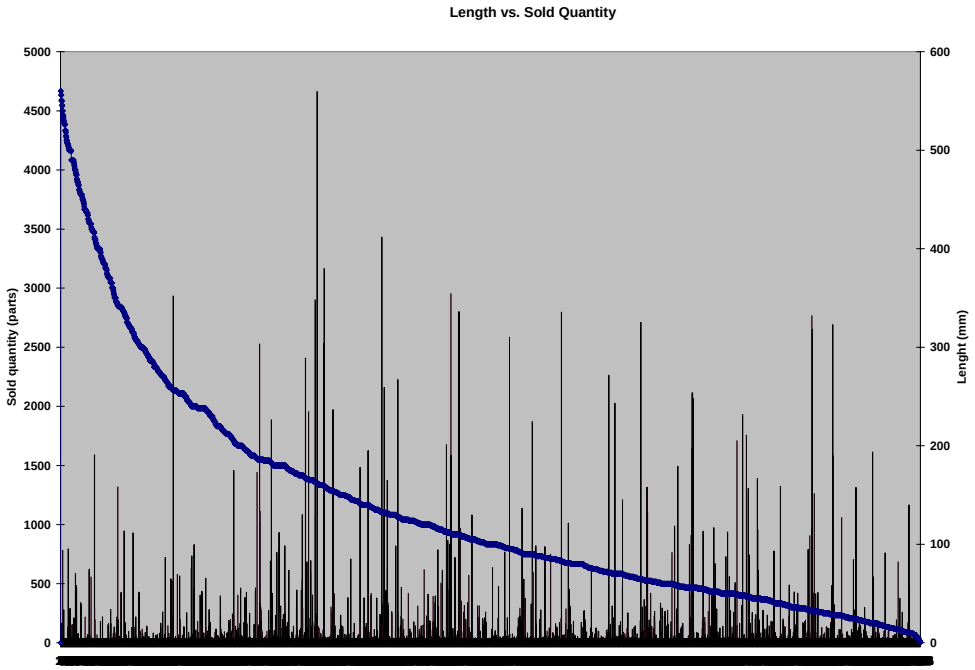

Figure 40: Length and. sold quantity of each part. Intervals adapted according to the derivative, hence more intervals to the left and fewer to the right

As the figure shows, we need shorter intervals in the left part of the figure since we there have a large derivative, and longer intervals in the right part of the figure as the derivative is small there.

After establishing a number of length intervals, the parts in every interval were studied according to their width. Hence, for every length interval, we examined how many parts there were and adapted the number of packaging solutions according to that. In order to achieve economies in production, the batches must be of considerable sizes. Therefore, we have adapted the number of packages in every length interval so that the average batch sizes within that interval were not too small. As a result, we had a number of widths for every length interval. Thereafter, every width interval was examined in the same manner in order to decide the number of heights needed for each of the established width intervals. We performed the iterations manually which is why we cannot be sure that the solutions are optimal, but the method is however good enough for our purpose.

An example can be seen in Table 9 below:

All unique Carton parts shorter than 70 mm and longer than 50 (that is the next length) can be packaged in the sizes described in Table 9 below. As the table shows, there are three widths for this particular box length; 70 mm, 50 mm, and 30 mm. For the width of 70 mm, there are two possible heights; 67 mm or 30 mm. For the width of 50 mm, there are two possible heights; 54 mm or 30 mm.

Length (mm)	Width (mm)	Height (mm)
70	70	67
70	70	30
70	50	54
70	50	30
70	30	30

Table 9: Example of the box length 70 mm

Results

The packaging sizes and their expected consumption based on the number of parts that the package shall be used for can be seen in appendix 8. As described in section 7.6.1, boxes higher than 160 mm must be slit boxes which is indicated in appendix 8. We also compared our results with the existing boxes and realised that there were sizes that were not covered by those we had developed. On the other hand, many of the old boxes' measurements were based on specific parts and it is not certain whether those specific parts were included in our selection.

Now we have 74 sizes of corrugated board boxes, which give an average batch size of 4200 boxes/batch, totally 360 000 packages. The total cost of the design change will be elaborated on in the overall cost estimation in section 9.4.1.

We do however believe that some more solutions might be needed in order to further optimise transportation efficiency. Due to the fact that Tetra Pak parts vary a great deal in terms of size, we could not reduce the number of sizes very much. Now we have 74 solutions compared to today's 90 solutions. These 74 solutions cover however a much larger range of products (5000 different parts) than the 90 existing ones being used to approx. 2000 parts.

Due to the fact that the cost of corrugated board packages are very volume dependent, see Table 3 and Table 4 in section 5.10.1, we need to increase the consumption in order to decrease the price per package. If Tetra Pak starts with the 5000 parts we have suggested, the consumption of corrugated board primary packages will increase significantly since those 5000 parts have a higher turnover than the 2000 parts being packaged in corrugated board today.

7.7.6 Conclusion number of packaging designs

- 74 boxes would cover all the parts that we have selected
- Changing the packaging design will mean that more than 2.5 times the number of parts being packaged in corrugated board today can be packaged

8 Organisation analysis

In this chapter, we will discuss how the organisations of Tetra Pak TS and Tetra Pak Carton Ambient affect pre-packaging. Moreover, we will present a suggestion to how we think the management of the pre-packaging can be improved. First, we will however compare Tetra Pak's spare parts organisation to Volvo Cars organisation in order to get a feeling for the subject.

8.1 Outline

This chapter deals with the third circle in Figure 41 below. See also section 4.1.

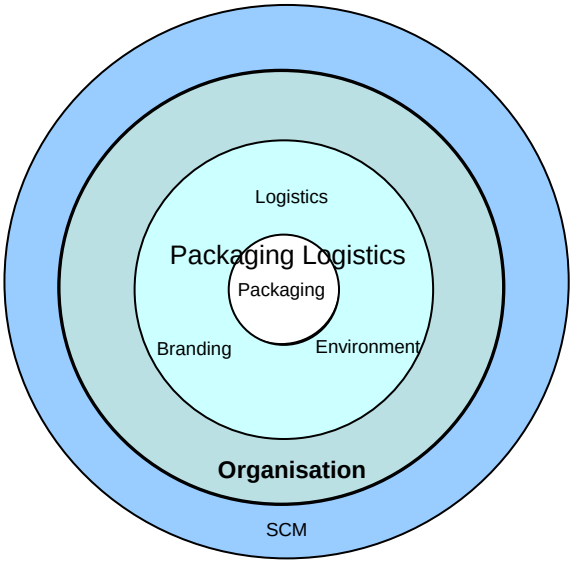

Figure 41: Chapter 8's connection to the theoretical framework

8.2 Tetra Pak vs. Volvo Cars regarding spare parts management

Both Volvo Cars and Tetra Pak have chosen to organise their spare parts business in similar ways, i.e. the spare parts are mostly dealt with in organisations specialised in spare parts management (in Tetra Pak's case it is Tetra Pak TS who handles the responsibility). There is however one main difference between the two companies; in the fields of purchasing and contract management. At Volvo Cars, the purchasing of the spare parts is treated separately from the purchasing of parts to the production, while at Tetra Pak the two are handled under the same departments, namely Supplier management Carton Ambient and Supplier management Processing.

According to the Volvo Cars representative, Volvo Cars does not synchronise the purchasing of spare parts and the purchasing of parts to production to any larger extent and this causes sometimes problems as the suppliers of both spare parts and

production parts are not willing to treat the two differently, for instance in terms of packaging.

In the case where Volvo Cars finds it too expensive to persuade the suppliers, the packaging takes place at the distribution centre in Torslanda, i.e. in-house.

8.3 Tetra Pak TS's packaging organisation

In this section we will analyse the key findings of the empirical material regarding Tetra Pak TS's packaging organisation:

- Lack of interest and priority from supplier managers regarding pre-packaging
- There is a general opinion within TS that the supplier managers are measured on price, not on quality
- Possible solution: two pricelists, one with pre-packaging specification to TS and one without to system suppliers
- Failure to implement recommendations produced in earlier pre-packaging projects

8.3.1 Supplier management

The role of supplier management concerning the packaging of parts and the management of packaging material suppliers are explained below.

Parts suppliers

Today there is no accordance between supplier managers' and TS co-workers' opinions regarding the responsibility of the pre-packaging of the parts. The supplier managers at Carton Ambient mean that their role is to secure the supply of components and are therefore focusing on selecting suppliers and on establishing global agreements on components to low prices. They are not interested in any special treatment of TS's parts and do therefore not feel that the packaging issue concerns them. Moreover, they mean that pre-packaging would increase their workload and degenerate their performance, as it is measured.

TS co-workers on the other hand are of the opinion that the business area, i.e. Carton Ambient in this case, must be responsible for the entire business during the machine's lifetime including its supply of parts, which in turn includes all matters concerning the parts' packaging.

The result of this incongruity is that nobody is working with the goal of improving the pre-packaging. Supplier management has the authority to negotiate with the suppliers but not the interest, and TS has the interest but not the authority.

Previous pre-packaging projects have recommended that pre-packaging is to be performed at the suppliers. This requires special attention from the supplier managers as they perform the negotiations with the suppliers. Moreover as the supplier managers' performance are measured on purchase price they are not interested in letting the suppliers charge Tetra Pak to pay for pre-packaging activities as that would increase the prices. As can be read in section 5.6.3 a possible solution to this is to

have two pricelists, one with pre-packaging that can be used for TS and one without that can be used for the remaining Tetra Pak companies and system suppliers, and let the supplier invoice pre-packaging separately. In doing so, the supplier managers' performance measures will not be affected negatively. Nonetheless, this requires some extra attention and possibly a heavier workload on the supplier managers.

Packaging material suppliers

The supplier managers handle the agreements with the packaging material suppliers, a task that they do not feel should lie within their responsibility. Hence we are quite certain that this is the reason why there are no contracts with the packaging material supplier. Furthermore, we question why the responsibilities for these suppliers are located under the supplier manager if their assignment is not to provide parts with packages.

In order to achieve a smooth and cost effective handling of the packaging material, it needs to be clear who has the responsibility for it. As we see it, there are three different options to organise the management of packaging material. The alternatives and their advantages and drawbacks, as we see them, are presented in the following list:

- Supplier management continues handling the packaging material suppliers. As Tetra Pak normally applies the concept of single sourcing it is probably wise to consider it also when regarding the supply of packaging material.
- TS, possibly under warehouse management, handle the packaging material suppliers. Regarding the export packages this is what is happening in practice. The advantage is that TS co-workers have an understanding of the importance of the packaging and are directly involved in the requirements posed upon it. Furthermore, they are interested in doing it.
- Business support handles the packaging material suppliers. The main advantage as we see it is that the Supplier management's workload decreases which in turn lets the supplier managers focus on what they define as their main responsibilities. We see however no reason as to why a movement of the packaging material supplier would improve the pre-packaging situation for Tetra Pak TS. We also question whether it is Business support's core competence to purchase packaging material. In addition, we see a risk that the communication between the packaging material responsible and TS is rendered even more difficult than today.

8.3.2 Pre-packaging organisation

Pre-packaging has never been a prioritised activity within Tetra Pak or Tetra Pak TS. Still, the overall notion seems to be that the pre-packaging is not an important issue with the consequence that recommendations produced in previous projects have not been realised. A possible explanation is that Tetra Pak is an organisation sluggish to change and/or that no means as to realise the recommendations were provided. We do however believe that the latter explanation is more likely, which is called manoeuvre sluggishness in section 4.3.2, since there are many examples of other projects that actually were realised. Therefore, in order to establish and implement

our proposals, we would like to emphasise the need of providing means and authority for the persons responsible for implementing the changes needed to improve the pre-packaging.

Until now, there have been two co-workers sharing the operational packaging responsibility of parts whilst the commercial responsibility for the packaging material supplier is located under a supplier manager from Tetra Pak Carton Ambient. Regarding parts, there is, as mentioned in section 5.6.3, a product manager having the technical responsibility. For packaging material, there is no product manager which makes the management of packaging material more difficult since the supplier managers cannot use their normal routines.

As we see it, the packaging of the parts is not treated on a strategic or even tactical level which means that the organisation is neither centralised nor centralised/decentralised if compared to the theoretical framework, see section 4.3.1. In other words, Tetra Pak parts packaging organisation is most alike the decentralised structure described in the theoretical framework.

As we see it, Tetra Pak TS is experiencing the same drawbacks as other companies such as IKEA did with the decentralised structure, see section 4.3.1, i.e. lack of communication and control, and insufficient packaging competence and authority using the decentralised structure. An example of the lacking communication and coordination is that projects affecting packaging are carried out simultaneously without the persons involved knowing something about it (e.g. Genuine Parts On-time project vs. Modular Packages project). We believe that this originates from the fact that Tetra Pak TS, like the rest of the Tetra Pak group, is quite decentralised, which means that the various departments within TS are relatively independent.

Moreover, Tetra Pak TS is not experiencing the same advantage as IKEA did, i.e. a close collaboration with product development, as that part of Tetra Pak's business are treated separately from TS's business. On the other hand, IKEA experienced that the decentralised structure provided a poor connection to logistics. We do not see this drawback of Tetra Pak TS packaging organisation since it is located within a department that is very focused on logistics and logistics improvement. The packaging types that Tetra Pak TS has used over the years have often been designed as to minimise the amount of transported air which is desirable from a logistics point of view.

Another aspect is that pre-packaging is regarded as a freestanding issue and its connection to export packages are not dealt with, neither acknowledged, probably due to the split of responsibilities between pre-packaging and export packaging. For the remaining packaging material suppliers, such as the suppliers of plastic bags or tubes, other measures might be needed, but such an investigation lies outside the boundaries of this study.

8.3.3 Conclusion – packaging organisation

Based on the discussion above, we recommend that the operational and tactical responsibility of packaging is collected under the same position. The advantage is that the coordination of pre-packaging and export packaging would be facilitated.

Furthermore, Tetra Pak TS would also gain leverage in the negotiations with the packaging material suppliers if they were forced to treat pre-packaging and export packaging, as the same customer. This is particularly true for the supply of corrugated board since such is consumed both at Goods receipt, and at Pick and pack.

Moreover, the strategic importance of packaging must be acknowledged throughout the organisation. For starters, there must be a person strategically responsible for packaging. As we see it, there is nothing hindering that the management of the packaging material suppliers are located within Tetra Pak TS. The possible drawback is that purchasing activities are then not located within the same organisation. On the other hand, since Tetra Pak TS is the main Tetra Pak user of packaging material economies of scale in purchasing activities would not be lost.

9 Supply chain analysis

In this chapter we will analyse all the findings we think influence the decision regarding the location of the packaging activities. Thereafter, we will analyse the implications of placing the packaging at the different possible locations, both quantitatively and qualitatively. The quantitative analysis will also deal with the cost implications of the new proposed packaging design. In the qualitative evaluation we will include all possible aspects we can come up with and analyse them one by one in order to decide whether they are important or not. Finally, we will merge the quantitative and the qualitative arguments into a comprehensive model whose output will be a decision regarding the location of the packaging activities.

9.1 Outline

This chapter deals with the outer ring in Figure 42 below. See also section 4.1.

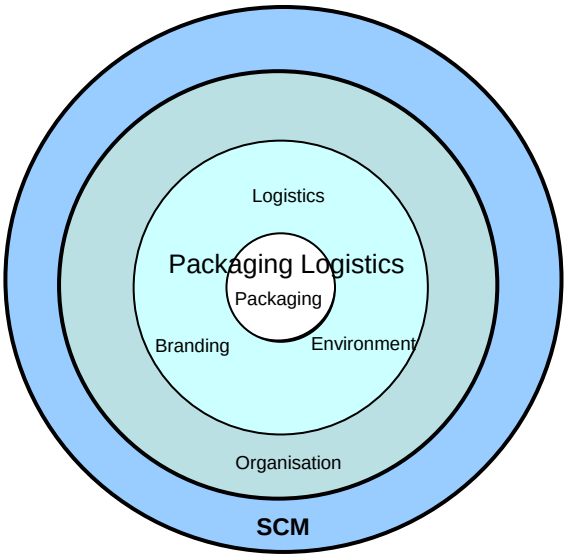

Figure 42: Chapter 9's connection to the theoretical framework

9.2 Parts suppliers

Our empirical findings, regarding the parts suppliers will be analysed in the following section:

- Suppliers are Tetra Pak dependent
- Suppliers produce small batches of many products
- Kits are treated differently in terms of packaging instructions
- Different agreements with the suppliers regarding packaging material

9.2.1 Suppliers are Tetra Pak dependent

One important finding regarding the Swedish unique parts suppliers we visited is that they are all very dependent on the Tetra Pak Group. Their dependence on Tetra Pak TS is however not equally strong. This explains why supplier managers at Tetra Pak Carton Ambient are not so interested in arranging special TS agreements since TS's share of many suppliers' Tetra Pak production is relatively small, at least for those suppliers we visited.

9.2.2 Small batches of many products

During our supplier visits, we also realised that the majority of those suppliers produced a wide range of products in relatively small batches. This implies that they need to keep a wide range of packaging material in stock if they are to pre-pack all Tetra Pak parts. It might even occur that some packaging sizes cannot be used at all if Tetra Pak TS's consumption of a specific part decreases dramatically or if TS switches supplier of a specific part.

9.2.3 Kits are treated differently in terms of packaging instructions

The suppliers of kits have all received a detailed instruction regarding how they shall package the kits. However, many suppliers deliver both kits and normal parts to Tetra Pak TS and for the spare parts there are, as previously discussed inn section 5.3, normally no instructions. We believe that this lack of consistency sends mixed signals to the suppliers. It is likely that the suppliers get the impression that the kits are valued higher by Tetra Pak, which might very well be true since the cost of one kit is relatively high. Then again we question if Tetra Pak really wants to send such a signal to the supplier. One part can be equally important to a customer if his business relies on it, and we therefore suggest that Tetra Pak must increase the demands on its suppliers, i.e. be clearer regarding how the packaging shall be performed.

9.2.4 Different agreements with the supplier regarding packaging material

The suppliers are treated differently when regarding packaging material and the cost for performing the packaging activities. Some receive the packaging material from Tetra Pak TS free of charge whilst some buy it directly from Tetra Pak TS's packaging material suppliers and then need to pay for it. They do however send the bill to Tetra Pak afterwards. In addition, some suppliers invoice their cost of packaging separately, and some perform the packaging activities free of charge if they in turn get the packaging material from Tetra Pak TS free of charge. In the latter case, the cost of packaging activities is accounted for separately in Tetra Pak's accounting system. We have however not been able to get hold of information regarding how many of the suppliers who invoice the cost of packaging material separately.

It is apparent that even though some suppliers choose not to charge Tetra Pak TS for their costs of packaging the parts, the cost still exists, which means that the suppliers could still include it in their prices.

All these different solutions make the cost of pre-packaging very difficult to overlook. Moreover, it might imply extra workload for the pre-packaging responsible and the

supplier manager who have to make a new decision every time a new supplier is introduced, regarding if they are to get the packaging material free of charge and whether or not they are to invoice the packaging activities separately. We believe that all these ad-hoc solutions derive from the fact that packaging is not included in the contracts with the parts suppliers. If it was, the suppliers would be treated in a standardised and uniform way, which should save the pre-packaging responsible work-load as well as making the cost of pre-packaging easier to overlook.

To conclude, we mean that TS co-workers, who know the strains the parts are exposed to during warehouse handling, must give their input to Supplier management's negotiations with the parts suppliers if the pre-packaging is to take place at the suppliers. It might not be necessary to implement a pre-packaging demand on all parts, but when a new part is introduced there must be a discussion regarding pre-packaging. If the output of such a discussion is that the part must be pre-packaged, this must work as input not only in the negotiation with the chosen supplier, but also as input in the supplier selection process.

9.3 Packaging material suppliers

In this section we will discuss the relationship between Tetra Pak and the packaging material supplier including the key finding:

- Tetra Pak has no contract with the packaging material supplier

As described in the theoretical framework, see section 4.4.2 the most common relationship between two parties of a supply chain is the traditional relationship where the customer and the supplier has a competitive relation and both parties try to eliminate the opponent's position of strength. We see this behaviour particularly in Tetra Pak's relation to its corrugated board supplier. For instance, there is no contract with this supplier, even though Tetra Pak and the supplier have been engaged in business since the 80's. This is particularly surprising since this supplier also deliver export packages being consumed in large volumes by Tetra Pak.

We mean that the fact that Tetra Pak still uses old packaging designs regarding the pre-packaging is a consequence of the traditional relationship since Tetra Pak does not make use of the supplier's competence. Our recommendation is however not to engage in a partnership relationship with this supplier. There is a high competition in the corrugated board industry which we think Tetra Pak shall derive advantage from. We are however of the opinion that a contract does not equal partnership, many of the advantages of the traditional relationships, for instance no dependence and easiness to switch supplier, can still be kept if even though there is a contract. Moreover, we see no reason why Tetra Pak should need to change corrugated board supplier acutely.

9.4 Pack in-house, at the suppliers or at both

In coming section we will analyse where the primary packaging activities for corrugated board packages should take place. Both the quantitative and the qualitative

analyses are based on three possible locations of the pre-packaging activities, namely in-house, at the suppliers or both.

Due to secrecy we are not allowed to present all the accurate figures in the quantitative analysis. We have therefore during our cost analysis used fictitious cost to be able to present a result. When the cost is fictitious the numbers in the tables are italic. We have also presented all the fictitious numbers in the text.

9.4.1 Cost estimations and analysis

One of the objectives with this thesis is to come up with a new corrugated board packaging solution to Tetra Pak unique parts, and develop cost estimations to this suggestion. We will in this section estimate the cost for the new packaging solution and compare it to the cost for today's solution. Moreover, the cost estimations are done in order to decide where in the supply chain to package the parts; in-house, at suppliers or both.

In the following chapters we have used three different scenarios for each possible location of the pre-packaging activities:

- The first is the costs as they are today, with today's volume and design.
- The second scenario is if we change the packaging design to the suggestion in section 7.6 but keep the same volumes and sizes.
- The last scenario is if we change the design, the number of boxes and at the same time increase the consumption, as explained in section 7.6 and 7.7.

Cost of packaging material

For the administration of packaging material there are three different alternatives:

- Tetra Pak TS keeps the present system of administration the packaging material, i.e. Tetra Pak only provides some of their suppliers with packaging material free of charge, and uses some in-house to perform pre-packaging activities at Goods receipt.
- Tetra Pak pays for all material that is needed to pre-pack the parts that should be pre-packaged.
- Tetra Pak lets the suppliers pay for the packaging material, sub-ordering from Tetra Pak's contracts with the corrugated board supplier or from Tetra Pak's storage in Lund.

At the end of the day, Tetra Pak will have to carry the cost for the packaging material used to package Tetra Pak parts even if the packaging is performed at the parts suppliers. Either Tetra Pak provides the parts suppliers with packaging material free of charge, or the parts suppliers buy packaging material and thereafter invoice Tetra Pak on the same amount.

In order to facilitate the supply and administration of packaging material to the suppliers as much as possible, we think that there should be uniformity in the supplier agreements regarding the supply of packaging material. Hence, we exclude today's

system since it implies several handling routines and as a consequence renders the general view of the actual cost of packaging material more difficult.

Consequently, we have two alternatives: Tetra Pak pays all packaging material the parts, or the suppliers pay for their consumption of packaging material needed to pre-package the parts they produce.

If Tetra Pak does not pay for any material, it means that Tetra Pak does not have access to any material and therefore all pre-packaging most be done at the suppliers. Today some suppliers pack their parts for free because they receive packaging material from Tetra Pak free of charge. If Tetra Pak starts to invoice the suppliers for this packaging material there is a risk that Tetra Pak has to start paying for the packaging activities, i.e. the working time to pre-package the parts. As said before, when it comes to it, it is Tetra Pak who will carry the cost for the packaging material, which is why we think Tetra Pak shall pay for it already from the beginning and hopefully gain economics of scale by buying large quantities of packaging material.

To estimate the cost for pre-packaging all the parts in-house with today's volume, we needed first to find out how many parts being pre-packed today in corrugated board boxes totally, i.e. the number of parts being pre-packaged at the suppliers and in-house. We know that Tetra Pak provides the suppliers with approx. 90 000 corrugated board boxes a year, see 5.10.1, and that in every box one part is being packed, mostly parts with a pre-packaging demand. On the other hand, we do not know whether there are parts being pre-packaged by the suppliers even if there is no pre-packaging demand on them. We do however believe that the majority of the unique parts suppliers pack the parts as little as possible and are therefore not pre-packaging if Tetra Pak has not explicitly stated that they should. With this in mind we make the following assumption:

Today, Tetra Pak pays for the packaging material needed to package 90 % of all parts with pre-packaging demand corrugated board box.

According to this assumption that would give us a total sum of 100 000 parts (90 000 parts that Tetra Pak today provides with packaging material/0.9) that need to be packed in corrugated board boxes.

We know that the average cost during 2004 for one corrugated board box is 5.90 SEK, as said in section 5.10.1. Changing the design as proposed in section 7.6 will increase the cost of packaging material. Because of secrecy we cannot here present the costs that the packaging material supplier gave us on changing the design and the batch sizes. We know that corrugated board are volume dependent and we use the fictitious figures presented in Table 10 below.

Batch size (pcs)	Brown without printing (SEK/pc)	White with 2-colour printing (SEK/pc)
Today's volume	5.90	*8*
New volume	*4*	*5*

Table 10: Cost for packaging material for different properties, fictitious figures

If we change the packaging design and increase the number of parts that get pre-packed and simultaneously narrow down the number of corrugated board box solutions the average fictitious price per box would be 5 SEK. This presupposes that Tetra Pak increases the average batch size, see Results in section 7.7.5.

In Table 11 we have estimated the total cost for packaging material for today's situation, for today's volumes but with new packaging design and finally for changing both the volume and the design.

Cost for packaging material	Today's cost (SEK)	Cost with new design but the same sizes and volume of boxes as today (SEK)	Cost with the new packaging solution and with the new sizes and volume (SEK)
Volume	100 000 pcs	100 000 pcs	360 000 pcs
Cost per box	5.90 SEK	*8 SEK*	*5 SEK*
Total cost of packaging material	**590 000**	***800 000***	***1 800 000***

Table 11: Estimated cost for packaging material (Tetra Pak pays all material, not depending on where in the supply chain the packaging occurs) fictitious figures

As seen in Table 11 changing the packaging design affects the price of the box and the total cost of the packaging material. We can see that by increasing the batch sizes we could receive lower prices per box. The total cost for the packaging material would however increase approximately three times by increasing the volume, but more than three times as many parts would be pre-packed. We want to emphasise that increasing the batches gives us a white, branded corrugated board box to an average price that is less per piece than the price for one brown unbranded box today.

For producing the boxes there is also a cost for manufacturing the tools for punching. If Tetra Pak changes its packaging designs, there will be a need to buy new punching tools. Moreover, if Tetra Pak decides to print on the boxes, new printing plates will be needed. As said in section 7.6.2 it is uneconomical to use any other alternative than two-colour print with wallpaper layout. There will be a need of approx. 7 printing plates for a cost of approx. 10 000 SEK per plate.

Cost of inventory

The cost of inventory is directly related to the average volume of packaging material in the storage. There are two alternatives regarding the storage of the packaging material, either the packaging material goes through Lund or it does not. Since the price per box increases with smaller batch sizes and due to the fact that the packaging material supplier produces by order, it is today not economically defensible for all of the parts suppliers to order packaging material directly from the packaging material supplier.

The decision regarding the stock level of packaging material is depending on different variables where the main issues are the space the packaging material requires in the miniload and the cost of ordering small batches from the packaging material supplier.

We are of the opinion that Tetra Pak should stop ordering packaging material in small quantities since that renders economy in packaging material production very difficult, provided that Tetra Pak cannot improve its forecasts. If Tetra Pak could produce more reliable forecasts, it is possible that the packaging material supplier could produce on those, instead as when ordered. As a consequence, it would be possible for the packaging material supplier to keep some sizes in stock and achieve economy in production. We do however not think that this is achievable in the near future which is why we make the following assumption:

The corrugated board boxes needed for pre-packaging the parts are kept in stock at the distribution centre in Lund

Moreover, we do not know how the inventory and the manner of ordering will change when we introduce the new sizes. We are therefore forced to make an assumption:

We presume that the inventory cost increases linearly and therefore gets the cost for new packaging solution with new sizes as today's cost multiplied with the proportion between the new cost for packaging material and the cost of packaging material today. These costs were discussed previously, under Packaging material cost.

Based on these assumptions the inventory costs will be as in Table 12 below. (Today's cost of inventory is 72 000 SEK of which 54% is due to corrugated board boxes see 5.10.3.) In the table the cost with another packaging solution but the same sizes and volume of boxes as today is based on today's cost multiplied with the new cost per box divided with today's cost per box explained earlier in this chapter. The cost with the new packaging solution and with the new sizes is today's cost multiplied with the total cost for packaging material for the new solution and sizes divided with the cost of today's solutions and sizes, see Table 11.

Cost of inventory	Today's cost (SEK)	Cost with another packaging solution but the same sizes and volume of boxes as today (SEK)	Cost with the new packaging solution and with the new sizes (SEK)
	54% of 72 000 SEK	*39 000 * 8/5.90*	*39 000*1800000/590000*
Cost of inventory for corrugated board	**39 000**	***53 000***	***119 000***

Table 12: Cost of inventory for different solutions (The material passes through the storage in Lund) fictitious figures

Table 12 shows that the cost of inventory would increase three times, but this cost needs to be compared to the saving that could be done by purchasing larger batches of the packaging material. This also implies a greater need of storage space.

Cost of handling

The cost of handling arises in every part of the supply chain where pre-packaging takes place. Today pre-packaging can be located at the suppliers, at Goods receipt and at Pick and pack. We do not know the cost for packaging one part at the average supplier since many suppliers are not invoicing this separately. We do however believe that there are some economies of scale to gain if more parts are being pre-packaged, a notion that leads to the conclusion that the cost of packaging one part will somewhat decrease with volume. Moreover, if we change the packaging design from today's solution to the new alternative, there will be time to save by reducing one activity while packing since the working operation of patching up the corrugated board box with tape will disappear. On the other hand, the amount of box sizes needed (at least 74 sizes) and the fact that the batches of every part are relatively small, render automation more difficult which is why we do not think the economies of scale are very large.

With this in mind, we have made the following assumptions:

It takes the average supplier 1 hour to package 35 parts in corrugated board boxes.

It takes an average Tetra Pak employee 1 hour to package 45 parts in corrugated board boxes if Tetra Pak has such a volume that economics of scale can be achieved.

The annual cost of one supplier employee is 400 000 SEK.

The average cost of packaging one part at the average supplier is calculated as follows:

$$\frac{\text{Annual cost/employee}}{47\ \text{weeks} * 40\ \text{hours} * 35\ \text{pcs}} = 6\ \text{SEK/part}$$

We already know that the annual cost of one Tetra Pak TS employee working in the storage is 400 000 SEK (see section 5.10.2). Then the average cost of packaging one part at Tetra Pak becomes:

$$\frac{\text{Annual cost/employee}}{47\ \text{weeks} * 40\ \text{hours} * 45\ \text{pcs}} = 5.00\ \text{SEK/part}$$

If we change the packaging design from today's solution to the new design there will be time to save by reducing one activity while packing since the action of patching up the corrugated board with tape will disappear. Therefore the cost decreases for all locations with this alternative.

We assumed that the cost for packaging at both would be in the same range as packaging at the suppliers. This because we know from section 5.10.1 that today Tetra Pak uses 7 000 corrugated board boxes in-house and the suppliers use 83 000 boxes, i.e. the suppliers pack the majority of the parts today. If the volumes increases there will be economics of scales to gain even at the suppliers.

Then, the cost of packaging one part can be seen in Table 13.

Cost of packaging one part	**With today's packaging design and volume (SEK)**	**With new packaging design and today's volume (SEK)**	**With new packaging design and new volume (SEK)**
At Suppliers	6	5.50	5
At Tetra Pak	5	4.50	4
At both	6	5.50	5

Table 13: Cost of packaging one part

Since we have come to the conclusion that the pre-packaging of the parts we have examined shall take place at Goods receipt or at the suppliers, see section 7.3.5, the cost at Pick and pack will reduce if more parts arrive pre-packed. We do not know how long time it takes to package a part in a plastic bag, which is the most common packaging material used at Pick and pack, see section 5.5.4, but have made the following assumption:

For every part that arrives to Pick and pack pre-packaged, i.e. the pickers do not need to perform any primary packaging activity more than fasten the label on the part's box, there will be possible to save 5 seconds in handling time for each part, which means 720 parts/hour.

We know that the average cost per employee is approx. 400 000 SEK. Then, we calculate the reduced cost at Pick and pack per part according to the following equation:

$$\frac{\text{Annual cost/employee}}{47\ \text{weeks} \times 40\ \text{hours} \times 720\ \text{parts/hour}} = 0.3\,SEK/part$$

Since the volume of parts being pre-packaged in corrugated board increases with approx. 260 000 parts (360 000-100 000 parts, see section 7.7.5 and the first assumption in section Cost of packaging material above) in our last scenario, the reduced outbound handling cost will then be for the new volume:

260 000 parts*0.3 SEK/part = 78 000 SEK

The cost for handling in-house can be seen in Table 14.

Cost of handling in-house	**In-house**		
	Today	New design	New volume
	5 SEK/pc	4.50 SEK/pc	4 SEK/pc
Handling inbound	500 000	450 000	1 440 000
Handling outbound (reduced cost)	0	0	-78 000
Sum of handling cost (SEK)	**500 000**	**450 000**	**1 362 000**
Sum of handling cost/ piece (SEK)	**5.0**	**4.5**	**3.8**

Table 14: Cost of handling in-house

The costs for handling at the suppliers can be seen in Table 15 below:

Cost of handling at suppliers	**At supplier**		
	Today	New design	New volume
	6 SEK/pc	5.50 SEK/pc	5 SEK/pc
Handling inbound	600 000	550 000	1 800 000
Handling outbound (reduced cost)	0	0	-78 000
Sum of handling cost (SEK)	**600 000**	**550 000**	**1 722 000**
Sum of handling cost/ piece (SEK)	**6,0**	**5,5**	**4,8**

Table 15: Cost of handling at the suppliers

The costs for handling at both can be seen in Table 16 below:

Cost of handling at both	At both		
	Today	New design	New volume
	6 SEK/pc	5.50 SEK/pc	5 SEK/pc
Handling inbound	600 000	550 000	1 800 000
Handling outbound (reduced cost)	0	0	-78 000
Sum of handling cost (SEK)	**600 000**	**550 000**	**1 722 000**
Sum of handling cost/ piece (SEK)	**6,0**	**5,5**	**4,8**

Table 16: Cost of handling at both

Tables 14-16 show that the most economical would be to pack all parts in-house at Tetra Pak since there would be economics of scale to achieve. We have however not taken into account the cost for space needed to perform the packaging activities. We can also see that the decrease in cost at Pick and pack is small in proportion to the cost for packaging due to the fact that today the pickers mostly pack in plastic bags, which takes less time then packaging in a corrugated board box.

Cost of disposal

We know that the flow of parts will be the same even if Tetra Pak decides that more parts shall be pre-packaged. This means that the amount of secondary packaging material, e.g. outer packages such as export packages, would be almost the same. The outer packages would increase little in size, since they now have to be dimensioned for parts being pre-packaged singularly, while the need of material for protection and filling material, such as chips and bubble plastic will decrease. The cost for disposal of packages is primary focusing on transportation packages. If Tetra Pak keeps it as today (both Tetra Pak and the suppliers pre-package) we do not believe that there will be any difference in disposal cost at the storage in Lund.

If Tetra Pak decides to outsource all the pre-packaging activities to the suppliers, the cost of disposal might be reduced. The reduction will however be quite moderate since the personnel at Goods receipt today pre-package such a small share of the parts. If those parts were pre-packaged by the suppliers instead, the cost of disposal would not be affected greatly since the personnel still would need to remove and dispose the secondary packages.

If Tetra Pak instead decides to perform all packaging activities in-house, the cost of disposal might increase. We are however of the opinion that the suppliers do not pack more than necessary and they therefore do not pack parts without pre-packaging demand. Consequently we do not think there will be any significant increase in the cost for disposal.

Based on the discussion above, we do not think that the cost of disposal will be affected greatly if the location of the packaging activities is changed. We will therefore not take this cost into account when determining the optimal location of the pre-packaging activities for the chosen parts.

Cost of transportation

The cost of transportation and how it is affected by packaging is very difficult to estimate since the cost depends on weight, volume and destination, variables that vary from case to case. Tetra Pak has a large range of products and customers all over the world. These customers demand different modes of transportation and all of the orders are unique, in the sense of contents, since every order is customer suited. Moreover, Tetra Pak does not know how much of its transports that are invoiced on real weight or volume weight. This makes it very difficult to estimate the average cost of transportation for one spare part.

Inbound

The transportation mode applied for inbound shipments to the distribution centre in Lund is mostly regular trucks. Since trucks have a high conversion factor (333 kg/m^3) it is likely that the cost of inbound transportation is volume dependent. Moreover, according to the Alfa Laval case that was described in 5.10.5 we see that the majority of Alfa Laval's truck shipments were invoiced on volume weight which supports our assumption that the majority of Tetra Pak TS's inbound transportation cost is likely to be volume dependent.

This means that for the different alternatives the transportation cost will be affected. If the pre-packaging takes place at the suppliers, the transported volume will increase, and the transportation cost will rise. To locate the pre-packaging activities in-house does however not mean that the suppliers can stop packing their parts. According to their contracts, the parts are supposed to reach Lund in good condition, and they therefore still require some packaging. We do however believe that there might be a marginal decrease of the transportation cost if the packaging is performed in-house. We do not include this in our calculations though since we find it too difficult to measure.

If Tetra Pak keeps it as today (with packaging at both the supplier and at Tetra Pak) the transportation cost will increase for those parts that are pre-packed at the suppliers.

We know that the more transported volume, the higher the transportation cost, which is why we have counted with a higher cost increase (+15% compared to 5 %) when the new volumes are introduced. We have given the supplier alternative and the both alternative the same cost increase since the majority of the parts being packaged in corrugated board boxes today are being packaged by the suppliers, (see section 5.3.3 and 5.5.1).

Based on the above discussion, we assume that the inbound transportation cost will increase as in Table 17 below:

Inbound	Cost increase, same volume	Cost factor, same volume	Cost increase, new volume	Cost factor, new volume
At suppliers	+5%	1.05	+15%	1.15
In-house	+0%	1.0	+0%	1.0
At both	+5%	1.05	+15%	1.15

Table 17: Influence on the inbound transportation for the two scenarios and three locations

Outbound

The outbound transportation cost does not depend on where in the supply chain the goods are packed. It will be the same independent on who packs the goods, the only difference for this cost is the volume that is pre-packaged. We know that approx. 90 % of the outbound shipments are performed using modes of transportation with conversion factors of 167 or 250 kg/m^3, compared to the conversion factor of 333 kg/m^3 for the inbound transportation, see section 5.10.5. We can therefore say that it is likely that a larger part of the outbound transportation is invoiced on real weight compared to the inbound transportation.

This means that if Tetra Pak adds a corrugated board box to the parts, the weight will increase marginally but as long as the box are well fitted, so that the volume weight of the shipment does not exceed the real weight, the transportation cost will not increase significantly.

According to the Alfa Laval case, 52% of its airfreight and express shipments were invoiced on real weight. This supports our line of argument and the assumption that the outbound transportation will not increase as much as the inbound when the volume increases. We have therefore decided to assume that the cost of outbound transportation will increase with 10 % when the volume increases.

Based on the above discussion we assume that the outbound transportation cost will increase as in Table 18:

Outbound	Cost with the same volume	Cost factor, the same volume	Cost increase with changed volume	Cost factor, the new volume
At suppliers	+0%	1.0	+10%	1.1
In-house	+0%	1.0	+10%	1.1
At both	+0%	1.0	+10%	1.1

Table 18: Influence on the outbound transportation for the two scenarios and three locations

Estimations

Because of the secrecy reasons, we cannot give the accurate cost for Tetra Pak and their transportation. We have therefore used fictitious numbers when estimating the transportation cost. We know from the empirical studies that the relationship between inbound and outbound transportation is 1:5. If we say that the inbound transportation cost is 100 000 SEK it would give an outbound cost of 500 000 SEK. Like we said these numbers are made up.

With our fictitious numbers the costs would be as in Table 19 below:

Cost of transportation/ year	**Cost of transportation today (corrugated board packed parts) (SEK)**
Inbound	*100 000*
Outbound	*500 000*

Table 19: Share of transportation cost for corrugated board packages, fictitious figures

For the three different alternatives we assume that there will be a change in transportation cost. The factors that we approximated earlier in this chapter are used to estimate the new transportation costs for each alternative, see Table 20.

Place of pre-packaging	**Today's volume (SEK)**	**New volume (SEK)**
At suppliers		
Inbound	*105 000*	*115 000*
Outbound	*500 000*	*550 000*
Total	***605 000***	***665 000***
In-house		
Inbound	*100 000*	*100 000*
Outbound	*500 000*	*550 000*
Total	***600 000***	***650 000***
At both		
Inbound	*105 000*	*115 000*
Outbound	*500 000*	*550 000*
Total	***605 000***	***665 000***

Table 20: Cost of transportation for the different volumes, fictitious figures

Cost of discrepancies

If the products' packages are improved there will be a decrease in the discrepancies. A discrepancy affects all the cost in the supply chain since it normally requires that a new part needs to go through the whole system again. It also affects the Tetra Pak brand value as a customer who reports a discrepancy probably is dissatisfied with Tetra Pak's service level. Moreover, the time from order to delivery will increase when parts need to be sent twice. If introducing a new design and increase the volume of parts that are being pre-packed, there should be the possibility to include those parts that have received a discrepancy due to poor packaging. This would minimise the discrepancies that derives from poor packaging. It is however never possible to reduce all errors and we have therefore made the following assumption:

90% of the cost of discrepancies deriving from packing errors will be eliminated with the introduction of a new package.

Due to secrecy reasons we are not allowed to present the actual cost of discrepancies. This cost will however not affect the decision regarding where in the supply chain to pack the parts since we assume that the cost of discrepancies will be the same independently on which part of the chain who packs the goods.

We draw the conclusions that if Tetra Pak pre-packs more goods it will give a small saving in cost of money for the parts, but the savings in qualitative measures are larger but more difficult to estimate.

Cost of scrapping of parts

Today's system at Tetra Pak TS for scrapping where all scrapped parts are collected under the same item in the account system makes it impossible to actually know how much of the parts that were scrapped due to obsolescence, low turnover, or damaged parts. Consequently, Tetra Pak cannot evaluate how much of the scrapping that derives from damaged parts due to the internal handling in the storage in Lund. As we have understood it there are a lot of goods that are scrapped due to damages during the storage when the parts move in the warehouse transportation systems.

As a consequence of the above, we cannot tell or estimate how much of the scrapping cost that could be avoided if the parts were packed properly. Better protection will however decrease the scrapping due to product damages.

Total cost of packaging alternatives

Table 21 below shows that the cost for packaging one part does not vary so much depending on where in the supply chain the packaging activity takes place. The least expensive alternative is to pack everything in-house according to this model. We do however need to take into account that some suppliers today do not charge Tetra Pak for the packaging activities while they receive the packaging material for free. If the pre-packaging is located in-house Tetra Pak will have a cost that so far has been for 'free'.

By changing the packaging design but keep the same volumes the total cost will increase, as will the cost per piece. By changing both the design and the volume the total cost will increase but the cost for packaging one piece will decrease. We can

also see that the largest factors that affect the decisions on whether to change the design, the volume and the location the pre-packaging activities are cost of packaging material, cost of handling and cost of transportation.

Total cost for packaging	**In-house**			**At supplier**			**At both**		
	Today	New design	New volume	Today	New design	New volume	Today	New design	New volume
Cost of packaging material	*590 000*	*800 000*	*1 800 000*	*590 000*	*800 000*	*1 800 000*	*590 000*	*800 000*	*1 800 000*
Cost of inventory	*39 000*	*53 000*	*119 000*	*39 000*	*53 000*	*119 000*	*39 000*	*53 000*	*119 000*
Cost of handling	500 000	800 000	1 362 000	600 000	550 000	1 722 000	650 000	600 000	1 722 000
Cost of transportation	*600 000*	*600 000*	*650 000*	*605 000*	*605 000*	*665 000*	*605 000*	*605 000*	665 000
Sum of costs (SEK)	**1 729 000**	**2 253 000**	**3 931 000**	**1 834 000**	**2 008 000**	**4 306 000**	**1 884 000**	**2 058 000**	**4 306 000**
Sum of cost /part (SEK)	**17**	**23**	**11**	**18**	**20**	**12**	**19**	**21**	**12**

Table 21: Total cost of packaging (italic figures are fictitious).

9.4.2 Qualitative analysis

Even though the cost analysis gave us the answer that the packaging generally is to be performed in-house, we still need to perform a qualitative analysis in order to make sure that no important aspects are overlooked. Furthermore, the differences in cost are not that large which imply a need of a qualitative analysis. First, we will analyse the size of suppliers who deliver the selected parts in order to get an understanding regarding the possibility of locating the pre-packaging activities there. Thereafter we will structure the analysis according to the following aspects:

- Location of the suppliers
- Outsourcing
- Packaging postponement
- Environmental aspects
- Direct deliveries
- Double handling
- Instructions
- Product responsibility

In connection to each analysed aspect, we will when relevant present a criterion we intend to use when rating the alternatives, i.e. in-house, at the suppliers or both. We will first rate the criteria according to their importance on a scale from 1-6.

Distribution of parts suppliers for the chosen products

The 5000 parts we have investigated as candidates for pre-packaging in corrugated board boxes came from 142 suppliers. The following table shows the suppliers' sizes measured as number of delivered parts to TS. As can be seen in Figure 43, a relatively small share, only 8% of the suppliers deliver more than 10 000 parts per year. In other words, there are very few suppliers delivering the majority of the parts, and many small suppliers with very few parts.

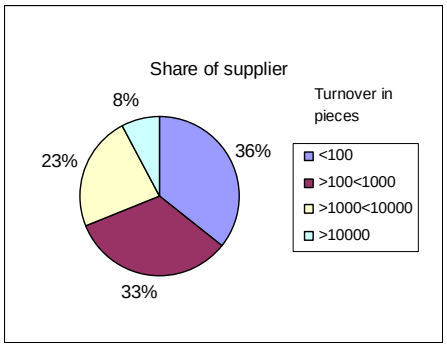

Figure 43: Share of suppliers delivering a certain amount of parts

The fact that 36% of the suppliers to the selected parts are very small (less than 100 parts per year) and 33% are quite small (less than 1000 but more than 100 parts per year) makes us believe that the location of pre-packaging activities at those suppliers would be inefficient. Suppliers who produce small batches of many different parts will need to keep a lot of packaging sizes in stock. On the other hand, most of the

suppliers we visited pack after customer demands. Therefore we question why it would be more difficult for them to pack after Tetra Pak's requirements compared to other customers.

If the suppliers are very small, it will require many small shipments of packaging material to them. This will require extensive handling at the distribution centre in Lund due to the fact that the packaging material supplier uses minimum quantities. We do therefore exclude too small suppliers from performing the pre-packaging activities since we judge that the costs would greatly exceed the benefits.

Location of the suppliers

Tetra Pak TS has both local as well as international suppliers. For instance, a few of TS's top ten suppliers in terms of sales volume to Tetra Pak TS are located in Italy. Parts coming from foreign suppliers must be well packaged, maybe singularly, in order to withstand transportation stresses. Therefore there is a risk that the location of pre-packaging in-house will imply double handling and re-packaging if the parts shall be sold in Tetra Pak branded boxes, which is our recommendation. We therefore recommend Tetra Pak to investigate the possibility of making a global agreement with a packaging material supplier so that the abroad parts suppliers can be supplied with packaging material from local production sites controlled by the global packaging material supplier. Such an investigation lies however outside the boundaries of this study.

If such an agreement cannot be achieved, it is apparent that it is not economical, neither environmentally friendly to send packaging material from Sweden to suppliers far away in order to let them pre-package their parts in Tetra Pak marked boxes. Moreover, we see a risk in making a general policy decision saying that pre-packaging always shall take place at the suppliers since that restricts Tetra Pak's possibility of locating more production at abroad suppliers, which can be desirable from certain points of view. For instance, we have come to understand that the workforce supply to the Swedish mechanical workshop is decreasing which provides a reason for Tetra Pak to locate a larger part of the production abroad.

Since we do not believe that the option of making a global agreement with a packaging material supplier is realistic in the near future, we therefore exclude foreign suppliers as candidates for pre-packaging in Tetra Pak marked boxes, at least for now.

Outsourcing

As described in the theoretical framework, see 4.4.3 outsourcing of non-core activities can provide higher efficiency, less bureaucracy, stronger market position and stronger strategic focus. We do not consider the pre-packaging of spare parts as a strategic activity for Tetra Pak TS, but on the other hand it is not a strategic activity for the suppliers either. Moreover, outsourcing is unlikely to occur when the buyer, i.e. Tetra Pak TS, can reach economies of scale in that particular activity. As can be seen in the cost analysis, 9.4.1 Tetra Pak TS can achieve such economies of scale. Furthermore, to outsource successfully, excellent suppliers and hence excellent purchasers are needed. Due to the fact that the supplier managers are not interested in

negotiating on special agreements to Tetra Pak TS, we see a risk in outsourcing the pre-packaging activity completely.

According to the theoretical framework, cost reduction is by far the most common motive when companies decide to outsource. Since we have come to the conclusion that there is no such cost reduction, we do not see that this argument is enough in order to recommend Tetra Pak TS to outsource all pre-packaging activities to the suppliers. From a strict economic perspective, outsourcing is recommended when the sum of external cost of production, i.e. the pre-packaging activity in this case, plus the cost of transaction is less than the internal cost of production (pre-packaging). We mean that Tetra Pak would be affected by all examples of transaction costs being described in the theoretical framework, such as costs of negotiation, contracts, transports, communications and control of the suppliers' performance. Since there must be two pricelists in the contracts, one where pre-packaging is included and one where it is not, there will apparently be an extra cost of contract and negotiation. Moreover, the packaging material must be transported to the parts suppliers and their supply of packaging material must be administrated by Tetra Pak if the suppliers do not start ordering in larger quantities, which we think is difficult to achieve since their production of parts will not increase due to our proposals (if they order in higher quantities, then they can administrate the supply of packaging material by themselves, but the majority of the suppliers are too small to do that).

Furthermore, if Tetra Pak decides to outsource the pre-packaging activity there is a need for the personnel at Goods receipt to control that the suppliers have performed the pre-packaging activities as supposed. This was actually recommended already in former pre-packaging projects, but according to the Goods receipt manager this is not possible for his co-workers since they do not have the time. The Goods receipt personnel do not have immediate access to information telling if it is them or the suppliers that should perform the pre-packaging, they can only see if the part is to be pre-packaged at all. If Tetra Pak TS should decide to outsource *all* pre-packaging activities this control would however be achievable.

To conclude, when regarding the arguments of outsourcing in general, we see no reason as to recommend Tetra Pak TS to strive in that direction regarding the pre-packaging. The main motive for outsourcing is cost reduction which we do not see in this particular case. Moreover, it is apparent that the cost of transaction cannot be disregarded as the administration and transportation of packaging material as well as the cost for contracting imply substantial costs. Lastly, according to our cost estimations, there are economies of scale to gain from placing the pre-packaging activities in-house, a factor that normally speaks in favour of in-house production.

We are of the opinion that the outsourcing argument is of medium importance, which is why we rate it 3 on a scale from 1 to 6.

Packaging postponement

According to theoretical framework, the factors determining when to postpone packaging are economies of scale in the packaging operation, transportation cost advantages from smaller cube and weight, and risk deriving from variations in forecasted demand. As described earlier Tetra Pak TS has economies of scale to gain

from postponing pre-packaging until the parts reach Lund DC. There are also transportation costs advantages if the pre-packaging is performed in-house, i.e. postponed, see 4.4.1. The risk of variations from forecasted demand is however not a factor we regard as determining when recommending whether to locate the pre-packaging activities in-house or at the suppliers.

Today, the concept that Tetra Pak TS applies can be described as logistics postponement, i.e. finished inventory is kept at a central location (DC Lund) and products are shipped directly only on demand. For the majority of the outbound shipments, Tetra Pak TS uses premium transportation, which is a typical characteristic of this strategy. We do however not recommend Tetra Pak TS to further postpone packaging, for instance through the use if the full postponement strategy, since the spare parts customers are not ready to wait a long time for their spare parts since their business might rely on the supply of that particular part.

As it is today, the majority of Tetra Pak TS outbound transportation is express shipments. Moreover, the co-workers in Lund are experiencing a high stress level, factors that speak against the in-house location of pre-packaging activities.

To conclude, we mean that locating the packaging in-house might imply a too long lead time for the spare parts customers. Thus, the time factor is a very important argument speaking against the in-house alternative. Then again, if Tetra Pak TS can carry through the genuine parts on-time project with the aim of making the customers improving their order planning, the time factor might be less important. According to the background material from the genuine parts on-time project, it should be possible for the customers to better plan their orders, with the implication that a greater deal of the spare parts deliveries can be foreseen. In this project we must however examine the situation as it is today, and we cannot rely on results from a project that has not yet been carried through. Therefore, the time factor is highly favouring the supplier alternative.

Based on the above discussion we give the time factor the rate 5 on a scale from 1 to 6 since it is a very relevant criterion.

Environmental aspects

As discussed in the cost analysis, we have assumed that the inbound transportations will increase if Tetra Pak decides to locate the pre-packaging activities of our chosen parts at the suppliers. Increased transportation is naturally not desirable from an environmental point of view. Moreover, the environmental impact of distributing packaging material must not be disregarded, especially not if Tetra Pak decides to increase the number of parts with pre-packaging requirement corrugated board box.

On the other hand, for parts that require singular packaging in order not to get damaged on the way, there will be less efficient transportation if the pre-packaging takes place in-house. Alternatively, parts will get damaged on the way and that is not an option. Moreover, to locate the pre-packaging activities in-house might imply less efficient use of the packaging material as Tetra Pak will have to get rid of all packaging material needed to protect the parts from the suppliers to Tetra Pak. It might for instance lead to that bubble plastic that are used today will have to be

disposed of. Then again, we believe that the use of export packages cannot be avoided since the products must withstand the transportation strains they are exposed on their journey from the supplier to Tetra Pak.

To conclude, we think that the increased transportation caused by pre-packaging at the suppliers is less environmental friendly than the potential waste of packaging material that arises if the pre-packaging takes place in-house. Accordingly, from an environmental point of view we believe that pre-packaging in-house is better.

We mean that the environmental criterion is quite important which is why we give it the weight 4.

Direct deliveries

If Tetra Pak in the future wants to introduce direct deliveries from suppliers to end-customers, it is disadvantageous to locate the pre-packaging activities in-house, at least if there is a demand to package those parts singularly, which is what we recommend.

Thus, from a direct delivery point of view, pre-packaging is with advantage located at the suppliers. Based on our knowledge regarding Tetra Pak's distribution set-up, we do not believe that the introduction of direct deliveries is close at hand. We do therefore not regard this argument as a very important one and give it the weight 1.

Handling

There is a risk that the handling is not performed optimally if Tetra Pak TS decides to pre-package the parts in-house. This is however only true if the parts suppliers who pre-package today are not willing to stop doing that. We do however not consider that an issue since we are of the impression that the suppliers are not interested in pre-packaging if they do not have to. Then again, for parts that require singular packaging in order not to get damaged on the way, there will be double handling, i.e. re-packing if the pre-packaging takes place in-house.

To conclude, from a double handling perspective it is better to locate the pre-packaging at the suppliers. We do however not think that this is such a strong argument since the suppliers will generally not pack singularly in corrugated board boxes if not asked explicitly. Handling is therefore given the weight 2.

Instructions

Due to the fact that Tetra Pak's suppliers have not received any packaging instructions regarding the parts, it would be easier to locate the pre-packaging in-house since there are fewer persons who need to be educated.

A common argument as to why pre-packaging shall take place at the suppliers is that they know more about the packaging requirements of their parts than Tetra Pak Goods receipt personnel do. We question however whether this is a correct assumption since our impression after our supplier visits is that it is not the same person manufacturing the parts as packing them. Therefore, it is uncertain whether the individual co-worker responsible for the packaging has any more competence than the Goods receipt co-workers regarding the packaging demands of the parts.

Based on the above discussion, the instruction argument speaks in favour of pre-packaging in-house, but we do not think this is such an important factor to consider since we believe that it is possible to develop packaging instructions and implement them at the suppliers to a reasonable cost. The instruction argument is therefore not taken into account when deciding where to package the parts.

Product responsibility

As described in section 5.8 the nature of the product responsibility law, i.e. joint and several, implies that the actors in the supply chain share the product responsibility. An injured party can sue either actor in the supply chain and has no responsibility to investigate which party who caused the damage. The sued party will be liable to damages if it has been in contact with the product. Consequently, Tetra Pak has the same likelihood of being sued even if they re-pack products since it is likely that the injured party will sue Tetra Pak if he bought the part from Tetra Pak, independently on who performed the packaging of it, Tetra Pak or the supplier producing it.

If Tetra Pak receives a writ of summons, it has to settle this with the other parties throughout the supply chain. As previously described, Tetra Pak controls this in the contracts with the suppliers and lets the suppliers be completely responsible for injuries caused by products they have manufactured up to a part of or multiple of their annual sales volume to Tetra Pak. However, if the pre-packaging of parts somehow damages the product so that it causes damage somewhere else in the supply chain, Tetra Pak will have to pay.

To sum up, Tetra Pak will only have to pay if it is possible to prove that they have caused the injury. In this context, Tetra Pak must only pay if the pre-packaging of the part somehow caused the damage for which Tetra Pak is sued, provided that Tetra Pak keeps controlling the suppliers' responsibilities in the contracts. Therefore, we will not let the product responsibility affect the recommendation regarding the location of the pre-packaging activities.

Conclusions qualitative analysis

For each alternative, in-house, at supplier or at both, we will rate how well they live up to the criteria. The best alternative will be given the score 3, and the worst will be given the score 1. The weights and the score are thereafter multiplied and we get a total score for each criterion. The weighted scores are thereafter summed up and a winner is appointed.

After having excluded the foreign suppliers, we still have to decide whether the remaining suppliers shall perform the pre-packaging or not. We think that the total cost is the most important criterion which explains why we have chosen to give that argument the weight 6 on a scale from 1 to 6.

Based on the discussions above, our conclusions regarding the locations of packaging will be summarised in Table 22.

Criterion	Weight	In-house		Suppliers		Both	
		Score	Weighted score	Score	Weighted score	Score	Weighted score
Estimated total cost	6	3	18	1	6	2	12
Outsourcing	3	3	9	1	3	2	6
Time factor	5	1	5	3	15	2	10
Environmental aspects	4	3	12	1	4	2	8
Double handling	2	1	2	3	6	2	4
Possibility of direct deliveries	1	1	1	3	3	2	2
Weighted sum		**12**	**47**	**12**	**37**	**8**	**42**

Table 22: Conclusions regarding the location of the pre-packaging activities; locate in-house

As the table shows, we think that the most rational is to locate the pre-packaging of the chosen parts in-house.

9.4.3 Need of investments

If the pre-packaging takes place in-house there is a need of investments, such as a better packing tables and this will naturally be of some cost. We have also identified a need of employing three pre-packers at Goods receipt. They will need a packing table each which gives a total investment cost of approx. 3*7000=21000 SEK.

There will also be a need of approx. 7 new printing plates for 10 000 SEK per piece and 74 new punching tools a 3000 SEK. The cost of investments for creating the branded corrugated board box will then be approx.:

$7 \times 10000 + 74 \times 3000 = 70\,000 + 222\,000 = 292\,000$ SEK.

10 Conclusions and recommendations

In this chapter we will present our conclusions and recommendations based on our analyses. We want to make clear that our results and recommendations are based on the selection of 5000 unique carton parts. We will first present the results concerning these parts, and we will thereafter discuss the possibility of drawing more general conclusions regarding the rest of the assortment. Thereafter, we will present our implementation plan and other recommendations that come up during the analyses.

10.1 Conclusions

The objectives of this project were:

- To evaluate a number of packaging solutions of corrugated board to a limited number of Tetra Pak unique Carton parts and produce recommendations regarding the number of package sizes needed to package these parts
- To develop a suggestion regarding where and how in the supply chain to primary package the parts we have chosen earlier
- To estimate the change in total cost deriving from the new proposed packaging solutions and new location of packaging activities

In the following sections we will present the conclusions regarding packaging design and number of packages needed as well as our conclusion regarding the location of the packaging activities for the selected parts.

10.1.1 New packaging design

We suggest that Tetra Pak introduces a new standard packaging design to the parts in form of the FEFCO 427 box. The package's construction has a sealing mechanism which provides the parts better protection and it is also more efficient to handle thanks to the elimination of the working operation of taping. The package shall be white since Tetra Pak is operating in the dairy industry which we think is associated with that particular colour. The package shall be printed with Tetra Pak's logotype, including the house mark, in two colours, namely blue and red. Under the logotype Tetra Pak 'Genuine Parts On-time' shall be written. The printing text can be seen in the following picture:

Figure 44: Logotype and text to be printed on the new boxes

Based on the selected 5000 unique Carton parts, we have come to the conclusion that at least 74 sizes are needed to package these parts properly. We do however want to emphasise that this is not the optimal solution and that it is possible to further improve it.

We see that an introduction of a new packaging solution in 74 packaging sizes to the selected parts would give an increase of the *total cost*, no matter where the pre-packaging activities take place. This cost assumes however that Tetra Pak starts ordering corrugated board boxes in larger batches than today. Our calculations are based on larger batch sizes, and if Tetra Pak continues to order in small quantities, the cost increase will be much higher than what we have estimated it to be.

The *value* of the new solution is however more difficult to measure quantitatively. We can however see a number of qualitative improvements:

- The new package gives an indication of the value of the part within and the fact that it is branded signals a Tetra Pak commitment to the part.
- The new improved package will hopefully increase the perceived value of the part inside it, and works therefore as a means of translating the quality of the parts into customer perceived value and customer perceived quality. As a consequence Tetra Pak's brand will be strengthened.
- The new package improves not only the perceived value but also the actual quality of the part as the chance that it reaches the end-consumer undamaged increases.
- If nothing is done we see a risk that the rest of Tetra Pak business is undermined; Tetra Pak has a reputation as a high quality producer of packaging material to the food industry, therefore the customers expect Tetra Pak to also package the parts in a high quality manner.
- The number of discrepancies due to packing error will decrease, which at the end of the day will lead to more satisfied customers which must be Tetra Pak Technical Service's ultimate objective.

Based on the discussions above our conclusion is that the benefits exceed the measurable costs. We therefore recommend Tetra Pak to implement the new packaging design to the selected unique Carton parts.

10.1.2 Location of pre-packaging activities

Based on our cost estimations and our quantitative analysis regarding 5000 unique Carton parts that shall be primary packaged in corrugated board boxes, we recommend Tetra Pak to locate the pre-packaging of them in-house.

Transferability to standard components

The suggestion that pre-pack the selected parts in-house is transferable also to standard components and it is very likely that it is the only option if Tetra Pak wants to sell standard components in Tetra Pak branded packages. If Tetra Pak should decide to re-pack standard components, that would however imply very large volumes and lots of double handling. Moreover, the cost per part would increase to some extent and we also question whether the margin of standard parts allows a significant cost increase.

Moreover, we do not recommend Tetra Pak to re-label standard components since there is nothing to re-label compared to today. All parts leaving the storage have a

Tetra Pak-marked label on them and we see no reason to change that. In addition, we do not see that re-labelling of standard components improves customer value.

Transferability to other primary packaging materials

The transferability of our results to other primary packaging materials will be elaborated on in this section.

Regarding *plastic bags*, we can see that we do not have the same incentives to locate the pre-packaging activities in Lund since plastic bags basically do not add either weight or volume to the parts. This implies that the transportation costs will not increase if the pre-packaging takes place at the suppliers as opposed to the corrugated board box case. Furthermore, we do not think that the economies of scale regarding the handling are as apparent as when regarding corrugated board boxes, provided that the packaging continues to be carried out manually.

The situation regarding the plastic bags will however be different if Tetra Pak decides to invest in machines that automatically sort the parts and close the plastic bags. Then the economies of scale will increase and working operations at Pick and pack can be eliminated. Due to the fact that 50 % of the picks require packaging activities, mostly in plastic bags, we think that there is a potential of rationalising and hence saving if those working operations disappear. Since the packaging in plastic bags was outside our scope, we recommend Tetra Pak to further investigate the cost of automating the packaging activities in order to make a decision regarding the location of those activities.

Regarding *nets*, the argumentation is almost the same as in the plastic bag case, i.e. they do not add volume or weight. We also judge the possibility of automating the packaging in nets to be small which is why we think that this kind of packaging is with advantage located at the suppliers.

When considering the *tubes*, we see that the same arguments that speak in favour of packaging in corrugated board in-house, namely that tubes adds weight and volume, which affect the transportation costs. It is however possible that there is a need from a product protection point of view to package in tubes in the journey from the suppliers. We do therefore recommend Tetra Pak to further investigate this matter before deciding where this pre-packaging shall take place.

To sum up, locating some of pre-packaging activities of parts at the suppliers requires though that there will still be administration and distribution of this pre-packaging material in Lund, a working operation we wanted to eliminate when we recommended Tetra Pak to locate the pre-packaging of parts in corrugated board boxes in-house. Despite this fact, we still think that the recommendation concerning the corrugated board boxes still is valid since the need of transportation will not disappear if the parts are pre-packaged at the suppliers.

10.2 Implementation plan

We recommend Tetra Pak to initiate a project in order to implement our proposals.

We suggest that Tetra Pak continues the co-operation with the corrugated board supplier in order to let them produce samples of the new box and thereafter evaluate whether changes are needed. As a first step, we advise Tetra Pak to send the data regarding the 5000 selected parts to the packaging material supplier and let them calculate the number of variants needed. We also suggest that the 5000 parts are analysed one more time in order to identify certain product groups that have a more apparent need or a less apparent need of being primary packaged in a corrugated board box.

SAP/R3 must be updated with pre-packaging demands on the chosen parts. Many of those lack such a demand. If the system is updated, there will be easier to achieve a more uniform packaging behaviour.

When regarding the standard components, we recommend Tetra Pak to first implement the new packaging solution to the unique Carton assortment and to thereafter evaluate the reactions from the customers and the market companies. Provided that their reactions are positive we recommend Tetra Pak to estimate the number of standard parts that need a corrugated board box in order to get a feeling for the amount of extra personnel and resources required.

In order to perform the corrugated board packaging activities in-house, Tetra Pak needs to reorganise the warehouse layout on Goods receipt. We suggest that a pre-packaging department is set up containing new packaging tables. As a first step we suggest that two new tables are purchased and two pre-packers are employed. We have estimated that there is a need of three pre-packages in our quantitative analysis but since that is merely an estimate, we suggest a little bit more careful roll-out.

10.3 Other recommendations

In this section, we will present our conclusions regarding findings we have come across that do not directly affect the purpose or the objectives of this thesis. We will start with packaging in particular and thereafter move on to Tetra Pak in general.

10.3.1 Packaging

In order to further rationalise the handling and management of packaging, we recommend Tetra Pak to do the following:

Pre-packaging instructions

We suggest that for all parts that should not explicitly be packaged in-house, there should be pre-packaging instructions and those should, as it is today, accompany the order that is sent to the parts supplier. This presupposes though that the question of pre-packaging has been dealt with before the contract is signed. Therefore, we recommend that Technical Service co-workers give their input and their requirements, for instance regarding packaging, in the parts supplier selection process. Particularly,

we would also like to see that this input is given *before* the signing of the contracts. Technical Service is after all one of Tetra Pak's three main business legs and we therefore think that demands coming from TS co-workers must be taken into account when choosing suppliers who will deliver many parts to TS.

Ordering of packaging material

We suggest that the routines for ordering packaging material are investigated. If internal consumption of packaging material was properly registered, less packaging material would be scrapped and less packaging material would thus be needed. Overall, there seems to be a need of evaluating the ordering system Syncron.

Working routines Pick and pack

We recommend Tetra Pak to overlook the working routines at Pick and pack. There is a need for warehouse management to clearly communicate to their employees that delivery on time is not good enough; good packing quality is equally important.

Responsibility of packaging material

We recommend that the responsibility of the packaging, both pre-packaging material and export packaging material are located under the same organisation. It is not necessary that it is the same person handling the two, but we recommend them to have a very close cooperation in order to gain leverage in the negotiations with the packaging material supplier.

Multiple quantities

We recommend Tetra Pak to investigate the possibility to introduce multiple quantities of parts. The use of multiple quantities would among other decrease the handling time at Pick and pack, and decrease the discrepancies due to miss calculations.

10.4 Concluding words

To sum up, we want to emphasise that Tetra Pak has great improvement potential in the area of pre-packaging, partly regarding the packaging design of the corrugated board boxes used to package the parts, partly regarding how the actual packaging is performed. If the recommendations we propose are implemented, we believe that Tetra Pak's brand will be strengthened and that activities relating to packaging will be rendered more efficient. Consequently, we judge that we have fulfilled our purpose which was to contribute to the development and implementation of an improved packaging solution to Tetra Pak spare parts that provides a higher customer value with the ultimate goal to strengthen the Tetra Pak brand.

11 Areas of improvement potential

In this chapter, we will present some Tetra Pak findings lying outside our scope that we have come across during this project. We think that there is improvement potential in areas which we have chosen to name Internal cooperation, and Measurements and business control.

11.1 Internal cooperation

We would like to see *clearer internal communication* between departments, particularly between Supplier Management at Carton Ambient and Tetra Pak Technical Service. We also see a need of improved communication routines within Tetra Pak Technical Service. We have experienced lacking communication between the outbound packaging responsible and the Genuine Parts On-time project, and we do not know if this is a common problem. If so, we recommend Tetra Pak to reflect on its communications channels in order to secure that important information reaches all employees affected by it.

We also question whether Tetra Pak has organised the *management of the suppliers* optimally. We see a risk in involving so many persons in the contacts with the suppliers; there are supplier managers, product managers, procurement co-workers, quality controllers and sometimes even a pre-packaging responsible dealing with various aspects concerning the suppliers. The risk we see is that the suppliers experience Tetra Pak as a fragmentised company where the one hand does not know what the other one is doing. Additionally, we think that the supplier could use this to his advantage in the negotiations.

11.2 Measurements and business control

Firstly, we are surprised by the troubles there seem to be regarding the possibility of finding statistics in SAP/R3. One example is that there is no statistics telling why a part was scrapped, a fact that makes follow-ups and continuous improvements very difficult to carry out.

Secondly, we question why Carton Ambient and Carton Chilled on the one hand and Processing on the other are operating so independently, concerning the *classification of the parts*. Processing classifies its components in one manner, and Carton in another. Moreover, Tetra Pak TS mixes the components independently whether they belong to the Carton assortment or the Processing assortment, for instance regarding pre-packaging.

Thirdly, we do not think that *measuring work performance in number of order lines* is the best way to motivate the co-workers. We do not think that this measure shows what is important, namely to ensure customer satisfaction, and therefore suggest Tetra Pak to investigate this matter more closely. There is for instance the concept of

Perfect order, i.e. when the customer gets exactly what he want at the time and place he wants it, which we think is a fairer way of measuring work performance.

We recommend Tetra Pak to further investigate *the cost of transportation* and how it is invoiced. This is important in the negotiations with the carriers, and is therefore central also in a wider picture, not only when investigating pre-packaging.

12 Future research

In this chapter, we present our suggestions regarding future research areas based on the gaps in the literature we have encountered during this project.

As described already in chapter 1, few studies have been conducted concerning the change in total cost throughout the supply chain if a new package is introduced or if a package is modified. In this thesis, we have tried to measure the total cost and how it is influenced by such a decision, but we still see a need of research in this area.

We have also identified a need of further research concerning the value of a branded package. There is literature dealing with the value of branding in industrial markets, but we have identified a need to further investigate the connection between the value of branding in general and the value of a branded package in particular. We believe that there is such a connection, but we see a need of verifying this proposition.

We have also got the impression that studies dealing with the value of packaging in business-to-consumer markets have been carried out, even though we have not been able to find any. We do however believe that the point of departure in business-to-consumer contexts is quite different since it is not likely that any companies would use a brown, unmarked box when addressing private consumers which some companies operating on the industrial markets do. Nevertheless, we think it would be interesting to validate whether such findings can be transferred also into industrial contexts.

Finally, we also would like to see further research investigating how the handling efficiency is affected when changing packaging design. In this study we have been forced to estimate this since we could not get hold of any studies dealing with the matter.

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Appendices

Appendix 1 - Parts supplier questionnaire

What is your name and position within the company?

Can you give us some general information regarding your company? (Number of employees, annual turnover)

What kind of products are you manufacturing, what is your core competence?

What kind of Tetra Pak supplier are you? Do you deliver to Tetra Pak's system suppliers or only to Tetra Pak TS in Lund?

Do you deliver kits to Tetra Pak?

Is there anything written in your contracts with Tetra Pak regulating how you shall package your components? Do you have any packaging specifications from either Tetra Pak or developed by yourselves?

What kind of packaging material are you using? (Wooden boxes, plastic bags, corrugated board boxes etc.)

Which suppliers for packaging material are you using? Are you engaging small local companies or larger multinational companies for your supply of packaging material?

Are your packaging requirements the same depending on whether the products are going to be used in production or if they are to be distributed directly as spare parts?

Do you have to adapt your production or your packaging activities depending on if the products are going to be used in production or in distribution as spare parts?

Do you treat Tetra Pak components any differently in terms of packaging activities compared to your other customers? If the answer is yes, how and why do you do it?

Which incoterm are you using for the deliveries to Tetra Pak?

Do you perform your packaging activities manually or automatically?

How would it affect you if Tetra Pak wanted you to put the Tetra Pak logotype onto all your packaging material (for Tetra Pak products)?

Appendix 2 – Tetra Pak Hoyer Questionnaire

The present situation

Do you re-pack everything at Hoyer today or do you require that some of your suppliers pack the parts in Tetra Pak branded packages?

How large volumes are you re-packing every year? Do you re-pack all parts, including standard components?

How many people and how much space is needed to re-pack the spare parts today?

For how long time has Hoyer re-packed the spare parts? How long time did it take for the implementation to succeed?

When you implemented the re-packaging did you investigate the possibility of outsourcing it to the parts suppliers? Did you do any cost estimation?

Which suppliers for packaging material are you using? Are you engaging small local companies or larger multinational companies for your supply of packaging material? What do you require from your packaging material suppliers concerning the package's appearance, manageability, protective abilities, environmental friendliness etc.?

Have you received any response or opinions from your customers regarding your branded packages?

After the takeover

How are you planning to persuade the suppliers to perform more of the pre-packaging activities? Do they all have the means of doing that?

If the suppliers are to perform the pre-packaging activities, which packaging material are they going to use? Will they use their own or Tetra Pak Hoyer's packaging material?

Will there be separate contracts and pricelists depending on whether the parts coming from your suppliers are to be used in production or to be distributed as spare parts?

Will your suppliers have to adapt their production or their packaging activities depending on if their products are going to be used in your production sites or in distribution as spare parts via the storage in Lund?

Are you going to keep the packages you are using today (those that are marked 'Genuine Spare Parts Tetra Pak Hoyer')? How do you think the customers will react to a change in the packages?

Appendix 3 – Volvo Cars Questionnaire

Name, title?

How do you package your spare parts today? Are all packages branded with the Volvo logotype?

Which were your primary motives when implementing today's packaging solutions for the spare parts? Have you seen any added profit? Have you counted on this in anyway? Increased sales etc.?

What is written on your packages? How did you decide what text to print on the packages?

Are your packaging requirements on you suppliers different depending on whether the products are going to be used in production or if they are to be distributed directly as spare parts? If yes, how do you handle the suppliers who deliver both to production and to the spare parts storage?

Do you have to adapt your production or your packaging activities depending on if the products are going to be used in production or in distribution as spare parts?

How many packaging solutions do you have?

Is it correct that the purchasing of spare parts and the purchasing to production are treated separately? Does this imply that there are two contracts and two pricelists? Is there any coordination between the two purchasing departments?

Have you been able to make suppliers of standard components to package spare parts in Volvo branded packages, do you re-pack or do you send such parts to the customers packed in their original packages? If you re-pack, have you considered whether the product responsibility is affected?

Are there any standard component suppliers who package in Volvo packages?

Do you have a package specification for the suppliers? Who developed it, Volvo or the supplier?

Who pays for the packaging material needed to package Volvo parts?

Which packaging material suppliers are you using?

How many employees are working with packaging/packages?

Appendix 4 – Sony Ericsson Questionnaire

Name:

Title:

Package specifications

How do you develop new packages? Do you do it by yourselves or do you hire other companies/packaging material supplier?

Is there a generic package specification that you use as a starting point when you develop a new package? Can you show us an example?

What is the most important factor regarding packaging design? Why?

Have you estimated the handling efficiency when it comes to choice of packaging design? If yes, how?

Have you calculated any possible increased value generated by the package? How do you estimate it?

How many packaging solutions do you have?

Do you differentiate the packages depending on the geographic location of the market and/or the customers?

How large share of the product's price derives from the package? Is there always a limit and how do you decide what it is?

Have you automated your packaging operations in anyway?

Packaging instructions

How did you develop your packaging instructions? Do you do it by yourselves or is it the suppliers who do it?

Is there a packaging instruction for each mobile phone or a generic that can be used to all mobile phones? Why?

To what degree do you specify your instructions? Is there something you leave out on purpose or something you are extra careful to specify?

Is the packaging outsourced or is it located in-house? Where?

Are there any cultural problems in using packaging instructions? Are there other possible solutions regarding telling how the packaging shall be performed?

Appendix 5 – Survey to market companies

Please rate the idea to use more commercial packages for our parts to better communicate the value of the parts (customer price will not be affected)?

Please rate today's primary packages for parts (the ‘inner’ boxes without any Tetra Pak marking)?

Appendix 6 – Supplier management Tetra Pak Carton Ambient

How is the packaging issue treated when you come to agreements with the suppliers? Is there anything written in the contract controlling the packaging of the part?

How do you treat the fact that the parts are not only going to be used in production but also be distributed directly to the customers as spare parts?

Have the standard component suppliers been asked whether they could package their parts in Tetra Pak marked packages? Have you received any offers regarding the cost for this?

What is your main focus within the supply management department?

Appendix 7 – Requirement specification new corrugated board packaging design

This document presents the requirements that a box of corrugated cardboard to Tetra Pak parts must meet.

A new package must live up to **marketing requirements**, i.e.:

- The new package shall be marked with the Tetra Pak logotype
- Discussion of printing requirements needed (one-colour, two-colour?)
- Discussion of colour needed (bleached or unbleached?)

A new package must withstand **mechanical strains** originating from the WCS and handling, i.e.:

- the package must be able to withstand products clashing into each other
- the package must not open during warehouse transportation (including conveyors and WCS)
- the package must withstand being placed under a heavier product and still provide a sufficient protection to the content, even if the content is fragile (questionable, might be easier/better to develop better work instructions for pickers and packers)

A new package must live up to **handling** requirements i.e.:

- the article number must be visible from outside the package
- the package design shall minimise the usage of tape
- the package shall minimise the raising time (rational raising)
- the package shall minimise the closing time (rational closing)
- the package's size shall be flexible (inserts?)

A new package must live up to **environmental** requirements i.e.:

- the package shall be as tight as possible
- the package shall be produced in returnable/recyclable material

A new package must live up to **transportation** requirements i.e.:

- the empty package shall have a high volume utilisation (empty packages) (definition of 'high' needed)
- the full packages shall have a high volume utilization (full packages) (definition of 'high' needed)
- Low weight (empty packages)
- Protection against transport damage

A new package must live up to **production efficiency** requirements i.e.:

- A new package must have a forecasted consumption of __ per year, at least
- A new package must have an order quantity of __ per order, at least
- A new package shall minimise the amount of packaging material needed

Appendix 8 – New sizes of corrugated board boxes

The highlighted ones are slit boxes, the remaining FEFCO 427.

Length (mm)	Width (mm)	Height (mm)	Number of parts (pcs)
560	480	73	28
560	60	50	137
450	286	170	22
450	99	81	83
450	50	36	183
360	267	193	27
360	99	51	60
360	60	40	171
300	250	230	3
300	250	139	10
300	209	130	32
300	120	70	75
300	50	47	142
250	246	180	3
250	246	80	30
250	180	137	33
250	140	106	36
250	91	64	217
200	172	168	3
200	190	62	7
200	165	95	9
200	144	118	6
200	145	51	19
200	111	92	21
200	111	52	124
200	51	45	171
170	145	95	16
170	118	96	108
170	50	39	117
150	146	120	14
150	146	49	13
150	116	115	20
150	116	57	14
150	90	73	12
150	90	40	20
150	70	60	42

Length (mm)	Width (mm)	Height (mm)	Number of parts (pcs)
150	50	40	60
150	30	30	97
130	123	83	22
130	100	80	26
130	100	40	33
130	70	63	23
130	70	30	33
130	50	45	37
130	50	30	65
130	30	30	25
130	30	15	76
110	110	80	24
110	90	92	11
110	90	60	48
110	70	65	27
110	70	30	47
110	50	50	29
110	50	30	41
110	50	15	102
110	30	30	93
110	30	15	16
90	90	81	35
90	90	61	44
90	70	74	64
90	70	35	52
90	50	50	92
90	50	20	63
90	30	30	42
70	70	67	77
70	70	30	41
70	50	54	149
70	50	30	77
70	30	30	140
50	50	50	263
50	50	25	105
50	25	25	90
30	30	30	43
30	30	15	40