Control and Synergies in the Outsourced Supply Chain –
Recommendations for how to improve and organize Tetra Pak’s supply chain.

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Preface

This master thesis has been written during the autumn of 2004 as the final part of our education. We have attended a Master of Science program in Industrial Management and Engineering at Lund Institute of Technology. The thesis has been conducted at Tetra Pak in cooperation with the Department of Industrial Management and Logistics at Lund Institute of Technology.

There are a number of persons we would like to thank. Our supervisor at Tetra Pak, Anders Ekberg, has given us great support, good advice, and a lot of laughter. Our tutor at Lund Institute of Technology, Robert Lindroth, has provided valuable guidance, and motivated us with his positive and enthusiastic spirit all along the way.

We are also grateful to all persons that have given us information and shared their knowledge during meetings, visits and numerous interviews. This goes to people within Tetra Pak, suppliers and also to the representatives from IKEA, Volvo CE and Alfa Laval that we have interviewed.

Friends and family have of course also had to put up with long expositions about our master thesis. Thanks for not hanging up the phone, and for still inviting us in!

Looking back it has been an interesting period where we have had the opportunity to make our academic education applicable in the industry. We are happy about what we have accomplished and the knowledge we have gained, at the onset of our new careers.

Lund 2005-01-17

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Summary

Title: Control and synergies in the outsourced supply chain
-Recommendations for how to improve and organize Tetra Pak’s supply chain.

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Problem analysis: Many companies characterized by a high level of outsourcing have experienced problems to manage the complex and growing supply chain. It can also be challenging to retain purchasing leverage when the manufacturing operations have been out-sourced. Tetra Pak has outsourced production to system suppliers and is an example of a company in the described situation. The company experiences a number of problems concerning its existing supply chain of components to production of packaging machines. The high number of suppliers adds additional complexity. Tetra Pak experiences a lack of control regarding what components in the production. In the master thesis we search for solutions to these problems that will also involve savings. The solution recommended to Tetra Pak must also fit the company’s overall strategies.

Purpose:
• To investigate how Tetra Pak, a company that has a complex supply chain characterized by a high level of outsourcing, can organize the system suppliers’ purchase of components to gain control and utilize possible synergies.

• To specifically evaluate Tetra Pak’s own suggested solution, which was a distribution central (DC) for both spare parts and components to the system suppliers’ production.

Method: To analyze a complex chain requires a holistic perspective. Tetra Pak and its network of suppliers for equipment have been analyzed with a system approach. A mix of quantitative and qualitative data has been gathered in interviews and by extracting statistics from different IT systems. A literature study within the relevant fields has been performed. We also interviewed representatives from three other companies facing partly similar challenges to broaden the perspective.

Conclusion: We found that the critical aspects for companies characterized by a complex supply chain and a high level of outsourcing are to evaluate which activities that shall be handled centrally versus decentralized. We think that the strategic and some of the tactical work should be handled centrally
in order to create synergies. We think that Tetra Pak and several other companies can achieve savings in global agreements negotiating the aggregated volume of its system suppliers. However, the operative work should be handled decentralized in order to achieve flexibility and nearness to production.

Crucial is also the correct and fast spreading of information in the supply chain. There are several benefits to achieve by integrating different information systems. We think that initiatives in new information tools should be initiated centrally. Today’s information technology enables information to be spread in the supply chain without time delay and little administrative work. However, no electronic tool fixes non-functioning processes. The electronic tools shall support the processes. The working procedures and responsibilities must be clearly defined in the supply chain to remove any double work.

It is our recommendation that Tetra Pak shall focus on optimizing today’s supply chain structure. By implementing a small number of important changes and tools many of the problems can be solved. A tool that can connect different sources of information such as bills of material, source list and forecasts would provide Tetra Pak valuable information and thereby also improve the control in the supply chain.

Further improvements can be found by investing in an e-commerce hub to be used by the suppliers. The hub has the possibility of making transactions in the supply chain more efficient. It would also give Tetra Pak valuable information on the exact needs of components to the production.

We see no reason to redirect the physical flow of components to pass through a distributional central (DC). Mainly because of two reasons:

1) The DC solution would require that the other solutions (e-commerce hub and tool to connect different sources of information) to be in place before a DC solution could be implemented.
2) When the other two solutions are implemented, most of the problems that the DC solution aimed to solve are already solved. Furthermore, a solution with a DC would turn the system suppliers more into contract manufacturers, which contradicts the overall strategy. The only extra value that the DC can bring is lowering the transport costs. We also come to the conclusion that this solution involves a big risk of increasing the complexity and would thereby not be profitable.

Key words: Supply chain management, supply chain design, complexity, control, purchasing, outsourcing, system suppliers
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1 Introduction

In the area of this master thesis, supply chain management, there have been vast changes recently. As a result, companies constantly face new challenges and have to take actions to stay competitive. Tetra Pak has a big supplier network that shall support the production and after market of packaging equipment.

1.1 Background

In the recent years there have been several forces that have increased the competition between companies. Such forces are for example: improved transport facilities, trade regions and information technology. Those forces have enabled the increased globalization, which has increased the competition.1

This development has forced companies to focus at their core competence. Therefore many companies have outsourced activities not considered to be core competences, which means that other companies, now suppliers to the outsourcing company, control that activity. Whilst more and more activities are outsourced, the purchasing function in the companies has become more strategically important. The purchasing function becomes the contact to the suppliers.2

However, outsourcing can bring not only positive effects but also some negative. It requires different skills to manage the out-sourced supply chain compared to managing in-house activities. Many companies have experienced problems to manage the complex and growing supply chain. Companies have experienced problems regarding, for example how to manage and control: quality, lead-time and delivery reliability.3 Purchasing has also problems in retaining leverage in the purchase when the manufacturing operations that consume the products have been out-sourced.4

Tetra Pak has outsourced its production of equipment and is an example of a company in the situation described above. Tetra Pak has system suppliers delivering modules that are assembled into packaging and distribution machines. Component suppliers deliver components to the system suppliers and also to Tetra Pak to be used as spare parts. There are approximately 700 component suppliers and approximately 45 system suppliers as illustrated in Figure 1.1.

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1 van Weele (2002), Purchasing and supply chain management, p. 5
2 Ibid, p. 8
3 Hill (2000), Manufacturing strategy, p. 202
4 Ellram & Billington. (2001), Purchasing leverage in outsourcing decision, p. 15
The large number of suppliers, for both systems and components makes the current supplier structure complex, with several interfaces and order locations.

One reason to the complex and growing supply chain is that Tetra Pak has not worked with standardization for long. Moreover, the influence from the purchasing department has been limited regarding which suppliers should be chosen as suppliers of components for the new machines. Another reason to the complex supplier structure is the fact that the machines at Tetra Pak have a very long lifetime, sometimes up to 40 years. It is in Tetra Pak’s interest that the machines are functioning as long as possible, since as long as the machines are running Tetra Pak has ensured that they are the supplier of packaging material. The sale of packaging material is Tetra Pak’s main source of income. This background explains why it is so crucial for Tetra Pak to store spare parts even for the old machines. This also explains that the effects of the standardization work are long-term effects, i.e. it will take many years before this work will reduce the total number of suppliers.

Alongside with the standardization work, Tetra Pak works actively with decreasing its supplier base. This is a complex process that will take years to fulfil. However it is a very important work since it will reduce the complexity in the supply chain, which further will make it easier to control.
1.1.1 Problem analysis

Tetra Pak is an example of a company that has outsourced its production and faces challenges in controlling and utilizing possible synergies in the supply chain. The complex supply chain of Tetra Pak suffers the following main problems:

- Tetra Pak experiences a lack of control:
  - Regarding which volumes of components that are bought from the component suppliers.
  - Regarding which suppliers that are used.

- Tetra Pak and the system suppliers experience complexity:
  - Many interfaces and relations between the component suppliers and the system suppliers.
  - Many order locations.

- Tetra Pak wants to know if there are any possible savings in an alternative supply chain structure. We have chosen to focus on:
  - Savings in transport costs
  - Savings in administrative and handling costs
  - Savings in inventory costs

Those were the problems that Tetra Pak explained to us as a base for our master thesis. One topic was added which is strategic fit:

- Strategic fit. We must take the corporate strategy of Tetra Pak in consideration in our master thesis. This topic ensures that our conclusions are aligned with the overall strategies.

Daily facing the problems with the complex supply chain thoughts of an alternative supply chain structure were created by purchasing managers and personnel at Tetra Pak. We were given the assignment to investigate how it is possible for Tetra Pak to organize the system supplier’s purchase together with Tetra Pak’s own purchase of spare parts. We were also given an idea of how this could be done by a distribution central that collects the orders to the components suppliers and distribute the components to the system suppliers and to the spare parts demand, see Figure 1.2 This solution will from now on be called a “DC structure”.
Figure 1.2 The DC structure

1.1.2 Purpose

- To investigate how Tetra Pak, a company that has a complex supply chain characterized by a high level of outsourcing, can organize the system suppliers’ purchase of components to gain control and utilize possible synergies.

- To specifically evaluate Tetra Pak’s own suggested solution, a distribution central (DC) for both spare parts and components to the system suppliers’ production.

1.1.3 Focus and Delimitations

This master thesis focuses on the supply chain for the equipment to the carton packaging systems, where Tetra Pak Carton Ambient is the largest business area.

Tetra Pak makes a distinction between standard components and drawn, also called mechanical, components. A standard component belongs to a supplier’s general assortment and is also sold to others while a drawn component is designed and manufactured especially for Tetra Pak, and Tetra Pak owns the drawing of the component, i.e. the intellectual property rights. For the standard components, but only in some cases with the drawn components, Tetra Pak makes agreements with the component supplier that shall cover the usage for
both spare parts and components to the system suppliers for the production of
new machines. Those agreements covering the aggregated volume are from now
on called global agreements.\footnote{Holmqvist O, Supplier and Development Certification Officer, Tetra Pak, 2004-08-24} The supplier structure is therefore somewhat
different for the drawn components. This structure might become more similar
to the structure of the standard components in the future. We have chosen to
mainly focus on the standard components in this master thesis, but
generalizations that also cover the drawn components are done in the end.

We have chosen to perform calculations on the main alternative i.e. the DC
structure, since Tetra Pak asked us to evaluate this alternative specifically.
Nevertheless, we decided to be open minded to other alternatives that might
solve the same problems but limit the calculations to Tetra Pak’s main
alternative, the DC structure.

The extent of a Master Thesis makes it impossible to go into detail in every
aspect of the problem stated. Therefore generalizations must be made. In the
case of statistics, information in one representative area was selected and used in
calculations where we then, by generalizations, drew conclusions over a larger
area. An example of that is using statistics over the commonality in four
different machines and then by reasoning with personnel making a
generalization over the total commonality between all machines.

The lack of exact information in some cases led us to use qualified assumptions,
made by personnel at Tetra Pak, in combination with the existing statistics.

We have chosen to limit the master thesis to Tetra Pak and its first and second
tiers in the supply chain i.e. the system suppliers and the component suppliers
and Tetra Pak. The suppliers to the component suppliers have not been
considered and neither have the customers of Tetra Pak.

\section{1.2 Company Description}

\subsection{1.2.1 The History of Tetra Pak}

In 1943 development work began on creating a milk package that required a
minimum of material and at the same time provided maximum hygiene. The
thought of a tetrahedron-shaped carton was created. The development also
involved, among other things, how to coat paper with plastics and sealing the
package under the level of liquid. Ruben Raising and Erik Wallenberg
established Tetra Pak as a company in 1951 as a subsidiary to Åkerlund &
Rasing. It was founded on the basic idea that a package should save more than
it costs. In the same year a package system was presented to the press. In the end
of the 1950’s the annual production of Tetra Pak packages exceeds 20 billion
units. At this time the development work also began on the rectangular shaped
Tetra Brik package. In the 1960’s Tetra Pak invented the aseptic technology. An aseptic package is one which has been sterilised prior to filling with sterilised food, resulting in a product which is shelf stable for over 6 months.6

In 1993 the Tetra Laval Group, with its headquarters in Lund, was established where Tetra Pak is one of four industry groups. The other three are: Tetra Laval Food, Alfa Laval and Alfa Laval Agri. Tetra Laval Holding Finance has the overall financial control of the Group. The Headquarters of the Group are still located in Lund, Sweden. In 1994 Tetra Pak created a new plastic packaging division and nine years later Sidel, one of the world’s leading manufacturers of machines for PET plastic bottle production was acquired to the group.7

1.2.2 Tetra Pak today

From the original site in Lund, Tetra Pak has continued to grow into an international company acting in 165 different markets with 21 100 employees and in 2003 the production of Tetra Pak packages added up to around 105 billion. This means approximately 15 packages for every human on the planet. If the packages would be placed on top of each other, they would create a column distanced equal to 16 roundtrips to the moon!8

Tetra Pak is a supplier of complete integrated processing, packaging and distribution lines as well as stand-alone equipment for liquid food. The company’s vision is: “To make food safe and available, everywhere.”9

Tetra Pak is organized in four business areas: Tetra Pak Carton Ambient, Tetra Pak Carton Chilled, Tetra Pak Plastics and Tetra Pak Processing Systems.

Tetra Pak carton packages that do not need to be stored cold are ambient carton packages using the aseptic technology. Tetra Pak Carton Ambient’s systems include Tetra Classic Aseptic, Tetra Brik Aseptic, Tetra Fino Aseptic and Tetra Wedge Aseptic. In Figure 1.3 the different packaging alternatives are illustrated.

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6 www.tetrapak.com, 2004-09-07
7 Ibid, 2004-08-31
8 Ibid, 2004-09-07
9 Ibid, 2004-09-07
Figure 1.3 From the left: Tetra Classic, Tetra Wedge, Tetra Rex, Tetra Prisma, Tetra Brik, Tetra Fino, Tetra Top, Tetra Recart and plastic packages.

Carton packages stored cold fall under Tetra Pak Carton Chilled, which consists of the systems: Tetra Brik, Tetra Classic, Tetra Rex, and Tetra Top. Tetra Pak Carton Ambient is the by far largest business area of the two involved in carton packages. In Figure 1.4 Tetra Pak’s organization is illustrated. 10

Figure 1.4 Tetra Pak’s organization 11

10 Internal Material, Tetra Pak Intranet 2004-09-01
11 www.tetrapak.com, 2004-09-02
Tetra Pak: “protects what’s good”, is the company’s motto and should characterize the whole value chain. In the work with the supply chain it shall be interpreted as:

*We seek to work in partnership with few suppliers that are innovative, financially solid and committed to our businesses aiming to jointly promote product innovation. This cooperation enables us to protect the high quality of our supplier’s materials.*

1.2.3 Tetra Pak Carton Ambient

The organization of Tetra Pak Carton Ambient is organized according to the three different segments of their products: Premium, value and emerging. The name of each segment reflects the customer’s priorities. Customers in the premium segment prioritize flexibility and have high demands of differentiation while lowest possible cost combined with highest possible efficiency is the main priority for the customers in the value segment. The emerging segment is targeted towards the lower end of the developing markets. Customer priorities here are primarily based on low entry cost, low cost operations and machine and system simplicity.

Tetra Pak Carton Ambient is currently implementing a process organization as illustrated in Figure 1.5.

![Figure 1.5 The organization of Tetra Pak Carton Ambient](image-url)

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12 www.tetrapak.com, 2004-08-31
13 Internal Material, Tetra Pak Intranet 2004-09-01
Approximately 80% of Tetra Pak’s sale of filling machines is Carton Ambient machines. Supply Managers in Tetra Pak Carton Ambient negotiates global agreements with component suppliers that shall cover Tetra Pak’s total need of standard components to production and the after market. Purchasing Development, a group within Tetra Pak Carton Ambient, is the group in which this master thesis has been performed.

### 1.3 Target groups for the thesis

This thesis is targeted towards managers and employees at Tetra Pak working with suppliers and the supplier structure. The other target group is students and other people within the academic world with an interest in logistics, purchasing and supply chain management.

### 1.4 Definitions

The following definitions are useful to know for further reading of the report:

**System Supplier (Sys):** Supplier delivering modules to Tetra Pak. Tetra Pak assembles these modules into packaging machines. The abbreviation used in this master thesis is “Sys”.

**Component Supplier (CS):** Supplier delivering individual components to system suppliers, who assemble the components into modules and to Tetra Pak as spare parts. The abbreviation used in this master thesis is “CS”.

**Supply Manager (SM):** The title of a person responsible for a group of component suppliers.

**Key Supply Manager (KSM):** The title of a person responsible for one or several system suppliers.

**Product Company:** the company that owns a product, i.e. a machine system. This company is responsible for the machine system including the development.

**Standard Component:** A component that belongs to a supplier’s general assortment. These components can either be found in many suppliers assortment for example fasteners, i.e. there is no intellectual property. The supplier can also have developed the component and by that means have the IPR, Intellectual Property Right. That supplier is then a single source.

**Drawn Component:** A component designed and manufactured specifically for Tetra Pak. Tetra Pak also owns the drawing, i.e. the IPR, Intellectual Property Right.

**Parts Supply Chain:** The organization in Tetra Pak that has the responsibility for the spare parts availability and a cost effective spare parts function.

**Global Agreements:** An agreement that covers the aggregated volume of components to both different production facilities as well as spare parts.
1.5 *The disposition of the report*

A traditional disposition has been used for this master thesis. Mostly the disposition follows our work procedure. The disposition of the master thesis can be divided into three main parts, as can be seen in Figure 1.6.

![Figure 1.6 The disposition of the report](image)

The first two chapters of the report, Introduction and Method, are connected since they together create the base to the report. In the introduction a background to our assignment is presented as well as general information about the company Tetra Pak. Chapter 2 explains different methodological techniques that can be used and which ones we have chosen for our purpose i.e. how our research has been performed. This chapter is meant to give the reader a possibility to further evaluate the credibility of the findings of this master thesis. After having read the first part the reader should be informed and understand the problem, the purpose and also how our work has been performed to fulfil the purpose.

The second part of the master thesis is the main part and starts with a chapter with the theoretical framework addressing the areas of interest for this master thesis, for example outsourcing and synergies in the supply chain, and after that a presentation of the empirical data that we have collected. The analysis is then based on the theories and the empirical data.

The different sections of the report all have a part in leading the reader to the third part, the conclusions that are presented at the end of the report. Here we also make our recommendations and generalizations.
2 Method

The method gives the reader the possibility to understand how the research has been performed. Knowledge of the method thereby makes it possible to evaluate the credibility of the results.

2.1 Scientific approach

According to Arbnor & Bjerke\textsuperscript{14}, there are three different approaches to science when performing research in the area of business: analytical, system and actors approach.

2.1.1 Analytical

Analytical researchers mean that the whole is the sum of its parts i.e. that it is possible to describe the whole as long as you have all information regarding the parts. When putting together the different parts, one will get to know the whole. A problem can therefore, according to this approach, be broken down into smaller parts of the problem and these parts could be solved individually.

Causality is important to the analytical researcher. The researcher searches for causal relations such as if the supplier base is reduced, the administrative cost, connected with purchasing, decreases. In the analytical approach the result is always the same no matter who the observer is. Furthermore, knowledge that is developed in the analytical approach is considered as consistent, which means that it does not change over time. The best possible soccer team is the team consisting of the best goalkeeper and the best forward etc, according to the analytical framework.\textsuperscript{15}

In our master thesis an analytical approach would imply that we only considered measurable facts such as transport distances, tied capital in inventory and administrative costs. The disadvantage of this approach in our case is that other facts, such as control and better relations is hard to measure furthermore estimates will be needed in our calculations otherwise it would be too time consuming.

2.1.2 System

The system approach means that the whole is not the sum of the parts. According to the system approach, the relations and the surrounding environment also affect the whole. So the base in the system approach is that

\textsuperscript{14} Arbnor & Bjerke (1997), Methodology for creating business knowledge, p. 49
\textsuperscript{15} Ibid, p. 50
there are effects, synergies that evolve when the parts are put together and those effects could not be seen or explained when the parts are studied separately.\textsuperscript{16}

In opposite to the analytical approach, the systematic researcher does not search for causality. The systematic researcher searches for forces that influence the system and the final relations between them.\textsuperscript{17}

Knowledge that is developed in a system approach is not as general as the one developed in the analytical approach, it is more about finding patterns in the system. The result that is found to be true at one system could be used as inspiration when other systems are investigated. The researcher could draw analogies with earlier systems when researching new systems but, in difference to the analytical approach, the researcher could not directly apply old results to the new problem.\textsuperscript{18}

A systematic coach would, not like the analytical one, choose only the best players; instead he would also take other forces in consideration such as: the opponent team, the field and the relations between the players.\textsuperscript{19} In our case, a systematic approach means that we do not only use calculations but also search for forces that affect the supply chain. Such forces could be long-term strategies of Tetra Pak, how the supplier’s relation to Tetra Pak is affected by the changes etc.

We have chosen this approach since it is suitable with the holistic purpose of the research. In fact it is a limited system that we have chosen to investigate. This system is the one interacting between Tetra Pak and their component and system suppliers. We have chosen to define our system as the one interacting between those companies within the red circle in Figure 2.1.

\begin{footnotesize}
\begin{itemize}
\item\textsuperscript{16} Arbnor & Bjerke (1997), \textit{Methodology for creating business knowledge}, p. 51
\item\textsuperscript{17} Ibid, p. 158
\item\textsuperscript{18} Ibid, pp. 67-70
\item\textsuperscript{19} Ibid, p. 51
\end{itemize}
\end{footnotesize}
2.1.3 Actor

The actors approach means that the whole only exists in the observers mind. In reality the whole is a social construction depending on the social mix of actors.

The actor’s approach differs from the others described regarding if there is one objective reality, to observe, that is independent of the observer. In the actor’s approach there is no reality to observe since this approach includes the observer as a part of the reality. Therefore, the reality looks different if there is another observer since the observer affects the other actors and also interprets the situation differently.20

If choosing a soccer team with the actor’s approach the technically skilled players, which also contribute to, a good team spirit should be chosen. This choice would also be dependent on the coach since the coach affects the social structure in the team. So the best team would be different if another coach was in charge.21 If we had chosen this approach we should have taken the social relations between the employees at the supplier and at Tetra Pak in

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20 Arbnor & Bjerke (1997), Methodology for creating business knowledge, pp. 70-71
21 Ibid, p. 52
consideration. Even though it is true that the personal relations in the supply
chain are important, especially since it historically has been “know who” more
than “know how” that has affected the choice of suppliers, we thought that it
would be extremely complex to investigate the problems with this approach.

2.2 Choice of research method

There are several different methods to conduct a research. Most important is to
know what methods, which are available and to choose method based on the
purpose of the study. At the same time it is important to be aware of the
consequences that a specific method involves.

2.2.1 Inductive or deductive methods

The difference between inductive and deductive approach is whether the
research starts with an observation in the reality or if it starts with a hypothesis
derived from theories. The inductive method is when no theoretical studies are
required before the research; instead the theory is developed based on patterns
and structures in the empirical data. The benefit of inductive methods is when
exploring new areas of science, then there are no theories to start with, instead
new theories are based on the observations.22

The disadvantage of using an inductive method is that it is rather difficult to
gather and research data open minded and without any influence of earlier
knowledge.23

The second approach, the deductive approach, is a hypothesis-testing process.
New hypothesis are developed from the theories, those hypothesis could then be
tested on empirical data and be proven true or false. Deductive methods are
common when conducting quantitative studies. Performing surveys is an
example of a deductive, quantitative method. The problem with deductive
methods is that the researcher only tests hypotheses that he believes in, out of the
box facts are hard to find with deductive methods.24

There is a third alternative called abductive approach, where the researcher goes
from empirical data and theories back and forth. The abductive approach starts
with a phenomena, the researcher tries to find the forces behind this phenomena
by excluding forces and conducting tests. There is a problem with the abductive
method since it is not a schematic method; it requires extensive experience of
similar cases.25

22 Wallén (1996), Vetenskapsteori och forskningsmetodik, p. 47
23 Jacobsen (2000), Vad hur och varför?, pp. 43-45
24 Ibid, pp. 42-43
25 Wallén (1996), Vetenskapsteori och forskningsmetodik, p. 48
Figure 2.2, shows how we have worked with the different research methods moving back and forth between the theories and the empirical work. Different parts of our investigation required different methods.

2.2.2 Qualitative versus quantitative

Two typical research methods are the qualitative and the quantitative method. In our thesis we use a mix of these two methods.

Qualitative research work is being performed when data that is not expressed in numbers is gathered, interpreted and analyzed. The opposite is true for the quantitative method, i.e. the study consists of information that can be measured or quantified. The qualitative method shall be used when one strives for a deeper
understanding in a specific subject or situation. The purpose of the study shall decide which method to use. 26

In our case we want to understand what a change in the supplier structure would mean. To achieve this deep understanding we need to perform a qualitative investigation as in interviewing personnel and suppliers. On the other hand we need to calculate if the alternative supplier structure shall be recommended from a financial point of view. For this part we will work with a quantitative method by for example collecting statistical data from Tetra Pak’s information systems. We started with a qualitative method in order to grasp the problem and develop new knowledge in the subject. After the initial phase quantitative methods were used in combination with further qualitative studies, an approach called method triangulation. In triangulation different methods are used to add different perspectives of a subject. 27

2.2.3 Research Design

Figure 2.3 presents a sample of techniques. We gathered data for analysis from the real world, i.e. empirical data. We used both qualitative and quantitative methods. Consequently, our work belongs to the two upper boxes in the table.

![Figure 2.3 Different research designs](image)

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26 Björklund & Paulsson (2003), *Seminarieboken*, p. 63
27 Jacobsen (2002), *Vad, hur och varför?*, p. 151
28 Ellram (1996), *The use of the case study method in logistics research*, pp. 95-97
As explained, we used a system’s approach in the master thesis and a natural choice of method is then a case study\textsuperscript{29}. In a case study a few studies are conducted but many aspects are being taken into account whereas in a survey many observations are made but regarding only a few aspects. Concerning our problem analysis, a survey approach was not suitable. We needed to cover many factors of a complex system and therefore we considered a case study as a preferable method.

### 2.3 Data collection

We have used two kinds of data in our master thesis. The first one is primary data, which is the data that we have collected ourselves. The second one is the secondary data, which is material that has been collected previously.

We gathered the primary data in personal interviews primarily. We thought that personal interviews were best since it gave us the opportunity to interpret not only the words but also how the interviewed person reacts at different questions. We used telephone and mail questions after the initial personal interview in order to ask complementary and confirming questions.

#### 2.3.1 Interviews

The interviews were meant to be qualitative. The ideal situation was therefore to be as open minded as possible and let the interviewee speak totally free without any guidelines from us. However, this method takes far too long time and the information received becomes so complex that it is very difficult to analyze.\textsuperscript{30} Therefore we chose to have a predetermined agenda in the interviews, so-called semi-structured interviews. We started with open questions and tried to put the focus at the interesting parts without leading the interviewee too much. In the end of the interview our questions became more specific to get the interviewees perspective at a few questions. Such a question could be to check if this interviewee had the same opinion, concerning a special issue, as a previously interviewed person.

We chose to inform the interviewees about the purpose of our research before the interview took place, even though we were aware of the risk that the interviewees could be affected by this knowledge and the answers could become reflected by personal interests. We found that the interviewees were more open when they knew the purpose. Some of the key persons for our research were also involved in assigning us the master thesis and were therefore already aware of the purpose. In the interviews we also wanted to establish good relations with the interviewees and also wanted to be able to have a direct discussion about advantages and disadvantages with the alternative supplier structure. However

\textsuperscript{29} Arbnor & Bjerke (1997), Methodology for creating business knowledge, p. 223
\textsuperscript{30} Jacobsen (2000), Vad hur och varför?, p. 162
we tried to explain the purpose of our research as objectively as possible avoiding any political statements.

2.3.2 Existing statistics

In investigating the DC structure from a financial point of view we used existing statistics and mapping of the current structure as a foundation for the calculations. The Purchasing Development group has earlier done a mapping of the supplier structure in the packaging machines and the commonality, which is how similar the machines are at component level. We reused this mapping as input to our calculations. Information about the purchasing activities is recorded in a SAP R3 system. From this system we extracted numerical data. The suppliers that were interviewed also contributed with input concerning their costs.

2.3.3 Literature studies

Literature studies are typical secondary data. The risk of using literature, written in other purposes, is that the text may not be totally objective, furthermore there is a risk that important information is missed when scanning literature, using keywords. The advantage of literature studies is that a base of knowledge in a theoretical area could be collected rather fast.

In our master thesis we used literature studies to gain knowledge concerning purchasing issues, logistics, methods and control. The sources of this information were mainly articles published in logistics magazines and also printed books within the same field.

2.4 Credibility of the thesis

2.4.1 Validity

Validity describes if the thesis is based on the right data i.e. that the right things are measured. In golf high validity of a swing would mean that the aim is correct. Picture A and C in Figure 2.4 has a high validity because there the aim is correct, though there are some random errors at the swings in A but the important thing to gain a high validity is to not have any systematic faults as in B.

Both of us have been present during all the interviews. Directly after the interviews we discussed the answers together making sure that we both had the same interpretation of the answers and the overall outcome. This procedure was meant to increase the validity.
In our thesis we have chosen to use triangulation to increase the validity. Triangulation gives us more than one perspective to the problems because people in different positions and with different interests were interviewed. In our research we started with qualitative studies, interviews with open questions then, when we really had understood the problem and what critical issues to investigate, we started with the quantitative part of our research (calculations at statistical data). This method triangulation increases the validity of the research.31

2.4.2 Reliability
Reliability describes how well the right things are measured. With a high reliability, the same results would be found if the research were done a second time. If we return to the golf parallel, the reliability in B and C in Figure 2.4 is high since there, the same result repeats itself i.e. the swing is correctly done it hits the aim. In picture C, both the reliability and the validity are high.

In interviews, the reliability increases if the same question is asked more than once in a similar way. The fact that we have used triangulation increases our reliability since then the same question is asked more than once and thereby the answers get confirmed.32

2.4.3 Objectivity
Objectivity describes how much personal valuations affect the result of the thesis. We have been conscious about the fact that valuations might affect our results. Therefore we have tried to report as many different opinions as possible and present which choices we have made. The people that we have interviewed have personal interests to protect. Both the suppliers and the personnel at Tetra

31 Björklund & Paulsson (2003), Seminarieboken, pp. 59-60
32 Ibid
Pak could be affected by the result of this thesis and therefore tried to lead us in specific directions in the interviews. Since the interviews were conducted with people in different functions and at different companies these personal interests sometimes contradict each other and therefore we see little risk in us being affected in favor of a specific party.

2.5 Work procedure

The structure in the master thesis reflects the working procedure we have followed. Different parts of the thesis require different methods. A mix of techniques also increases the credibility as mentioned. We started with interviews to grasp the problem very rapidly and in the mean time identify and get to know strategic key contacts. The key contacts further helped us to get in touch with the system suppliers and component suppliers. After and partly alongside with the initial interviews the method studies were carried out. The method was studied in literature and discussed internal between us, as well as with our tutor. The theoretical frame of reference was gathered by literature studies. Our tutor provided us with some literature while others were our own choice. The literature gave us a good base for the further studies. The empirical studies were performed with interviews at the different companies in the supply chain. Furthermore a benchmarking study was performed in order to get influences from other companies, facing similar problems as Tetra Pak. The analysis was performed partly by calculations made in Excel. We did detailed calculations on the main alternative, the DC structure. The analysis also contained a study were we evaluated different strategies against the problems that we found in today’s supply chain. The analysis then gave us the conclusions consequently. The different methods are illustrated in Figure 2.5.

33 Björklund & Paulsson (2003), Seminarieboken, pp. 59-60
Figure 2.5 Working procedure
3 Theoretical frame of reference

The role and responsibilities of the purchasing function has been changed because of the trends towards globalization, increased competition and outsourcing. Since the surrounding conditions are changing in a faster rate than ever accurate information is critical. One of the key questions is whether to meet the future challenges with a centralized or de-centralized organization.

3.1 Introduction

In order to refine products the purchasing of material and services is most often necessary, since very few companies make a product directly from raw material.

Different changes in the competition have affected the supply of material and services in companies, which have changed the role of purchasing. Many of these changes are directly or indirectly linked to the globalization.

The transport facilities have improved, which makes it possible to move goods longer distances more efficiently. That is one of the reasons why physical distances no longer can be seen as a strong barrier for competition. Another reason is the communication technology, which enables fast information exchange independent of geographic distance. From a purchasing point of view, global sourcing has become an alternative to using suppliers next door. The global sourcing demands new skills in purchasing. Apart from being a good negotiator, have solid knowledge of the supply market and know the internal purchasing policies and routines the role, as Supply Manager requires other skills. Qualifications such as cross-cultural knowledge, language proficiency and knowledge of international finance, logistics and the capabilities of information technology are some examples.

The increased competition puts focus on the supply chain of the company. Non-core activities are often outsourced to specialist suppliers. That is one of the explanations to the increased importance of supplier management. Supplier performance has become increasingly crucial for the performance of the buying company. Competition can, as Martin Christopher\textsuperscript{34} noted:

“They have realized that the real competition is not company against company but rather supply chain against supply chain.”

Therefore cooperation and development together with the suppliers is essential.

\textsuperscript{34} Christopher (1998), \textit{Logistics and supply chain management, strategies for reducing cost and improving service}, p. 16
Holistic focus forces companies to organize their activities process oriented rather than in traditional functions. Process oriented organizations instead of functional organizations decrease the risk of sub-optimized functions. Furthermore, it is easier to find and eliminate activities that do not add value to the customer.35

One part that does not add value is the time in stock for a component. This is the background to the philosophy of just in time, JIT. With JIT, the supply of material is planned to resemble a continuous process from raw material to finished goods36. Process orientation, JIT and shorter lead-times require close cooperation between the different parties involved. Purchasing is then part of cross-functional teams or projects that also involve the suppliers.37

According to van Weele38, there are three different levels of responsibilities and tasks for the purchasing function:

1. **Operational**: The order process, supplier evaluation and other daily activities.
2. **Tactical**: Global agreements, handling improvement programs at the suppliers, selection and contracting of suppliers.
3. **Strategic**: Make or buy decisions, single vs. multiple sourcing decisions and long-term contracts.

The following parts of the theoretical frame of reference are structured after these three levels.

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35 Lumsden (1998), Logistikens grunder, p. 80
36 Gunasekaran (1999), *Just-in-time purchasing: An investigation for research and applications*, pp. 77-84
37 Ibid
3.2 **Purchasing function, operational and tactical level**

The activities related to the tactical and operational supply of material and services to a company can be explained in a purchasing process.

![Diagram of the purchasing process](image)

*Figure 3.1 The purchasing process*[^39]

The purchasing process shows the role and the responsibilities of the purchasing function in a company. As can be seen in Figure 3.1 the process goes from the internal customer to the supplier.

- **Determine specification.** In the first activity the requested function is specified. Either it further specifies which method that should be used to achieve the function or the specification leaves this choice to the supplier. Besides the functional or technical description, the specification also contains other important aspects such as quality, logistics, maintenance and legal requirements.[^40]

- **Select suppliers.** In the second part of the process it is time to explore the market. In practice the steps in the process are tightly linked together meaning that the specification is often made with a few suppliers in mind. A bidders list is developed based on preliminary qualifications of suppliers. Request for quotation/proposal is sent out and the answers are

[^39]: van Weele (2002), *Purchasing and Supply Chain Management*, p. 15
[^40]: Ibid, p. 52
then analyzed, where it is important to distinguish the technical and commercial evaluation.  

- **Contract.** Negotiations concerning the contract are held with the supplier where among other things, prices, delivery, terms of payment are discussed. The agreement should cover the performance of the delivered material or service. Penalty clauses in case of quality problems etc are agreed.  

- The operational purchase contains the two steps: *ordering* and *expediting*. Often a call-off agreement is negotiated, which the buyers use when they place their orders. For the material to production, MRP-systems that regulates when the ordering should take place and in what quantities are commonly used.  

- **Follow up.** Evaluation should be performed continuously during the purchasing process. The buyers should notice the supplier’s quality, delivery record and also the supplier’s ability to be innovative and competitive. These facts should be taken into consideration in the vendor rating. In other words the purchasing department should use a holistic perspective, called total cost of ownership.  

### 3.2.1 TCO - Total cost of ownership

One of the most important responsibilities within the purchasing function is the choice of suppliers and how to cooperate with them. The choice of supplier has historically been based on price only. If the suppliers are evaluated on a holistic perspective, including all the additional costs connected with the purchased product over its lifetime, the picture of the total cost of ownership appear. This implies that the preferred supplier might be a different one compared to which one that was preferred on price basis. Total cost of ownership is about finding those additional costs connected with the purchase and include those costs in the evaluation of the suppliers and in the strategies for different products.  

Additional costs could be: administrative costs connected with the purchase, costs of running out of stock, warehousing, service, scrapping costs, quality issues, delivery costs etc.

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41 van Weele (2002), *Purchasing and Supply Chain Management*, p. 54
42 Ibid, p. 59
43 Ibid, p. 63
44 Ibid, p. 69
45 Schary & Skjøtt-Larsen (2001), *Managing the global supply chain*, p. 204
46 Ibid
Hence, by choosing the right suppliers the costs related to for example quality problems can be drastically reduced. Work with product standardization can result in the avoidance of a supplier’s specific brands and the company is then less dependent of the suppliers. The standardization in purchased products also means a decreasing number of different products and instead a higher volume of less products, which results in economies of scale. The inventory levels can for example be lowered with fewer article numbers. Administration and handling connected to every supplier is consequently reduced if the number of suppliers is smaller. If the design is standardized a product can be used for more than one purpose and the wheel does not have to be invented again.

Total cost of ownership is about not only looking at the company but the supply chain. By working together with the suppliers, innovative solutions can be found concerning both new products and in the development of existing products. Special stock arrangement and just-in-time scheduling of deliveries are examples of how companies can work with these aspects together with the suppliers.

When it comes to what a company shall keep in-house and what activities that preferably are bought, make or buy studies are performed. Purchasing is then a natural source of information because of their knowledge about the market and should therefore be involved.

To be able to perform efficient purchasing and sourcing strategies the purchasing function must be involved in the engineering and production planning. “The goal is to make optimal use of purchasing’s knowledge of products and markets for the benefit of the product design.”\(^{48}\) In order to have an impact on the total cost of a product, this involvement must come early in the development process.

### 3.3 Strategic themes in purchasing

According to Gadde and Håkansson the strategic responsibility of purchasing can be divided into three dimensions:\(^{49}\):

- Make or buy
- Supplier base structure
- Individual relations with suppliers

In the following section we will go into these dimensions and also address areas related to those.

\(^{48}\) van Weele (2002), *Purchasing and Supply Chain Management*, p. 24
\(^{49}\) Gadde & Håkansson (1998), *Professionellt inköp*, p. 38
3.3.1 Make or buy

Historically the choice whether to make or buy have been based mostly on costs and cost savings. However, as the TCO theory implies, there are other factors that need to be evaluated. To buy gives the company access to the suppliers’ resources and competence. On the other hand the company takes a risk when they display their technology to their supplier. Furthermore the outsourcing strategy implies that the company becomes more dependent on their supplier. The outsourcing of a lot of activities also means an increased need of coordination.

A high level of vertical integration means higher level of control. That must be weighed against the higher flexibility, which is the result of outsourcing. A decision to buy, instead of as before make, is hard to reverse, once outsourced the competence in the area is quickly lost.

The main question to answer must be if the material of interest is considered to belong to the core of the business. By focusing on the core competences i.e. keep it in-house, and outsource other activities, a number of advantages can be accomplished. First of all, effort is laid where the company is best so the return on internal resources will be maximised, and at the same time the company can utilize the competence of its suppliers. There is a long-term perspective of the competence issue, even though the company can compete with the external suppliers today; it will require investments to maintain the capability in the long term. By that means the outsourcing gives the company access to the R&D investments of the supplier. Focusing on core competences does not involve outspending competing companies in terms of R&D investments. Instead R&D should be focused at the areas were the company have their core competence. This strategy includes striving to keep the employees that contribute to the core competence. Those employees should be considered as strategic assets.

By developing, and focus on, the core competences the barriers against competitors are also strengthened. Another advantage is lower internal investments, which reduces risk.

One argument for separated focused companies is the complexity. Either outsourcing or separate internal companies could achieve focused companies. In a situation of overcapacity it can be tempting for a company to fill it up with another type of business. The new business area will then share the overhead costs and hedge against future uncertainty and risks. However, what companies often miss is the extra complexity that comes with administrating business areas with different needs under the same organization. In big organizations,

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50 Gadde & Håkansson (1998), Professionellt inköp, p. 40
51 Quinn & Hilmer (1994), Strategic Outsourcing, pp. 44-54
52 Prahalad & Hamel (1990), The core competence of the corporation, pp.81-83
53 Quinn & Hilmer (1994), Strategic Outsourcing, pp. 44-54
relationships certainly become more formal as many layers of bureaucracy separate the top level from the workers. Of course there need to be some bureaucracy but too much seems to take away the flexibility in the organization. And it is the flexibility that enables organization to meet changes in the demand of the customer.54

To summarize, it is clear that decisions regarding make or buy can be hazardous if they are not based on a meticulous analysis. Therefore issues of make or buy must be considered as a strategic management responsibility. Research shows however that make or buy decisions often are made without a strategic perspective or an overall policy55.

3.3.2 Supply base structure

The corporate focus on the supplier base structure has increased. In many companies there is a clear strive and work being performed to reduce the number of suppliers. This is due to the realization of the cost of handling a supplier.56

Many Japanese companies show a high level of hierarchy, i.e. many tiers in the supply chain. Tiers in the supply chain means that instead of delivering individual components, the supplier delivers and take responsibility for a whole system of assembled components. This course of action is illustrated in Figure 3.2. When the company organizes their suppliers in tiers they reduce their number of interfaces to the suppliers. Furthermore small focused organizations are created. It is important that the information exchange is well structured and effective between the tiers; otherwise there is a risk of bullwhip effect, which will be described in section 3.3.3.

54 Hill (2000), Manufacturing strategy, p. 164
55 Ford & Farmer (1986), Make or Buy – A Key Strategic Issue, pp. 54-62
56 Gadde & Håkansson (1998), Professionellt inköp, p. 60
When the supplier base is analyzed, decisions have to be made concerning whether, or when, to use single or multiple sourcing. Multiple sourcing makes the dependence on each supplier less significant. Furthermore, multiple sourcing reduces the risk connected to the supply of material. Multiple sourcing also enables a continuous competition between the different suppliers of the same material or service. By that means the negotiating power increases when there are more than one supplier to choose from. However, single sourcing could also increase the negotiating power of the buying company, since a higher volume is offered to one supplier. If a partnership relation shall be used, it almost requires single sourcing which in some cases results in a lower total cost. It is clear that different situations require different sourcing strategies. This will be discussed further in section 3.3.4, where Kraljic’s portfolio techniques are explained.

### 3.3.3 The bullwhip effect

The bullwhip effect is a describing name of the amplification of demand volatility, which increases as demand moves upstream in a supply chain. Another name of this phenomenon is the Forrester effect. Along the supply chain information gets distorted and the result can often be a high level of inefficiency. As a result of the distorted information the different parties in the supply chain stockpile because of the high level of uncertainty in demand. A big part of the problem is a lack of information: every company has to base

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57 Schary & Skjött-Larsen (2001), *Managing the global supply chain*, p. 446
decisions, about orders, only on orders coming from the adjacent downstream company.

Naturally the actions of each company are affected of their rational behaviour. However, looking at the supply chain as a whole the decisions that each company make may seem irrational. Rather than to try to change the rational behaviour of the companies the infrastructure of the supply chain must be changed. According to Lee et al. there are four major reasons for the bullwhip effect: 58

- **Demand forecast updating:** The forecast is based on the demand of the closest downstream actor and not on the actual demand of the customers.

- **Order batching:** The demand is accumulated into batches before an order is placed. Orders are also often placed with a particular frequency for example weekly.

- **Price fluctuation:** Orders are in many cases placed in beforehand because of attractive offers from the suppliers, so called “forward buy”.

- **Rationing and shortage gaming:** In the cases where the demand is bigger than the supply a supplier often rations the products to its customers, i.e. the suppliers allocate the remaining products to the customers based on demand. Customers may take this into consideration and therefore place a bigger order than actually needed.

Each of these causes of the bullwhip effect must be considered when a company tries to counteract it. By sharing information along the supply chain a lot can be accomplished. Furthermore, the planning that concerns pricing, transportation and inventory must be aligned through the supply chain. Improved performance, for example reduced lead times, will also help to minimize the bullwhip effect. 59

Communication is essential in the supply chain. The information technology offers a unique opportunity to reduce inventory levels in the supply chain while improving the customer service. Furthermore, integrated information systems enable reduced lead-times, and consolidated freights. 60

58 Lee et al. (1997), *The bullwhip effect in supply chain*, pp. 546-558
59 Ibid
60 Stock & Lambert (2001), *Strategic logistics management*, p. 217
3.3.4 Kraljic

In 1983, Kraljic\textsuperscript{61} introduced a portfolio technique suggesting different sourcing strategies for different products. Kraljic divided the products based on two parameters:

- **The importance of purchasing**, i.e. how much the product influences the result of the company. This depends on the value of the product but also the contribution to the perceived end consumer value. Bottom line impact is also depending on how close the product is connected to the core competence of the company.

- **Complexity of supply market.** The complexity of the market affects the risk connected to the supply i.e. long- and short-term availability of the product. The risk depends on how easy it is to replace the product/supplier with others, the cost connected to the change of supplier, the competition on the supplier market, storage possibilities and entrance barriers for new suppliers on the market.

These two parameters are combined into a four-field matrix as illustrated in Figure 3.3.

\begin{figure}[h]
\centering
\includegraphics[width=0.6\textwidth]{four_field_matrix.png}
\caption{The four segments of products/suppliers.}
\end{figure}

1) **Non-critical products** are those where the value is low and the number of potential suppliers high. Typical products in this segment are

\textsuperscript{61} Kraljic (1983), *Purchasing must become supply management*, pp. 109-117
fasteners, office supplies, and some cheap bulk material. The value of those items are low, therefore it is critical to keep the administrative costs connected with the replenishment of those products low. One strategy to decrease the administrative time and cost is to order full kits of products in the segment at the same time. Another strategy is to let the supplier handle the replenishment.  

The procedure where the supplier handles the replenishment is called VMI, Vendor Managed Inventory. VMI can create a win-win situation since it has several advantages for both parties in the relation. On the buyer’s behalf it reduces the administrative cost connected with the purchase of those non-critical products. On the supplier’s behalf, VMI enables visualization of the real consumption. By that means VMI creates visibility and interaction in the relation, which further reduces the problems with fluctuating demands based on forecasts, i.e. the bullwhip effect.

It is important to prevent maverick buying (ad hoc buying), which is common on non-critical products, therefore the supplier base and articles should be limited and defined. To reduce and define the suppliers, VMI or a catalogue defining the suppliers that should be used in the different segments could be useful.

2) **Leverage products:** These products are expensive and they have a significant impact on the bottom line. However, there are several suppliers that could provide the similar product so the switching cost connected with a change of supplier is low. The strategy, proposed by Kraljic, for leverage products is competitive bidding where the suppliers compete for volumes on a price basis. The buyer should also increase their market knowledge and by that means really understand the suppliers’ costs in this segment. This knowledge enables the company to work with target pricing. Because of the high value of the leverage products, optimal order quantities are important since it reduces the tied capital in inventory.

3) **Strategic products** are often high volume products that are customer specified. Strategic products could, for example, be gearboxes for an automobile manufacturer. First of all, it is important to choose the right supplier for strategic products, a supplier for a long-term relation. Kraljic suggests a close collaboration with the strategic supplier, using open costs and a wide interface between the companies. In this segment

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63 Stock & Lambert (2001), *Strategic logistics management*, p. 216
64 Target pricing means that the aimed price is pre-defined as a target
of products the supplier is chosen with focus on the total cost of ownership and not only on the price. Since the transaction and interaction frequency between the companies are high, it is beneficial to invest in an EDI connection.66

EDI enable the partner companies to exchange data information without any delay or administration. EDI requires a predefined protocol for how that data should be structured and interpreted. Hence, it is easier to implement EDI the fewer parties that are involved.67

4) **Bottleneck products** are products with a low value but with few or only one potential supplier. Typical bottleneck products are spare parts and products protected by patents. According to Kraljic, companies should try to reduce the risk connected with bottleneck products. There are short- and long-term strategies to decrease the risk. In the short-term perspective, it might be possible to secure the availability by stocking the product. In the long run it is important to search for alternatives and create strategies for how to avoid bottleneck products and the dependence connected with them. Hence, to reduce the dependence the companies should use multiple sourcing instead of single sourcing if it is possible. Ideally a company should avoid bottleneck products by innovative design and solutions.

3.3.5 **Individual supplier relations**

The right type of relationship with the suppliers will result in high efficiency. Lately a lot of focus has been put on partnership relationships with suppliers. The character of the purchase must however decide the closeness of the relationship.68

Partnership versus arms length relationship, or adversarial model as Saunders69 calls it, are contrasting models.

The adversarial model is characterized by a lack of trust: a win-lose approach in negotiations, short-terms focus, little direct contact and refusal to share information. This approach might be beneficial when purchasing products in the left segments of the Kraljic matrix where there are several similar suppliers to choose from.

The alternative approach is partnership, which is characterized by win-win attitudes in negotiations, sharing of information, high level of trust, frequent contact between different positions in the companies, long-term focus and

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67 Stock & Lambert (2001), *Strategic logistics management*, p. 161
68 Gadde & Håkansson (1998), *Professionellt inköp*, p. 50
69 Saunders (1997), *Strategic purchasing and supply chain management*, p. 255
proactive quality work. This approach fits better with the purchase of strategic products, top right in the Kraljic matrix, where the total cost of ownership is in focus.  

Gadde et al. describes the complexity of a strategic long-term partnership. In a partnership-relation several relations are established between the companies. In one case Gadde describes, there were 600 people from the buyer in active contact with 200 people at the supplier! Contacts were established between several functions such as: production, quality, R&D, purchasing department and marketing. If one considers the complexity in one relation, it is easy to imagine the enormous complexity that occurs when several interacting relations are handled. The purchasing function and the corporate management must be aware of this complexity and respect the complexity but in the meantime search for opportunities of how to reduce the complexity. One strategy is, as mentioned earlier, to reduce the number of suppliers, which naturally decreases the complexity and thereby the administrative costs.

The alternative short-term adversarial approach creates a far less complex relation. Most common the contact is handled between the purchasing department and the sales department at the supplier.

However, there are many more types of relations than the ones described above. Bensaou identified four characteristic types of relations as described in next section.

### 3.3.6 The Bensaou model

In the 1980’s the traditional approach to suppliers was to keep them at an arm’s-length distance. However, in the middle of the 1990’s there was more focus on strategic partnerships. Bensaou made a survey where he mapped the parameters that affect the relationship between the buyer and supplier.

Bensaou found that the level of specific investments made by the different parts in the relation strongly correlates with the characteristics of the relation.

Based on the level of investments made in the relation from the buyer respective the supplier he developed a model. The model is illustrated in Figure 3.4.

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70 Saunders (1997), Strategic purchasing and supply chain management, p. 255
71 Gadde & Håkansson (1998), Professionellt inköp, pp. 94-96
72 Ibid, p. 96
73 Bensaou (1999), Portfolio of buyer-supplier Relationships, pp. 35-43
Specific investments in the relation include concrete investments such as production facilities that are adjusted to the other part in the relation but also more intangible investments such as learning the other parts system and development of the relation.

1) **Market exchange:** In the market exchange relation, neither of the parts in the relation has made any investments in relation specific assets. Market exchange products are often made out of mature technology. Market exchange has a lot in common with the strategies in the non-critical product segment described by Kraljic. For example little time is spent on the contact in the relation i.e. low administrative cost.

2) **Captive buyer:** In this segment the buyer has made specific investments to fit the supplier. Such investment could be that the design of the buyer’s product requires the product from the supplier. There are often a limited amount of established suppliers where those relations occur. This segment relates to the bottleneck product in the Kraljic matrix, where the supplier has a strong negotiation power in both these segments.

3) **Strategic partnership:** Characteristics of strategic partnerships are a high level of communication, early supplier involvement in design and large relation specific investments required.
4) **Captive supplier** is the relation that is most common in Japan and not, as many believe the strategic partnership. Though the suppliers have good technology, it is easy for the buyer to shift supplier when new technical models are developed. Japanese assemblers often have three suppliers providing the same component. The assembler is shifting volumes between the suppliers to make them really compete for orders with higher volumes.

### 3.4 Centralized versus de-centralized

There are several arguments for both centralized and decentralized organizations. Here the purchasing function, warehouses and transports are analyzed regarding this eternal question.

#### 3.4.1 How to structure the purchasing function

The main question is whether the purchasing function in a company should be centralized or decentralized. Centralized purchase gives several advantages such as: larger volumes, which further result in better negotiation position and better prices. Furthermore it is possible to utilize specialized purchasers in a centralized function and it is also easier to coordinate the activities between the company and the suppliers when having a centralized organization.74 A reduction of the supplier base is significantly easier to facilitate when it is handled by a centralized purchasing organization75. One disadvantage with centralized purchasing function is that it removes responsibility from the different decentralized business units. Often the business units are convinced that they can reach better conditions and lower prices on their own76.

The advantage with decentralized purchase is the nearness between the purchase and the end user of the products, the production for example. If purchasing is an integrated function with the production it is impossible to keep that contact fully when purchasing is centralized.77

There are advantages with both options; therefore the choice of purchase organization will always be a compromise. The main issue is to try to get the good pieces out of both types of organizations. The centralized purchasing function could for example be combined with purchasers localised at the production plant handling the purchase of critical components that has a close connection to the core production processes. On the other hand a decentralized organization could be combined with corporate agreements where the aggregated volume is negotiated and that means that the scale of the purchase is

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74 Gadde & Håkansson (1998), *Professionellt inköp*, p. 184
75 van Weele (2002), *Purchasing and supply chain management*, p. 239
76 Ibid
77 Gadde & Håkansson (1998), *Professionellt inköp*, p. 184
achieved. Centralized or decentralized, there is no perfect organization. Companies will constantly try to achieve the advantages of the organization that they do not use. The type of organization used can be seen as a pendulum over time, moving between different levels centralization.78

Basically the compromises often result in that standardized components and commodities used in several production units is centrally purchased, while special components that are important for only one production unit are purchased decentralized close to the production.79 In other words; the greater the commonality is between the different business units, the greater are the benefits of a centralized purchase. Another parameter to consider is the geographic location; due to cultural differences it may seem more complicated to have a centralized approach when the business units are far away from each other geographically. Supplier base structure also affects the choice, the fewer and stronger the suppliers are in a segment the stronger the need is for a centralized structure to get a more equal power balance. Sometimes expertise is required in the purchase, for example if the price of a commodity is exposed to significant price fluctuations it is easier to handle those challenges with a centralized approach.80

The discussion whether to centralize purchasing operations is interesting from an outsourcing point of view. As mentioned a centralized purchase could negotiate better prices. Many organizations have experienced a lack of leverage when they have outsourced some of their production. Therefore, many organizations have tried to regain the leverage in their purchase by negotiating the aggregated volume covering both the internal need of components and the need of components at the outsourced manufacturer. Such global agreements have proven to be efficient if the material and order flow still is direct between the supplier and the manufacturer.81

It makes little or no sense for the buying organization to receive the components and distribute them to the manufacturer. The only reason for such choice should be to gain control of the usage and costs of components at the manufacturer. In such case it is probably more efficient to invest in better information system in order to gain this sort of control. The most inefficient strategy is to physically store the components before delivering them to the manufacturer. This involves potential errors, delay in time, damage, wasted handling costs etc. This could only be reasonable if the need of kitting is extremely high or if the manufacturer

78 Gadde & Håkansson (1998), Professionellt inköp, p. 184
79 Ibid, p. 186
80 van Weele (2002), Purchasing and supply chain management, pp. 245-246
81 Ellram & Billington. (2001), Purchasing leverage considerations in the outsourcing decision, pp. 15-27
is only used temporary and the buying organization therefore neglect to give the manufacturer authority to order them by them self.\footnote{Ellram & Billington. (2001), \textit{Purchasing leverage considerations in the outsourcing decision}, pp. 15-27}

### 3.4.2 Centralized warehouses

The modern information technology has enabled the possibility to manage and structure a huge amount of data. This facilitates that different organizations could exchange information without any delay. This has enabled a new distribution structure. The new distribution structure is based on a centralization of both the warehouses and the administrative operations. The previously most common structure was a vertical organization of the warehouses, containing central warehouses and regionally controlled regional warehouses.\footnote{Abrahamsson et al. (1998), \textit{Distribution channel re-engineering –organizational separation of the distribution and sales functions in the European market}, p. 238} However, there are several signs indicating that the centralized structures lead to decreased costs and furthermore also increased service levels. Abrahamsson et al.\footnote{Ibid} discuss the reasons for these effects, which can be summarized in the following points:

- **The whole assortment is available** at the central warehouse. Therefore the lead-time is fixed, short and well known. Furthermore the transport cost is also fixed and well known. This would be very difficult to accomplish with several regional warehouses.

- **The product flow through a centralized warehouse is much easier to control.** If two warehouses are merged, the **total safety stock could be decreased** because the demand from the different customers is never 100\% correlated i.e. the maximum demand do not occur at the same time for both warehouses. When safety stock is lower, cost of tied capital in inventory is decreased. The reduction in safety stock as an effect of centralization can be defined as the Portfolio Effect\footnote{Zinn et al. (1989), \textit{Measuring the effect of inventory centralization/Decentralization on aggregate safety stock: The “square root law”}, pp. 1-15}. The portfolio effect is affected by a number of variables: the number of past stocking locations that are merged into a centralized warehouse, sales correlation between the past stocking locations and the standard deviation of sales of the different stocking location.

- **Economies of scale.** When doing all the administration at the same place, investments in automatic processes and computer tools pay off faster, i.e. more effective tools and a higher level of automation can be used to handle the goods. When handling all warehouse operations at the same place, savings in personnel could be done.
• **Savings in learning.** Fast introduction of new components and less scrapping costs when replacing an old article.

• **Reduction of the bullwhip effect.** The bullwhip effect is directly correlated to the number of stocking points in the supply chain. Therefore, centralized warehouse structure reduces the bullwhip effect. Estimates that have been done indicate that the bullwhip effect is amplified to the double for every level of warehouses in the supply chain.  

• **Less non-value adding activities.** With a centralized warehouse the number of non-value adding moments such as loading, un-loading, packaging, sorting and controlling is decreased.

The number of warehouses should be determined by the required lead-time i.e. the only reason why an extra warehouse should be built is to meet lead-time requirements. It is very important that the required lead-time is determining how many warehouses that are optimal.

The information system that should be used to manage the centralized warehouse should be linked directly to customer needs. When the customers place an order, the order should immediately be transferred to a replenishment order at the central warehouse. The speed of the information system enables production and replenishment to be based on point of sales data combined with forecasts. As a result the administrative lead-time should be close to zero and all information gathered at all the different markets should immediately be available to the distribution administration.

The management of a supply chain must reflect the product characteristics. A functional product with stable demand suffers a hard price competition. Therefore, it is crucial to optimize such a supply chain in terms of optimal order quantities and minimized inventory levels. This could be achieved when the forecast is accurate, which facilitates better production planning. An innovative product on the other hand with unstable demand and a lot of variants must prioritize the lead-time rather than the price, since the incentive to bring new products to market as soon as possible is high. A responsive supply chain rather than optimized, fits for innovative products.

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86 Mattson (2002), *Logistik i försörjningskedjor*, p. 248  
87 Ibid, p. 249  
88 Abrahamsson et al. (1998), *Distribution channel re-engineering –organizational separation of the distribution and sales functions in the European market*, p. 240  
89 Ibid, p. 245  
90 Fisher (1997), *What is the right supply chain for your product?*, pp. 105-116
3.4.3 Hub and Spoke

Hub and Spoke is a type of network structure for the distribution of goods. Rather than to route goods directly from origin to final destination the Hub and Spoke structure connects the different points of origins and destinations in one or several hubs. If there is more than one hub these are connected to each other with higher volume pathways. Single transports are gathered in a central point in the supply chain, the hub, where the goods are cross-docked and sent via channels, spokes, to their destinations. The hub then resembles a central warehouse. An example where this structure is used is in the air travelling business. Passengers from one city going to different destinations travel on the same flight to a hub where they are regrouped, with passengers from other cities, and travel to another hub or their final destination.

The transports to and from a hub become frequent and therefore a company could take advantage of economies of scale in the hub operations.\textsuperscript{91}

There is also a great difference in the number of relations, or transport combinations, in a hub and spoke system compared to a conventional system.

When the number of terminals is high, the reduction in the number of contacts is very high. At the same time the requirements of the hub increases with a higher number of terminals. The hub requires an advanced material handling system to keep track of all the goods.

The hub and spoke system can be further developed so that the terminals work as points where the goods are cross docked or split up into smaller orders for a lower tier in the structure.

The necessary number of vehicles for transportation is lowered with the decreased number of transport relations. That results in a higher loading ratio in the vehicles.

3.4.4 E-commerce solutions

It is crucial to make transactions in a supply chain in a system that fits with the requirements in each relation. In high frequency relations it is more beneficial to invest in an automatic transaction tool. There are different systems in which transactions could be made all with some positive and negative aspects:

ERP solutions

ERP (Enterprise resource planning) systems reduce the manual activities related to the financial, inventory, customer order activities and capture data from the transactions. ERP systems use a single data model that decides how data should

\textsuperscript{91} Pirkul & Schilling (1998), \textit{An Efficient Procedure for Designing Single Allocation Hub and Spoke Systems}, pp. 236-240
be stored and transferred. Thus, ERP achieve a high level of integration. However, to use the same data model within a supply chain and even in larger companies has proven to be difficult. The single data model should represent and fit how companies work in best practice. Nevertheless, the problem many companies experience during implementation of an ERP system is that they both have to implement the ERP system and change the way they work in order to fit with the ERP system. This results in a very painful and time-consuming implementation process. Unlike today’s ERP systems, a supply chain solution must be able to cope with all the different information systems in the supply chain. The benefit with ERP systems is the high level of integration that it involves and the downside is the inflexibility. Therefore ERP solution is recommended for single companies but it could be very difficult to implement it in a whole supply chain.  

**EDI communication**

The ordering process between two companies could be significantly more efficient using an EDI connection. EDI, which is the acronym of Electronic Data Interchange, is a predefined protocol that enables direct communication between the companies computer system. The difference that this involves for the order flow is illustrated in Figure 3.5.

EDI facilitate more effective order flow. Same level of improvement could be seen in other contacts in the purchasing process such as order confirmation and invoice handling. The potential benefits of EDI are therefore:

- Reduced paperwork
- Improved precision due to reduction in manual processing
- Increased speed in the transmission of the order and other data
- Reduced clerical/administrative work in data entry, filling, mailing, and related tasks
- Reduced inventory due to improved precision and reduced order cycle time

The benefit of EDI must be weighted against the cost that one connection involves. An EDI connection could be established between two companies directly. However, with complex supply networks, that course of action involves a risk. The risk is that several independent systems evolve causing an expensive and redundant network. That is the benefit with a hub solution where several companies connect to the same hub administrating the orders by EDI.

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**Hub solution**

A hub has the benefits that every company in the network gets one single interface towards the other companies in the system. A hub could furthermore act as a converter if two companies do not use the same data standard for communication. The frequency in the information flow in the connection to the hub is higher than the information flow in one single direct connection. Therefore the investment in an EDI-connection pays off faster using a hub-solution than when investment is made in individual direct connections. A hub solution is therefore beneficial for supply networks. A hub is easier to implement if there is a strong company in the supply network that initiate the implementation of such a hub and thereby force the other companies in the network to cooperate with the hub.93

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4 Empirical Findings

Tetra Pak has a complex supplier structure. This supplier structure has evolved over time and Tetra Pak uses strategies in terms of quality, relations, and agreements etc. in order to control it. Still both internal employees and external contacts experience some inconvenience and problems in utilizing potential synergies.

4.1 Tetra Pak

In Tetra Pak there has been a strong technology focus. Design and quality have come first, which means that a low price has not been equally important when a design engineer has chosen or designed a new component. The main source of income for Tetra Pak has been the packaging material. The packaging machines have therefore been the equipment that enables the sale of packaging material and the main priority of the machines is that they shall function without problems. When the machines function correctly and have a long lifetime the sale of packaging material is guaranteed. Prior to 1990, the most of the machines were leased out with the constraint that the customer should buy packaging material from Tetra Pak. In the early 1990, there came an anti-trust legislation that forbids this procedure. Another change came in 1991 related to the acquisition of Alfa Laval. Alfa Laval had much more focus on costs, which influenced Tetra Pak. It was decided that every company within the newly formed Tetra Laval group should aim for positive bottom line result. Furthermore there came a new anti-thrust legislation from the EG that forbid Tetra Pak to sell its packaging machines to a lower price than the manufacturing cost. Hence, the time of subvention of machines was over, which made them more expensive and more threatened by competitors. Therefore, the reduction of costs has been increasingly prioritized.94

Historically the design engineers could freely choose any supplier for new components. There was also little focus on standardization since the costs were not prioritized. As a result, the supplier base was expanding and the articles were not always sourced from the most suitable supplier to the best price.95

Today Tetra Pak consists of four different business areas. Earlier there were a larger number of smaller divisions. The product development departments in the different business areas have been working more or less independently. This has resulted in a low commonality between the different business areas. In order to increase the commonality, Tetra Pak has introduced machine platforms. The idea is that future machines should be developed from those platforms in order to increase the degree of commonality.

94 Nilsson E, Supplier - Quality - Assurance Engineer, Tetra Pak, 2004-10-26
95 Boccolari S, Manager Manufacturing Technology, Tetra Pak, 2004-09-17
Originally Tetra Pak assembled the machines themselves. In the 1970’s Tetra Pak introduced the concept of suppliers that deliver a whole module of a machine. Component suppliers then delivered directly to the module suppliers. In 1995 these suppliers were called system suppliers since Tetra Pak performed an education program aiming to increase those suppliers’ knowledge and by that means give the system supplier more responsibility. The system supplier should not as before only be responsible for assembling, purchasing and manufacturing but also for the quality of the module. Thus, after the education the system suppliers got full responsibility for the module.\textsuperscript{96}

With the system supplier concept Tetra Pak only did the final assembly and testing in-house. Shortly after the system supplier concept was implemented the family supplier concept was planned. Instead of having many suppliers manufacturing Tetra Pak designed shafts, Tetra Pak was going to choose one family supplier for that segment of drawn components, which are the components that are designed by Tetra Pak. Due to a number of reasons this project was never fully completed.\textsuperscript{97}

The trend of outsourcing has increased at Tetra Pak. Today there are system suppliers that also perform final assembly of a whole machine and deliver the machines direct to the customer after final testing. Some system suppliers are also more involved in the design of the machines. There are, however, a number of technologies that Tetra Pak wants to keep in-house since they are considered to be the core competence within the design of packaging machine. Such strategic technology is for example the aseptic, sealing and filling technology.\textsuperscript{98}

In the area of sourcing and the supply chain structure there are, according to Peter Carlsson\textsuperscript{99}, a number of strategies set up to accomplish greater competitiveness:

- The number of suppliers is to be reduced.
- Tetra Pak wants to have the same supplier for a component independent of if it is going to be used in production or as a spare part.
- Greater effort is going to be put on standardization work to reduce the complexity in the wide variety of articles. An earlier involvement of purchasing competence in the design phase shall result in the commercial aspects of sourcing being taken into consideration better.
- Tetra Pak now investigates sourcing in China as a part in the search for suitable suppliers.
- Work according to World Class Manufacturing is performed with key suppliers to assure competitive production.

\textsuperscript{96} Holmquist O, Supplier and development certification officer, Tetra Pak, 2004-10-26
\textsuperscript{97} Nilsson E, Supplier - Quality - Assurance Engineer, Tetra Pak, 2004-10-26
\textsuperscript{98} Boccolari S, Manager Manufacturing Technology, Tetra Pak, 2004-09-17
\textsuperscript{99} Carlsson P, Director Purchasing & Component Management, Tetra Pak, 2004-08-27
In a time-period of four years these actions are part of an overall evolvem ent, which shall result in better performance and therefore also great savings.

### 4.1.1 Supplier structure

Tetra Pak has organized their suppliers in tiers where system suppliers are responsible of a whole module, with a predefined interface to other modules in the machine.

The system suppliers buy components from the component suppliers, as illustrated in Figure 4.1. There are, as mentioned, two different types of components: drawn components, where Tetra Pak owns the design and standard components, where the supplier owns the design or the intellectual property rights are equal to zero. One of the differences between standard and drawn components is the way they are handled by the system suppliers. Regarding the drawn components, which often are low technology components, it is the system supplier’s choice whether they should produce the component themselves or if...
they want to buy the component from a supplier. Furthermore, it is also up to the system supplier to choose the supplier that they prefer. 100

Regarding the standard components, unlike the drawn components, it is Tetra Pak that decides which suppliers that should be used. Tetra Pak negotiates global agreements that cover both the need of standard components for spare parts and the need of components to the assembly at the system supplier. 101

Since this master thesis is limited to standard components, from now on the word component will refer to standard components.

It is the Supply Manager (SM) that negotiates the prices and handles the relation with component supplier; the main contact for Tetra Pak from the component supplier is a Key Account Manager (KAM). 102

A Key Supply Manager (KSM) at Tetra Pak and a KAM at the system supplier handles the relation between the system supplier and Tetra Pak. Some system suppliers have organized one more tier in the supply chain. They have outsourced some of the assembly-activities to sub assemblers. Those assemblers sometimes also have the right to purchase components according to Tetra Pak’s agreements. 103

4.1.2 Component suppliers

Tetra Pak has approximately 700 component suppliers. The corporate strategy is to reduce this number of suppliers and, as stated in the corporate strategy, to work with a few suppliers in partnership relations 104. Several customers apart from Tetra Pak use the standard components. However, in some cases Tetra Pak is the only customer of a standard component due to a small customization that is done to the standard component to make it fit Tetra Pak’s needs. Such customization could for example be different cable lengths and different fastening solutions. In Tetra Pak’s system, the components are still defined as standard components after this customization. 105

Main areas of components are for example: pneumatics, fasteners, motor drive system, sensors and switches and bearings and bushings. Tetra Pak has big global companies as suppliers, e.g. SKF, Trelleborg and Omron, whereas other suppliers are minor companies.

100 Martini H, Supply Manager, Tetra Pak, 2004-09-02
101 Westman E, Supply Manager, Tetra Pak, 2004-08-26
102 Ibid
103 Thelin L, Key Supply Manager, Tetra Pak, 2004-09-06
104 www.tetrapak.com, 2004-08-31
105 Aveling L, Key Supply Manager, Tetra Pak, 2004-10-11
The global suppliers have a distribution system of their own, which enables them to supply the customers from local warehouses. However, central warehouses combined with direct deliveries to the customers are also common, for example Busak+Shamban, the main supplier of seals, has a central warehouse in Stuttgart from where they perform direct deliveries\textsuperscript{106}.

The lead-time is regulated in the agreements and it is approximately 2-6 weeks. By extracting data from the SAP R3 system we could calculate the distribution of lead-times is illustrated in Figure 4.2. This rather long lead-time of six weeks is based on worst-case scenario, i.e. that the component is out of stock and production is required to fulfil the order. Typically it is the Tetra Pak customized components that have a long lead-time since the supplier does not naturally have those components in stock\textsuperscript{107}.

\begin{figure}
\centering
\includegraphics[width=\columnwidth]{figure4.2.png}
\caption{The distribution of lead-times on components.}
\end{figure}

In some cases the system suppliers make sub-agreements with the component supplier, where they agree on a shorter lead-time than the one agreed with Tetra Pak. Omron has a warehouse in Copenhagen where Tetra Pak has a dedicated place for their buffer of components. It is only when the component is out of stock it is a problem to deliver within one week. Therefore it is possible to

\textsuperscript{106} Hagen H, Technical manager, Busak+Shamban, 2004-10-06

\textsuperscript{107} Ibid
deliver within a lead-time of one week in 95% of the cases, Kalle Hansson\textsuperscript{108} at Omron explains.

Among the component suppliers there are complaints regarding the lack of accurate forecasts from customers connected to Tetra Pak’s agreements.\textsuperscript{109}

Another problem that many component suppliers experience today is the lack of corporate structure of the order locations connected to Tetra Pak. SKF has 45 order locations related to Tetra Pak. Ulf Persson KAM at SKF had after one year as KAM still not got the total picture of the material flow. He explained that he experienced a lack of governance in the product flow\textsuperscript{110}.

The high number of order locations and the rather small order volumes is the reality for the component suppliers. Holger Hagen at Busak+Shamban explains.

\textit{“It is possible to disperse small orders but of course, it costs money.”}\textsuperscript{111}

It has been a strategy from Tetra Pak’s side not to allow different prices based on order volumes. Tetra Pak has in negotiations demanded a fixed price/item no matter how many that is purchased each time. Those agreements do not give any incentive to the system suppliers, or Tetra Pak Parts Supply, to order a large amount of items each time.\textsuperscript{112}

Even though Tetra Pak has several order locations it is not considered to be a problem by many of the component suppliers. Kalle Hansson at Omron explained that they have so many customers and order locations anyway. Therefore it is not a problem that Tetra Pak adds 45 order locations to the customer structure of Omron since Omron have hundreds of order locations connected to other customers anyhow.\textsuperscript{113}

The reason why some system suppliers sometimes get better prices than the Tetra Pak agreement is the fact that they are ordering only one component number from the component supplier’s assortment to only one order location, and share information about their needs. So even though the total volume is less, their price is better in some exclusive cases.\textsuperscript{114}

In some cases the component supplier does kitting for Tetra Pak. Kitting means that the supplier collect and package all articles that Tetra Pak needs to do a

\textsuperscript{108} Hansson K, Key Account Manager, Omron, 2004-09-09
\textsuperscript{109} Hagen H, Technical manager, Busak Shamban, 2004-10-06
\textsuperscript{110} Persson U, Key Account Manager, SKF, 2004-10-07
\textsuperscript{111} Hagen H, Technical manager, Busak Shamban, 2004-10-06
\textsuperscript{112} Schött E, Supply Manager, Tetra Pak, 2004-10-13
\textsuperscript{113} Hansson K, Key Account Manager, Omron, 2004-09-09
\textsuperscript{114} Schött E, Supply Manager, Tetra Pak, 2004-10-13
special upgrade or reparation of a machine in a kit.\textsuperscript{115} Some component suppliers do kits even to the system supplier containing several of the components needed to a machine. Jens S, a component supplier, assembles some components to the system suppliers and by that means the system supplier receive a kit of components ready to insert in the module\textsuperscript{116}.

The component suppliers strive to be involved in the development of new machines. For example, SKF has made an effort by offering design services for free once a week in Lund. \textit{“It is in the beginning of the design process that we really could contribute with our knowledge and thereby do ample savings by doing right from the beginning.”}\textsuperscript{117}

\subsection*{4.1.3 Supply Managers}

The Supply Manager handles, as mentioned, the relation between Tetra Pak and the component suppliers. This role embraces: negotiations, agreements and update of data in SAP R3. Every Manager handles approximately 30-40 suppliers. The Supply Manager writes agreements with these larger suppliers. The smaller suppliers are not connected to a Supply Manager and Tetra Pak tries to get rid of many of the smaller suppliers in order to get a supplier base with fewer big suppliers who match the size of Tetra Pak\textsuperscript{118}.

The Supply Manager experiences a lack of information regarding the annual volumes purchased by Tetra Pak’s system suppliers. The purchased volumes to spare parts are controlled but not the volumes purchased to the production. Therefore the Supply Manager has to ask the component supplier how much that was bought on the Tetra Pak agreement last year. Then based on those volumes the new agreement is made\textsuperscript{119}.

Apart from the difficulty of knowing the consolidated quantities of the components the Supply Manager does not always know which component suppliers that the system suppliers use. Therefore the same standard component is in some cases purchased from one supplier for spare parts and another one for production\textsuperscript{120}. Lack of control over which components that actually are used in the production is also an issue from a quality point of view. Tetra Pak must find a structure where they have total control of which suppliers of components that are used in the machines\textsuperscript{121}.

\begin{flushleft}
\textsuperscript{115} Persson U, Key Account Manager, SKF, 2004-10-07 \\
\textsuperscript{116} Blom L, Key Account Manager, Jens S, 2004-10-28 \\
\textsuperscript{117} Persson U, Key Account Manager, SKF, 2004-10-07 \\
\textsuperscript{118} Widestadh S, Supply Manager, Tetra Pak, 2004-10-20 \\
\textsuperscript{119} Ibid, 2004-09-03 \\
\textsuperscript{120} Schött E, Supply Manager, Tetra Pak, 2004-10-13 \\
\textsuperscript{121} Holmqvist O, Supplier and development certification officer, Tetra Pak, 2004-08-24
\end{flushleft}
4.1.4 Parts Supply

Parts Supply handles Tetra Pak’s after market and has the mission to create a single process from supplier to end-user. The target is to increase availability of spare parts, optimize stock levels and reduce costs.¹²²

Parts Supply has one central warehouse in Lund. Besides the central warehouse, there are also warehouses in Dubai, Singapore and Greenwood USA due to lead-time requirements. The central warehouse distributes components to the other warehouses but direct deliveries to the customers in Europe are also performed. The strategy is to have Lund as the only interface to the suppliers. However, Greenwood purchases some components directly from the suppliers when the suppliers are located in the USA.¹²³

Tetra Pak guarantees its customers that Parts Supply should be able to provide all spare parts to a filling machine in the first ten years of a machine’s lifetime. However, it is Tetra Pak’s strategy to provide spare-parts far longer than the first ten years since a long lifetime guarantees the sale of packaging material. Furthermore, Tetra Pak makes money on the spare parts, which is another good reason to keep up the support of spare parts.¹²⁴

In 2000 the central warehouse in Lund invested in an ILD (Internal Logistic Device) system, which is an automatic picking system. This investment was based on the fact that Parts Supply at that time started with direct deliveries to the customers instead of having local warehouses at every market company. This increased the number of order lines that should be distributed from Lund. ILD was planned to handle this distribution more efficient. After some initial problems the first years the expected capacity of the system was achieved in the summer of 2004.¹²⁵

The employees in the warehouse in Lund are organized in three teams: Goods reception who handles the inbound-logistics, packaging and shipping who handles the outbound logistics. There are 15 employees working in the goods reception, and they receive 500 order lines each day. There are 40 employees working in the packaging section delivering 4500 order lines each day. Finally there are 9 employees handling the shipping operation.¹²⁶

The warehouse in Lund has implemented new IT tool, Synchron, to manage their inventory levels. Synchron base inventory levels on number of order/year for each component combined with the total demand and the value of each component. As a result the more expensive a component is and the less number

¹²² Internal material 2004-10-15
¹²³ Magnusson B, Director parts supply chain, Tetra Pak, 2004-10-08
¹²⁴ Merkenius R, Manager Inventory Management, Tetra Pak, 2004-08-27
¹²⁵ Persson U, Project leader, Tetra Pak, 2004-10-25
¹²⁶ Leander L, System coordinator, Tetra Pak, 2004-10-14
of orders there is at the component the fewer items are kept in stock. In fact this new system has suggested that several components should not be kept in stock at all. Another change in the new system is that larger orders are suggested for cheap components than before. Synchron is now going to be implemented at Tetra Pak’s other spare parts warehouses in the world. That way information about the inventory levels at the different warehouses can be found centrally.127

4.1.5 Transports

Tetra Pak shares transport agreements with other companies within the Tetra Laval group, such as Sidel and Alfa Laval. The Tetra Laval group buys transports for 300 million SEK annually. The transport department collects the need of transports of all companies within the Tetra Laval group for a specific geographic area and writes agreements with haulers on those transports. Today 194 million SEK of the transport costs are covered by agreements. The main supplier used by Tetra Pak is the company Schenker but depending on different geographic areas other haulers are contracted.128

The pricelist within Sweden is based only on weight and distance. However, the pricelist in Europe are based on weight and postcode. The postcode in Europe is important because it determines how easy it is to get loading on the return transport.129

In Tetra Pak’s supply chain both the components and systems are delivered according to the Incoterm FCA (free carrier alongside ship)130, which means that the buyer pays the main part of the transport. Therefore, it is the system supplier or Tetra Pak Parts Supply that covers the transports from the component supplier.131

4.1.6 System supplier

Tetra Pak has approximately 45 system suppliers. In most cases the system supplier is responsible for one or several modules. A module can for example be an electrical cabinet, the machine body, the infeed module etc. The different modules are illustrated in Figure 4.3. There are also a few system suppliers that are responsible for an entire machine. In that case they get some of the modules from other system suppliers and assembly some of them themselves.

127 Stigborg S, Co-ordinator spare parts, Tetra Pak, 2004-08-31
128 Nilsson P, Logistics, Tetra Pak, 2004-09-21
129 Ibid
130 Incoterm is an abbreviation of international commerce terms.
131 Internal material 2004-10-15
The system suppliers are, as mentioned, subscribers of the agreements for standard components made by the Supply Managers at Tetra Pak. However, there is no guarantee that the system suppliers use these agreements. The agreement states the delivery time for each component and other conditions such as payment procedure, delivery and in some cases minimum order quantity\textsuperscript{132}.

A system supplier has a small internal purchasing organization. The purchasers place orders at the component supplier based on the prices and conditions in the agreement with Tetra Pak. The number of standard component suppliers that are needed for the supply of the components in the modules varies. A big system supplier like Fuji has for example 250 different standard components suppliers\textsuperscript{133}. For a smaller system supplier like for example Wahlquist Verkstäder the number is lower, 75\textsuperscript{134}. Most often the orders are placed by fax, mail or in some cases e-mail. Fuji Autotech is an example of a system supplier that has implemented an Internet based tool for the process of placing orders to

\textsuperscript{132} Widestadh S, Supply Manager, Tetra Pak, 2004-09-24
\textsuperscript{133} Strand M, Purchasing Manager, Fuji Autotech, 2004-09-23
\textsuperscript{134} Niskala L, Purchasing Manager, Wahlquists Verkstäder, 2004-09-22
lower the administrative costs\textsuperscript{135}. Some system suppliers use an automatic fax, which is more effective than ordinary fax. A purchaser then approves a proposition on what orders to place made by the materials handling system. When approved, the order is automatically sent by fax to the component supplier. However, the component supplier receiving the fax must then administrate it manually.

The system suppliers use some sort of material planning system to decide the timing of when to buy and in what quantities. Depending on the value of the component, they place orders more or less frequent. CMS is an example of a system supplier that uses a simple ABC-analysis for this purpose. Components with a low value, C-components, are then ordered less frequent and in larger quantities each time and then kept in stock until needed in the production. The A-class components should be ordered to fit the demand of that component in the production. That way the system supplier tries to minimize the capital tied in inventory and the cost of handling orders. A buffer of a component is also needed in the cases where the lead-time for the supply is too long for JIT purchasing. Therefore a small inventory of components is very common at the system suppliers.\textsuperscript{136}

The system supplier uses a mark-up for the material handling of components. This mark-up should cover the costs of administration, purchase of the components, goods reception, inventory etc. The system supplier, CMS has a mark-up of approximately 4-13\% depending on the value of the component\textsuperscript{137}.

In some cases the system supplier does not, as mentioned, assembly the whole module themselves. They sometimes use suppliers that assemble sub modules. The supply of components to these “sub system suppliers” can be organized in two ways. Either the sub system supplier is also a subscriber of the Tetra Pak agreement and handles the purchase of the components themselves\textsuperscript{138}. Otherwise the system supplier does the purchase for the sub system suppliers and delivers the components to them.\textsuperscript{139}

If the system supplier is not pleased with the terms in the agreement they can turn to the component supplier and make an additional agreement\textsuperscript{140}. In some cases it is a question of lead-time. There is a continuous pressure for shorter lead-times. The lead-time for a module varies. For Tetra Pak Carton Chilled it is approximately 6 weeks\textsuperscript{141}.

\textsuperscript{135} Strand M, Purchasing Manager, Fuji Autotech, 2004-09-23
\textsuperscript{136} Vaccari A, Diretore Generale, CMS, 2004-09-13
\textsuperscript{137} Ibid
\textsuperscript{138} Söberg H, Key Account Manager, TP Ståhlvall, 2004-10-07
\textsuperscript{139} Vaccari A, Diretore Generale, CMS, 2004-09-13
\textsuperscript{140} Henrik Wiese, Key Supply Manager, Tetra Pak, 2004-09-10
\textsuperscript{141} Thelin L, Key Supply Manager, Tetra Pak, 2004-09-06
Tetra Pak Carton Chilled has a different way of planning the production compared to the other machine systems in Tetra Pak. Tetra Pak Carton Chilled plan the production according to a rate. The product owner decides the rate that is adjusted according to the forecast and sales of the machines. This course of action helps both the system supplier and the component supplier to plan their production since the components will be needed according to the rate of production. A shorter lead-time means less inventory needed to guarantee the supply of components to the production. Other system suppliers that do not deliver to Tetra Pak Carton Chilled plan their production to fit the forecast but deliver according the customer order. The forecast is often not accurate which makes planning very difficult for the system suppliers. The forecast is set annually and should be updated during the year. Tetra Pak informs the system suppliers about the forecast but it is never a commitment. This means that the system supplier has no right to financial compensation for the difference between the forecast and the actual purchase made by Tetra Pak.

The system suppliers are more and more involved in the design of the modules. In the new development steps of the machines the system supplier takes part by adding their knowledge of the production of the module. Cost reduction projects are sometimes performed on a machine. In such a project the system supplier plays an active role making propositions for the redesign of the module.

Overall the system suppliers are responsible for the whole system that they deliver. They shall see to that their logistics, purchasing and production works well to be able to deliver correctly, on time to Tetra Pak. When problems arise they should be able to solve them.

The system suppliers are geographically dispersed. Approximately two thirds of them are located in Sweden. Up to one third can be found in Italy. There are also a few in the USA, one in Austria and one in Thailand. The geographical location of the system suppliers is illustrated as yellow dots on the map in Figure 4.4

142 Thelin L, Key Supply Manager, Tetra Pak, 2004-09-06
143 Holmqvist O, Supplier and development certification officer, Tetra Pak, 2004-08-24
144 Fridström K, Key Supply Manager, Tetra Pak, 2004-08-30
145 Holmqvist O, Supplier and development certification officer, Tetra Pak, 2004-08-24
4.1.7 Key Supply Manager

A Key Supply Manager, KSM, is the contact person at Tetra Pak for the system supplier. The KSM writes the agreement with the system supplier’s main contact the Key Account Manager, KAM. The agreement states the system supplier’s responsibilities. A KSM normally handles one or a few system suppliers. The agreements are often negotiated once a year\textsuperscript{146}. Before the negotiations the KSM investigate the development at key cost drivers such as price development on stainless steel, cost per hour for assembly etc. Based on this information the KSM compare the price development of the whole module or machine\textsuperscript{147}.

\textsuperscript{146} Fridström K, Key Supply Manager, Tetra Pak, 2004-08-30
\textsuperscript{147} Thelin L, Key Supply Manager, Tetra Pak, 2004-09-06
The KSM shall also inform the system supplier of any changes ahead in design and forecast etc. After the point of order the customer sometimes makes changes in, for example, package size. Those changes shall be communicated by the KSM to the system supplier.

4.1.8 Purchasing Development

Purchasing Development is a group within the purchasing department consisting of three people. Anders Ekberg is the manager of this group and the reference for the description of their responsibilities and tasks.\textsuperscript{148}

The main purpose with the purchasing development group is to measure other purchasing departments and to coordinate and participate in projects performed in the interface between suppliers and Tetra Pak. Purchasing development does, in addition to this, support the purchasers with relevant IT tools.

Tetra Pak has experienced a lack of information regarding which components that can be found in which machines and in what quantities, largely due to the fact that system suppliers perform the production. Therefore extensive effort in the Purchasing Development group has been put on mapping the supplier structure on a component level in the packaging and distribution machines. This information is useful in cost reduction projects concerning a specific machine. Purchasing Development participate in these cost reduction projects. Based on their knowledge of the current state, Purchasing Development can together with the Supply Managers make propositions, on changes that can be made to cut costs on component level.

The work of Purchasing Development is also dedicated to the development of a supplier portal. The supplier portal is an Internet based tool where the suppliers and personnel at Tetra Pak can find the different agreements made with different types of suppliers. Contact persons within Tetra Pak and at the suppliers are also found. The access of different external parties is limited so that each supplier only can read the agreements needed.

Quarterly Purchasing Development measures the performance of the Purchasing and Component Management group for standard components. The price development and agreement coverage\textsuperscript{*} of the standard components in equipment, i.e. packaging machines and distribution machines, are measured. This result is a part of the Balanced Scorecard.

Purchasing Development also did the initiating work of reducing the number of component suppliers which further led to the master thesis\textsuperscript{149} prior to ours where

\textsuperscript{148} Ekberg A, Manager Purchasing Development, Tetra Pak, 2004-08-23

\textsuperscript{*} How big share of the components in a machine that are covered by agreements

\textsuperscript{149} Davidsson V et al. (2003), \textit{Supply base rationalization}
strategies for how to reduce the number of suppliers where evaluated. The responsibility for this is now moved to the group of Supply Managers.

4.1.9 Quality assurance

The component suppliers are responsible for the quality of the components they deliver. In the same way the system suppliers have responsibility of the modules they deliver. The system supplier must therefore be assured that the whole module and all of its components are functioning as agreed when the module is delivered. A conflict can arise if there are quality issues in the module that can be linked to a faulty component in the module. In a situation like this it is the system supplier’s responsibility to detect the faulty component before the assembly. On the other hand, it is the component supplier that is responsible for not delivering any faulty components to the system supplier. In a case of a quality problem with standard components a system supplier commonly solves this directly with the component supplier. This is part of their responsibility as a system supplier. If there is a serious problem they sometimes also escalate it to Tetra Pak. Tetra Pak is now aiming to use the Supplier Portal as a forum where the quality problems should be reported. When a system supplier then experiences a problem with a component supplier they shall report in the Supplier Portal. The system suppliers shall still solve the problems but Tetra Pak wants to be informed so that they can work proactively.

Problems with spare part components are reported to Tetra Pak. A group within Tetra Pak, Supply Chain Quality, handles the quality issues. They also make assessments of the suppliers. Continuous work is also being performed in accordance with the “World Class Manufacturing” to achieve high quality in a proactive way. The assessments evaluate the supplier at several dimensions. First of all the quality and delivery performance is scrutinized. The assessment can be divided into three main levels of evaluation: management level, production level and component level. Each level contains several topics. The supplier is given a grade in each topic, such grade could be, phase out, improve, good or excellent. Phase out is the worst grade and is a direct signal that Tetra Pak will search for an alternative supplier. Tetra Pak has a standardized phase out program aiming to reduce scrapping costs i.e. phase out is done after the inventories are emptied. Tetra Pak does not demand that their suppliers shall be ISO-9000 certified, but they shall work according to the methods stated in ISO-9000.

Tetra Pak works actively with quality issues in the whole supply chain mainly at the system supplier but as mentioned, also with the component suppliers. The

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150 Strand M, Purchasing Manager, Fuji Autotech, 2004-09-23
151 Holmqvist O, Supplier and development certification officer, Tetra Pak, 2004-11-19
152 Karlsson B, Purchasing Co-ordinator, Tetra Pak, 2004-10-21
strategy aims to improve the current supplier instead of to start working with new suppliers.\textsuperscript{153}

### 4.1.10 Agreements

As mentioned in previous chapters, Tetra Pak negotiates agreements with both the component suppliers and the system suppliers. In the agreements there are fixed prices of the products purchased. Other conditions such as delivery time, terms of payment etc are also stated. The prices and conditions are negotiated. The initial negotiations are normally made face to face and follow up communication are made by e-mails and telephone.\textsuperscript{154}

In the negotiations regarding standard components a Product Manager most often accompanies the Supply Manager. The Supply Manager has the commercial responsibility and a Product Manager the technical responsibility for the components.

Even though a component supplier is covered by a contract, it does not include all components that are needed in the production from that supplier.\textsuperscript{155}

A long-term general agreement is written with the system supplier. In this agreement the status System supplier is stated and the agreed terms for this long-term relationship. The Key Supply Manager has the responsibility for this agreement and he or she gathers the resources needed to write the agreement for example legal experts. There is a six months notice to terminate the agreement for both parties. A product agreement is then updated and written once a year. The product agreement is related to the module or machine that the system supplier delivers. In this agreement the delivery time for the module or machine is written. The costs of making the module are broken down and the price that Tetra Pak pays for the module is also written.\textsuperscript{156}

In the agreements it is stated that Tetra Pak has the responsibility to inform the suppliers of the yearly forecast which then is updated monthly. However, the forecasts are as mentioned always non-binding.\textsuperscript{157}

\textsuperscript{153} Karlsson B, Purchasing Co-ordinator, Tetra Pak, 2004-10-21
\textsuperscript{154} Schött E, Supply Manager, Tetra Pak, 2004-10-13
\textsuperscript{155} Strand M, Purchasing manager, Fuji Autotech, 2004-09-23
\textsuperscript{156} Ottosson J, Key Supply Manager, Tetra Pak, 2004-10-18
\textsuperscript{157} Ibid
4.2 Summary

In order to summarize the issues and the important topics that we discovered in the empiric study, a list was made:

**Issues:**

- Many suppliers
- Low commonality
- Not always same supplier for production and spare parts
- Little purchasing involvement in the design
- Long lead times
- Lack of control of which suppliers that are used
- Lack of control of which volumes that are sold
- Problem to communicate forecasts both on machine and component level.
- Inventory at the system supplier
- Transport costs
- Administrative costs
- Handling cost

**To be considered:**

- Increased responsibilities of the system suppliers
- Possible future sourcing in China
- World class manufacturing is performed with the system suppliers
- The component suppliers have a distribution system of their own
- Orders are placed by fax today
- The rate production at Tetra Pak Carton Chilled
- Complexity
- Time from component supplier to system supplier

These issues and aspects to consider in Tetra Pak form the overall understanding of the situation and will be the platform from which alternative solutions will be discussed and analyzed later in the master thesis.
4.3 Benchmark study

A benchmark study has been performed. The purpose was to gather knowledge of how other companies handle the problems that Tetra Pak is facing. The three benchmarking objects are all big companies acting on a global market having different aspects in common with Tetra Pak. IKEA has, like Tetra Pak, no production of its own. The products of Volvo Construction Equipment are similar Tetra Pak’s products in their structure and in the need of spare parts. Alfa Laval tries to optimize the purchase of components used in production by investigating the needs of different production units.

Apart from that we wanted to find out more about the possibilities of e-commerce. Therefore we visited Sync, a company in Malmö providing e-solutions.

4.3.1 IKEA

This benchmark study was performed by interviews with Kent Larsson at IKEA, who is the key reference for this material.\footnote{Larsson K, Affärsutvecklare, IKEA of Sweden & Modul, 2004-10-20}

IKEA is a global company selling furniture. IKEA’s business idea is: \textit{to offer a wide range of well-designed, functional home furnishing products at prices so low that as many people as possible will be able to afford them}.\footnote{IKEA facts & figures, The IKEA Group 2003-2004} The furniture is sold in warehouses around the world and also on the Internet. The total sales in 2003 were 12.8 billion EUR\footnote{Ibid}, which can be compared to Tetra Pak: 7.3 billion EUR\footnote{www.tetrapak.com, 2004-10-20}.

Furniture manufacturers

IKEA has 1500 suppliers that manufacture furniture. They are located in 55 countries. China, Poland, Sweden, Italy and Germany, in falling order, are the largest countries in terms of purchased value. IKEA tries to cooperate with suppliers that are big enough to handle big volumes. However, compared to IKEA the suppliers are often small. Competitive bidding between the suppliers is used to accomplish low prices in the supply chain. The furniture is delivered from the suppliers to distribution centres or directly to the warehouses, as in the cases with beds.

The relationships with the suppliers are handled through 43 trading service offices in 33 countries. From the trading service offices the prices are negotiated and the production of the suppliers is monitored.
The suppliers have become more and more specialized. As a result, the share of what the suppliers purchase in components increases. Today on average 65% of the value of the furniture comes from the components and the remaining 35% are related to the manufacturing made at the furniture supplier. Components are for example leather, glass, fabrics and fittings. The component suppliers are often, in contrast to the furniture suppliers, big global players.

**Modul**

Naturally fittings, such as screws and bolts, are used, by many of IKEA’s suppliers. Modul was first formed to guarantee the correct supply of fittings to the suppliers. Modul buys fittings, quality tests them, and packages them to fit the needs for different furniture. Suppliers are then offered to buy their fittings from Modul.

Three years ago Modul also started activities concerning other types of components that are used by many suppliers. IKEA had discovered that their suppliers often were too small to establish a good relationship with the big and therefore powerful suppliers of some components, such as the glass, leather and fabrics suppliers. To achieve economies of scale IKEA wanted to consolidate the volumes, which now has been done in some areas by Modul. Modul have three different solutions to make the purchase of their furniture-manufacturing suppliers more efficient.

1) The most common strategy is to collect the total volumes of components that are needed by the furniture suppliers and to write agreements on the whole volume. Modul is the party that administrates this action. First they ask their furniture suppliers which volumes they purchase annually. Then Modul asks their furniture suppliers what price they pay for the components. Modul then gives the furniture supplier an opportunity to sign an agreement. The agreement states that if Modul can agree a lower price on the components than before, the furniture manufacturer commits to buy from that supplier, on the agreed price, for two years further. After the two years a new negotiation occurs. Modul found that they could negotiate better prices when negotiating the aggregated volume together. Furthermore, the power balance is more equal when IKEA through Modul does the negotiation than when the small furniture manufacturer does it. However, after the agreement is done, the operative purchase is handled as normal between the furniture manufacturer and the component supplier.

2) The second strategy is used by IKEA when the furniture supplier has low financial credibility, which implicates that the component supplier does not want to sell directly to the furniture suppliers. In this strategy, IKEA acts as a buyer instead of the furniture supplier. However the components are still delivered directly from the component supplier to the furniture supplier. This course of action means that IKEA takes the
financial risk and the strategy is mainly used as a solution for the furniture suppliers in Russia.

3) The last strategy is the one used on fittings. Here IKEA, through Modul, acts as the buyer and the products are delivered from the component supplier to one of Modul’s central warehouses in China, Slovak Republic or Sweden. Modul makes the package containing the right amount of fittings and then they sell the packages to the furniture suppliers. The furniture supplier is free to choose whether they should buy from Modul or find suppliers themselves and do the packaging of fittings in-house.

However, in most cases Modul is the cheapest solution since they gain economy of scale in purchasing and packaging operations. Furthermore, IKEA has decided that this operation handled by Modul should not make any profit. All profit should instead be made in the retail store. When Modul writes agreements Modul takes a commission that should cover the administrative work behind the agreements.

IKEA sees no need to stop using direct deliveries in any other commodities than fittings. IKEA does not experience that the small volumes ordered by the furniture suppliers is a problem. There are no really small order volumes of components since these orders reflect the size of the furniture orders, which are rather large. The pricing in the agreements also makes it more beneficial to order several items each time. Furthermore, IKEA accepts responsibility for the inventory at the furniture supplier if there is a change of model or if sales go down. IKEA then pays the supplier for the inventory, providing that is not unreasonably big. When there is a change of model, which affects which components that are used, IKEA does a “phase in phase out” action in order to empty their suppliers’ inventory before the new model fully takes over.

The leather is mainly bought from South America. If several furniture suppliers are situated in, for example China, IKEA tries to find a good logistical solution. The typical solution is that one supplier, situated in China, buys all the leather and does some value adding activity on the leather and then sells the leather to the different furniture suppliers in China. This means that the shipping from America is collected and handled centrally.

Main learning from IKEA:
- Global agreements with suppliers in the second tier has given IKEA better prices and conditions since the first tier suppliers are small in comparison to both IKEA and second tier suppliers.
- For the commodity fasteners the DC solution fits well for IKEA since the commonality is high and there is a need for kitting.
- IKEA takes on some responsibility for the suppliers’ inventory.
4.3.2 Volvo Construction Equipment

Volvo Construction Equipment, Volvo CE, is a division within the Volvo Group. The customers cover a broad spectrum, ranging from multinational companies to local family-run companies. Within the business area, a total of more than 150 different models of excavators, wheel loaders, motor graders, compact construction equipment and articulated haulers are produced. This case study is based on an interview with Åsa Eliasson, Global Buyer at Volvo CE.\(^{162}\)

The total sale of the Volvo CE in 2003 was 22, 75 billion SEK. Volvo CE has, because of several acquisitions the past years, assembly and production facilities around the world in France, Germany, Poland, Sweden, Brazil, the U.S., Korea and Canada. Due to the acquisitions, Volvo CE has a large number of suppliers. Today there are approximately 1500 suppliers spread around the world in clusters around the different assembly and production facilities of Volvo CE. Effort is now being put on trying to develop the synergies that can be found in economies of scale.

Volvo CE buys components for approximately 170 million SEK each year. The majority of the components that Volvo CE buys are Volvo designed components and the number of standard components is rather low. The components are handled in the same way more or less regardless of if it is a standard or a Volvo designed component.

**Components to the production and the after market**

In Volvo CE’s production facilities, both assembly and manufacturing operations are performed. They buy several different components from suppliers such as: welded components, electronics, hydraulics, fasteners etc. The commonality between different production facilities is low due to a low level of standardization. The low level of standardization could be explained both by the fact that it is different machines that are produced in different factories but on top of that, the acquisitions have decreased the commonality since the acquisitions of other companies bring other designs and components. Each production facility has an own warehouse nearby the production facility. Spare parts have a separated system of warehouses. Transportation of the components from the suppliers to the production facilities is handled by Volvo Logistics.

Volvo CE does not want to mix spare parts with parts to production because there is a completely different requirement when packaging spare parts than when the components are packaged for production. Spare parts are to be packed one by one with a package that provides protection for a long time, whereas the package to production does not have such tough requirements. In the production Volvo CE wants to have packages that are easy to open and to handle in the production logistics.

\(^{162}\) Eliasson Å, Global Buyer, Volvo Construction Equipment, 2004-11-03
Volvo CE has divided their components in commodity groups. Each commodity is handled by a group that focus on the global need of those components at a strategic level including work with the supplier base etc.

The suppliers are in some cases involved in the design of new machines. The involvement naturally depends mostly on what type of products that the supplier delivers. If the products are considered to be strategic the involvement comes earlier and is of greater importance.

The global commodity group writes agreements with the suppliers. First of all a frame agreement is written that states the general terms of the relationship and warranties etc. A long-term agreement on a components level is then written, which is re-negotiated in two to five years.

The global commodity group negotiates long-term agreements covering the entire volume needed from each supplier, which includes both spare parts and the need for one or several assembly and production facilities of Volvo CE. There is a long-term commitment in the agreement, which ensures that the supplier will support with spare parts even after the time when production of the machine has ended. By that means that Volvo CE ensures that they use the same supplier for production and spare parts. In the agreements, a minimum order quantity is stated. Volvo CE tries to dimension this quantity based on an economic order quantity. The minimum order quantity is a compromise between the needs at the spare parts division and the production; alternatively different order quantities are stated for production and for after market. The delivery times for the components are not stated in the agreements.

**Forecasts**

Each production facility has a department planning their supply of material. This department gives forecasts to the suppliers on the following three levels:

1. A forecast of the components on one year’s basis. This forecast is based on the forecast of sold machines at the different markets and the information comes from the different market companies in the world. The planning department breaks down this forecast to a component level based on the bill of material. This forecast is rolling and updated once a week. The forecast breakdown at component level is available to the suppliers by EDI. If a supplier wants to see the forecast of components to one production facility they get this information by EDI. Since this information is not available at a centralized level, the component supplier has to connect to all their order locations of Volvo CE in order to get the aggregated volume.

2. The second level of forecast is delivered similarly, separately by the different production facilities. This is a forecast on shorter terms. Volvo
CE commits to this forecast, which means that Volvo CE promises to at least pay for the material cost for the volume stated in this forecast. As a result the suppliers can order the material they need to fulfil a future order, without taking any risks. This enables short lead times.

3. The third step is the real order and is committed with a promise to buy the components produced.

The prognosis system on the different levels works well and is rather reliable even though it is a complicated task to gather the information from the different markets and break it down to more detailed levels.

Main learning from Volvo CE:
- Volvo CE uses the same suppliers for production and after market.
- Volvo CE negotiates long-term global agreements to gain economy of scale. With the agreements they also ensure that the supplier will support with spare parts.
- By automatically connecting the bills of material, the source lists and forecasts Volvo CE has created an effective tool for disaggregating the forecasts on a component level.

4.3.3 Alfa Laval

Alfa Laval is an international company providing equipment, systems and services to optimize the performance of its customer’s processes. Their products heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals. The products are produced in around 20 different production units around the world and sold to customers in around 100 different countries. The total sale in 2003 added up to 13.9 billion SEK. This case study is based on an interview with Magnus Linnér, Operations Purchasing, Alfa Laval.\(^{163}\)

The majority of the components that Alfa Laval buys from suppliers are specially designed for Alfa Laval. Other components such as a portion of the fasteners for example are standard components.

Each production is a legal entity within Alfa Laval responsible for its own productivity etc. Each production unit has its own purchasing organization responsible for the supply of material to the production. There is also a global purchasing organization. They try to utilize the economies of scale that can be found when several production units use the same suppliers. When all the suppliers to the different production units are summed it adds up to around 4000

different suppliers. The global purchasing organization writes agreements with around 100 suppliers, which together represents a majority of the total purchased value. The different production units are free to write their own agreements with their unique suppliers. They also handle the operative purchase on their own. They handle their own purchase but they are forced to use the global agreements and the globally agreed suppliers whenever possible.

The operative purchase is made with fax or other tools depending on the production unit. Sometimes EDI is used. There is no standardized, global tool for placing orders at Alfa Laval. In an ongoing project Alfa Laval is now looking at an e-commerce portal to use when VMI is implemented. The portal shall be used by the supplier and is connected to Alfa Laval’s production planning system. However, at the moment there are no plans for implementing a portal to use for placing orders for the purchasing organization at each production unit.

Alfa Laval also has a number of distribution centres around the world for the supply of spare parts to the customers. When the global purchasing organization writes agreements with suppliers these are based on the total need of components from that supplier including spare parts. Apart from the global agreements covering components to both production and the aftermarket these two areas are clearly separated. A production unit cannot buy any of its components from a distribution centre.

**Distribution**

Alfa Laval tries to utilize the distribution network of the supplier as much as possible. If a supplier cannot handle several order locations it is probably not a suitable supplier anyway, Magnus Linnér reasons. The most effective way is that the supplier delivers directly to the production unit. They also deliver to the different distribution centres for spare parts.

The lead-time for the components is specified in the agreement. In the agreement a maximal level of inventory at the supplier on the components are also stated. If the demand of a component drastically falls due to for example a change in design Alfa Laval agrees to buy the inventory of the supplier up to the maximal level of inventory.

The process of implementing design changes of components is not as effective as it could be mostly due to lack of structure in the information network within the company. There are, however not many problems when a supplier is phased out. In those cases the inventory at the supplier is used up and then the change is implemented. Inventory at the supplier is needed so that the supplier can deliver the components on a shorter lead-time. Otherwise the supplier’s lead-time for producing the component would be added to the total lead-time to Alfa Laval.

If a production unit only needs a very small volume of a component it can in some cases buy it from another production unit instead of buying it directly from
the supplier. That is since the volume is lower than the optimal order quantity set with the supplier.

As mentioned, VMI is used at some commodities like fasteners for example. To be suitable for VMI the usage of the commodity must be steady and not too irregular according to Alfa Laval. By VMI it is possible to achieve a higher service level with lower means. This is due to that the supplier has greater knowledge of the components and by knowing the actual usage of the components in Alfa Laval’s production they have the possibility to optimize the supply.

Alfa Laval prefers to turn directly to the producers of components. In most cases their usage is big enough to write advantageous agreements on the aggregated volume and therefore a wholesaler would not be able to make a better deal. However, depending on the product wholesalers are also sometimes used, as in the case with fasteners.

Forecast
A yearly forecast is given to the suppliers. This forecast is not broken down on a components level. It is a percentage change in demand since last year. Each production unit then sends a rolling forecast updated every month to its suppliers. This forecast is on a components level and is based on information extracted from their information planning system and not on bills of material.

To see the total need of components the production units send reports on their usage to the global purchasing organization. That way they get the overall picture and can analyze cases of commonality between different plants.

Quality issues
If there is a problem with a supplier the purchasing organization at the production unit affected by the problem deals with it directly. Quality issues especially shall be solved directly between the production unit and the supplier. If there is a serious problem it can be escalated to the global purchasing organization.

Main learning from Alfa Laval:
- Alfa Laval negotiates global agreements to gain economy of scale for some commodities but prefer direct deliveries.
- VMI is used for some commodities. In those cases Alfa Laval investigates the possibility of making their inventory levels visible by using e-commerce solutions.
4.3.4 Sync

In order to receive information regarding e-commerce possibilities we contacted the company Sync. The following material is collected from an interview with Carl-Johan Andersson\textsuperscript{164}, Senior partner and Chief architect at Sync.

Sync is a supplier of an e-commerce solution that could be used as a middle layer between different organizations. The middle layer, from now on called “e-hub” facilitates all activities related to the order process to be handled towards one interface regardless of how many companies or organizations that are involved. There are two main benefits with such a solution.

- **Effectiveness:** Every company connected to the e-hub gets one interface where they could handle all their orders to the other companies connected to the e-hub. Furthermore, the order handling process gets more or less automatic depending on which connection the different organizations choose to connect to the e-hub. This saves enormous amount of administrative work on the order process including order, order confirmation, invoices etc.

- **Information:** The e-hub collects important information regarding all processes in the supply chain. With the e-hub the supply chain becomes visible which reduces the complexity.

There are, as illustrated in Figure 4.5, different possibilities in how to connect to the e-hub:

1. If the frequency in the relation between one organization and the e-hub is more than one event/hour, it is beneficial to invest in a real-time tool for connection, EDI for example. EDI facilitates information to be automatically transferred back and forth from the company’s ERP system, SAP for example, into the e-hub without any manual input. This reduces the administrative work and increases the quality of the data since no human errors related to input process increase such risk.

2. If the frequency is less than 1 event/hour, it is probably not worth the money with an automatic tool for connection. Instead information has to be written or read manually on a web interface.

3. If an organization already has developed an interface to handle orders or relations with other companies, they probably want to use the same interface handling their relation to the companies connected to the e-hub. This is not a problem since it possible to convert data from the e-hub to make it fit with the existing solution. This limits however the

\textsuperscript{164} Andersson C-J, Senior Partner & Chief architect, SYNC, 2004-11-30
number of services that could be performed in the connection to the number of services in the existing tool.

Apart from those possibilities, there are a few more options in how to receive information from the e-hub. This could be done by fax, e-mail or even SMS to a mobile phone.

Regardless of how the different companies choose to connect to the e-hub, the information of the transactions is always stored.

Apart from the services described, the e-hub could also provide:

- Information regarding inventory levels at different companies in the supply chain
- Tracking functions, easy to track an order and see where it is.
- Easy to remove and replace one company connected to the e-hub without disturbing other companies in the supply chain.
- Facilitates cross selling. For example in case of scarcity it is possible to see which other company that has ordered the limited component and agree to share that order.

The implementation time for a system as the e-hub that Sync provides takes 6-12 months to implement, which is fast compared to the implementation of ERP systems.
Main learning from Sync:

- An e-commerce solution has the possibility of increasing the effectives in the supply chain.
- An e-commerce solution has the possibility of giving very valuable information about the transactions made in the supply chain.
5 Analysis

During our work many different aspects of Tetra Pak’s problems have arisen. The analysis of those problems has been related to the problem analysis in Chapter 1, i.e. complexity, control, cost savings and strategic fit. There are different potential strategies to structure Tetra Pak’s supply chain of components. To analyze the outcome the DC solution, we have to consider aspects on an operational, tactical and strategic level.

Due to secrecy reasons the costs and savings in the following chapters have been multiplied with a secret factor and the currency set to Tetra Pak Krona, TPK, a fictitious currency. Since all hidden numbers are multiplied with the same factor it is still possible to see the proportions between different numbers.

5.1 Operational level

There are several aspects on the operational level that need to be analyzed. On the operational level we calculated direct savings.

5.1.1 Costs

As described in the problem analysis, a part of the task consists of finding out whether or not savings can be made in a DC structure. Such structure will affect the order handling process in the supply chain and therefore also the costs related to this process. The cost of transporting the components in the supply chain will also be changed if the distribution system is changed. Redirecting the physical flow of components will also change the inventory structure in the supply chain. We have performed all calculations in an Excel model from now on called the “model”.

The Model

The calculations in our model is partly based on the need of standard components to 16 different machines in 2003, both distribution and packaging machines. Those 16 machines represent 80% of the Tetra Pak’s total sale of equipment in 2003. All the components in those machines and the component suppliers delivering those components were input to our model. Altogether this included 366 different suppliers. We also analyzed the spare parts delivered by these 366 suppliers by extracting data from Tetra Pak Parts Supply information system. We collected information regarding the characteristics of the different components from each supplier from the SAP R3 system.

We divided the components into three different classes A, B and C, see Table 5.1, depending on their value, because the value influences the inventory costs and thereby the order pattern of the component. This was to find out if there was a difference in the result depending on the value of the components.
<table>
<thead>
<tr>
<th>Value (SEK)</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;500</td>
<td></td>
<td>100 - 500</td>
<td>&lt;100</td>
</tr>
<tr>
<td>% Of total value</td>
<td>73</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>% Of the components</td>
<td>35</td>
<td>21</td>
<td>44</td>
</tr>
</tbody>
</table>

Table 5.1. ABC classes

In the model, information about the system suppliers in Sweden and Italy was also added. Their geographical distance to Lund and Italy was calculated to enable the mapping of transport costs. From the Supplier Portal we extracted information on these suppliers. In our model we included 80 system suppliers delivering to the 16 machines. Some of them are big such as Fuji Autotech while others are just delivering a sub-module to a bigger system supplier.

The 366 component suppliers have on average 20 order locations in our model. Interviews have shown that a system supplier has around 50 to 250 different component suppliers. A system supplier has in the model an average of 92 different component suppliers.

In the model the optimal order quantity is calculated using the Wilson formula and by that the optimal frequency for placing orders. The Wilson principle minimizes the cost of tied capital in inventory and the order handling cost. Tetra Pak Parts Supply has not mapped its order-handling cost before, so in our study we calculated this value based on employee costs in different departments at Tetra Pak Spare parts, connected to order handling. This information worked as input to our model and is presented in Table 5.2

<table>
<thead>
<tr>
<th>Cost:</th>
<th>Value (TPK)</th>
<th>Per</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inbound order administration</td>
<td>9000</td>
<td>Order</td>
</tr>
<tr>
<td>Inbound logistics, physical handling</td>
<td>5600</td>
<td>Order line</td>
</tr>
<tr>
<td>Outbound order and shipping administration</td>
<td>8100</td>
<td>Order</td>
</tr>
<tr>
<td>Outbound packaging, physical handling</td>
<td>1900</td>
<td>Order line</td>
</tr>
</tbody>
</table>

Table 5.2. The estimated costs connected to order handling.

The study of Tetra Pak Parts Supply revealed that there are on average 2, 4 order lines per order in the inbound flow and 9 order lines per order in the outbound flow.

Transport costs were calculated based on the pricelist from the hauler Schenker.
Inventory costs in today’s structure and in the DC structure were also calculated. Tetra Pak Parts Supply interest rate for tied capital, which is 8%, was used in the model.

The model is constructed so that a number of variables can be changed and the result of the change is easy to follow. For example we wanted to see the change in result when changing from a maximum of daily deliveries to weekly deliveries. By changing different variables we also have the possibility to perform a sensitivity study of the model, i.e. see which in-data that has the greatest impact on the outcome.

**Costs related to order handling**
The order handling costs are likely to decrease if the number of orders is reduced in an alternative structure.

In an alternative structure with a DC, from which the suppliers get all their components, the component supplier would have a reduction in the number of order locations to 1 instead of on average 20. The system suppliers would, in such a structure, place orders to one point instead of the on average 92 different component suppliers. This means that the number of operational relations due to the placing of orders is reduced with 95%, from around 8000 to 450. At this point it is reasonable to believe that this decrease in operational relations also will decrease the number of orders. However, the number of order lines per order will increase in the relation between the DC and the system supplier. It is the level of commonality between the system suppliers that decides to what degree the number of order lines can be decreased in the relation between the DC and the component supplier. The commonality study shows that two different system suppliers have on average 25% of their component suppliers in common.

For the component suppliers, the change is both in the number of order locations but also in the number of orders. They have to distribute the same amount of components in a DC structure but they will be distributed to only one order location, which will significantly decrease the number of orders but not so significantly the number of order lines due to low commonality. In Figure 5.1, the number of orders, in today’s structure, to the system suppliers (calculated in the model) and spare parts (info from SAP R3) are summarized.
Figure 5.1 The number of orders and order lines in today’s structure

The administrative costs due to the administration of every order are then decreased in correlation to the decrease in the number of orders. The physical handling, such as goods reception and packaging is not decreased in correlation to the number of orders but in correlation to the number of order lines. The number of orders and order lines in a DC structure calculated in our model is presented in Figure 5.2.
Table 5.3. shows the calculated change in number of orders and order lines that are distributed in a DC structure compared to the structure of today.

<table>
<thead>
<tr>
<th>Change in order and order lines</th>
<th>Today</th>
<th>DC structure</th>
<th>Change</th>
<th>SUM:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orders to Sys</td>
<td>65 885</td>
<td>4160</td>
<td>-61 725</td>
<td>-82 198</td>
</tr>
<tr>
<td>Orders to TPS/DC</td>
<td>31 584</td>
<td>11 111</td>
<td>-20 473</td>
<td></td>
</tr>
<tr>
<td>Order lines to Sys</td>
<td>140 386</td>
<td>181 238</td>
<td>40 852</td>
<td></td>
</tr>
<tr>
<td>Order lines to TPS/DC</td>
<td>72 320</td>
<td>113 887</td>
<td>40 567</td>
<td>81 419</td>
</tr>
</tbody>
</table>

Table 5.3. Presentation of the number of orders and order lines in different structures. TPS; Tetra Pak Parts Supply, Sys; System supplier.

The order handling is decreased for the component supplier and the system supplier. On the other hand there is an increase in order handling cost in the alternative structure for the distribution central since the orders will go through this point. The savings made at the system and component suppliers must outweigh the added order handling costs in the DC.
The savings that can be made in order handling is calculated and the result is presented in Table 5.4:

<table>
<thead>
<tr>
<th>Administration Saving (MTPK)</th>
<th>In total</th>
<th># of suppliers</th>
<th>Saving /supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>880</td>
<td>366</td>
<td>2400 (TTPK)</td>
</tr>
<tr>
<td>TPS/DC</td>
<td>-570</td>
<td>1</td>
<td>-570 (MTPK)</td>
</tr>
<tr>
<td>SyS.</td>
<td>330</td>
<td>80</td>
<td>4100 (TTPK)</td>
</tr>
<tr>
<td>SUM:</td>
<td>640</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.4 The calculated saving in administration per supplier.

As can be seen there is a potential saving in the administrative work if a DC structure is implemented. The saving is based on the decrease in the number of orders. However, there is a risk that the cost connected to the administration of an order increases as the number of order lines is increased from 2, 4 order lines/order today to 19 order lines/order in the DC structure. This has not been considered in our model.

Apart from the decrease in number of orders another saving can be possible. Fewer operational contacts in the supply chain make it easier to implement automatic handling of orders and invoices. Today the system suppliers mainly use the fax when placing orders. Some system suppliers use an automatic fax, which is more effective. However, it is possible to implement a portal or hub to handle invoices and orders automatically even though the physical flow is direct from the component suppliers to the system suppliers.

**Transport costs**

According to Schenker’s price list for Tetra Pak, the price for a transport depends on the weight and distance. Crucial for the total transport cost is the number of transports. The number of transports can be reduced in a hub and spoke system if different components can be transported together. That must be weighed against that every article in a hub and spoke system must be transported more or less twice: from the sender through one of the spokes to the hub and then through another spoke to the receiver.

Commonality in which component suppliers that the system suppliers use will result in a reduction in the number of orders placed to the component suppliers, as discussed above. When several system suppliers use the same component supplier their need can transported as one load to the hub. Out from the hub components from different component suppliers can be consolidated into one transport to a system supplier.

The number of transports is also highly dependent on how often transports are made to and from the hub. The transport cost is decreased if a maximum of
weekly deliveries are used instead of daily etc. The result of our calculations, with weekly deliveries, is stated in Table 5.5:

<table>
<thead>
<tr>
<th>Transport costs (MTPK)</th>
<th>Today</th>
<th>Future</th>
<th>Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Sys</td>
<td>1350</td>
<td>410</td>
<td>940</td>
</tr>
<tr>
<td>To TPS/DC</td>
<td>450</td>
<td>680</td>
<td>-240</td>
</tr>
<tr>
<td>SUM</td>
<td>1800</td>
<td>1100</td>
<td>700</td>
</tr>
</tbody>
</table>

*Table 5.5 Results from the transport calculation*

There is a saving potential in the transports as can be seen in Table 5.5. The calculations in our model further showed that when we tried daily deliveries the saving decreased from 700 MTPK to a loss of 60 MTPK. Therefore it is critical for the transport costs that enough orders are merged before the transport is sent. Daily deliveries require one week to collect transports. This involves a delay in the transport of a component of maximum one week before the transport is sent. It should be said that the calculations compare future weekly deliveries with direct deliveries in today’s structure. There are savings to do already in today’s structure if Tetra Pak gives Schenker, the preferred hauler, one week’s time window to send the transport. It is then Schenker’s responsibility to schedule the transports more efficiently. However, in a DC structure it is the administrator of the DC that more or less does this work instead of Schenker. The DC sends and receives more or less full truckloads than today’s structure. Hence, the cross docking ability that Schenker provides with other goods is then less utilized. That is the reason why Schenker could provide better prices in the DC structure. This must be weighted against the extra handling of the goods at the DC.

**Inventory costs**

Each of the 80 system suppliers tries to keep its inventory levels low. However, due to the rather long lead-time in the deliveries from the component suppliers the system suppliers are forced to hold some components in their inventory in order to meet the short lead-time requirements that Tetra Pak demands from the system suppliers. Furthermore, administration and transport costs force the system supplier to order many components each time, the ones that are not needed in production immediately are put in stock.

The cost of tied capital in inventory is divided in two parts: the safety stock and the buffer from which components are taken into the production as described in Figure 5.3.
The safety stock should cover the variation in demand during lead-time. There are two reasons why it is difficult to predict the demand during the lead-time. First of all there are fluctuations in demand during the lead-time. Second there could be fluctuations in the lead-time. Tetra Pak suffer both uncertainties, primarily it is the fluctuations in demand that is difficult to predict. The demand fluctuates and furthermore the specification of which variant of the machine that should be sold is often changed late in the process, far beyond the point of order. The lead-time in the agreements is on average 3 weeks. The result of the calculated changes in the safety stock costs at the system suppliers and Tetra Pak Parts Supply/DC is presented in Table 5.6. This calculation is based on an average lead-time from the component supplier of 3 weeks and an average lead-time from the DC of 1 week.

<table>
<thead>
<tr>
<th>Safety stock costs (MTPK)</th>
<th>Today</th>
<th>Future</th>
<th>Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>At TPS/DC</td>
<td>110</td>
<td>250</td>
<td>-140</td>
</tr>
<tr>
<td>At Sys</td>
<td>280</td>
<td>160</td>
<td>120</td>
</tr>
<tr>
<td>SUM</td>
<td>390</td>
<td>410</td>
<td>-20</td>
</tr>
</tbody>
</table>

*Table 5.6 Result of the safety stock calculations.*

The cost of the buffer is linked to the order frequency at each component. The cost could be kept very low if the frequency is high. The problem is that such alternative will increase administration and transport cost. In Table 5.7, the calculated costs and savings in the buffer at TPS/DC and the system suppliers are presented.
Table 5.7 The buffer costs

It is reasonable to argue that Tetra Pak should manage to negotiate better lead-times with the component suppliers on the standard components. As Fisher stated it is critical to prioritize a short lead-time when handling products with unpredictable demand, which is true for Tetra Pak machines.

Some suppliers that deliver components to the system suppliers do a kit out of the different article numbers that the system suppliers needs. It is impossible to continue with kits from the component supplier in a DC and at the same time have portfolio effects in the inventory. So either the kits must pass trough the DC without portfolio effects or the component must arrive to the DC as separate components.

Summary of financial impact of DC structure

Summarizing the financial impact in inventory, transport and order handling costs gives the total result. The result presented in Table 5.8 shows that only weekly deliveries involve significant savings.

<table>
<thead>
<tr>
<th>Savings:</th>
<th>Daily deliveries</th>
<th>Weekly deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MTPK</td>
<td>%</td>
</tr>
<tr>
<td>A class</td>
<td>92</td>
<td>57</td>
</tr>
<tr>
<td>B class</td>
<td>66</td>
<td>41</td>
</tr>
<tr>
<td>C class</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>SUM:</td>
<td>162</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.8 Results of our model

It is, according to the calculations made in the model, much more beneficial to implement weekly deliveries than daily deliveries. This is because the model takes the number of orders and transports in consideration. Naturally more orders and transports are merged when weekly deliveries are used instead of daily. The down side of this choice is the delay in lead-time. However, weekly deliveries seem like the best strategy according to the model, therefore the rest of this chapter will present the sub results of the weekly delivery strategy.
It can further be observed in Table 5.8, that 61% of the savings is in the segments of A-components, which represents 35% of the component numbers. Since the A-components are the most expensive components they are ordered more frequently. Therefore the merging of orders that the DC structure involves, have a larger impact on the A class components.

The model evaluates the total cost of the supply chain. It is interesting to see how the savings are distributed on the different companies in the supply chain. This is presented in Table 5.9.

<table>
<thead>
<tr>
<th>Saving</th>
<th>In total (MTPK)</th>
<th># of suppliers</th>
<th>Saving /supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>1990</td>
<td>366</td>
<td>5400 (TTPK)</td>
</tr>
<tr>
<td>TPS/DC</td>
<td>-930</td>
<td>1</td>
<td>-930 (MTPK)</td>
</tr>
<tr>
<td>SyS.</td>
<td>310</td>
<td>80</td>
<td>3900 (TTPK)</td>
</tr>
<tr>
<td>SUM:</td>
<td>1380</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 5.9 Distribution of the savings in a DC structure.*

### 5.2 Tactical level

As the Total Cost of Ownership theory implies, there are several other aspects to consider than just direct costs therefore we chose to evaluate the problems at a tactical and strategic level to. On a tactical level we can evaluate how the complexity of the supply chain is affected by a change in its structure. We can also see if, and in what ways, Tetra Pak can achieve greater control of the supply chain. Both control and complexity are two wide areas and must therefore be evaluated from different point of views.

#### 5.2.1 Control

Today Tetra Pak experiences a lack of control. In an alternative structure where components pass through one point the information regarding volume, prices and which components used can be extracted from the DC. For Tetra Pak control regarding the components gives two main advantages:

- It increases the ability to trace the components. This is an important factor since Tetra Pak is in the food industry, thus the company must guarantee safety.
- It gives Tetra Pak information regarding which components it is critical to negotiate cheaper prices on.
We see four important aspects, which affect the control of the supply chain and therefore need to be evaluated:

- Coordination of information
- Forecasts
- Quality issues
- Agreements

**Coordination of information**

Since Tetra Pak’s network of suppliers is complex, the need for coordination is large. The experienced lack of control is considered crucial to many of the parties that we have interviewed. According to the theory of the bullwhip effect the spreading of the correct information along the supply chain is highly important to counteract the bullwhip effect. An important question is then: Is the DC structure the best way to coordinate the information and thereby achieve control? In a DC the physical flow of components is redirected. The DC becomes a central not only for the components but also for the information. The gathered information can be seen as a positive consequence of the DC structure. However, if the main objective is to get information concerning the components used in the equipment it can probably be accomplished by a redirection of the information channels without changing the physical flows between the tiers in the supply structure.

In the alternative structure the DC acts as a third party in the middle. When an extra tier is introduced in the supply chain, correct homogenous information to the different parties in the chain becomes increasingly important. Otherwise there is a risk of an increased bullwhip effect if information is spread from the closest downstream player with a time delay in every step. To avoid this kind of delay in the alternative structure, the DC needs to get the information early so that its inventory can be adjusted and minimized.

**Forecasts**

The lack of reliable forecasts must be considered a large problem for Tetra Pak. The problem is hard to solve because the actual sale of equipment is irregular. The yearly forecast for 2004 is 685 packaging machines and 1195 distribution machines to be sold through Tetra Pak’s different market companies. Since the sold volume is low compared to other industries, such as the automotive industry for example, the oscillations in sales become bigger. Furthermore, there are so many different versions that even though it would be manageable to predict the sales, it would be hard to predict which modules that are needed. Because it is difficult to make accurate forecasts it is important to distribute the actual sales to the involved parties without any delay. This would facilitate better planning in the supply chain. Today there is no centralized forum where the component suppliers and system suppliers can see an updated forecast on their components.
The forecast comes from the market companies and it is delayed in several steps before it reaches the system suppliers.

Volvo Construction Equipment is an example of a company that has accomplished to break down the forecasts to a component level and update it continuously. A solution like this would increase the possibility for Tetra Pak’s system suppliers and component suppliers to plan and optimize their production and inventory. An accurate bill of material is required for such a solution.

A solution with a DC for the components is unfortunately not a solution to the forecast problem. The solution to this problem has more to do with the information systems, which is an important issue in itself. However, by knowing the production plan, based on the real orders of machines, disaggregated to component level, the parties in the supply chain and especially Tetra Pak would get better control.

Quality issues
In the current structure the system suppliers have to solve problems concerning the components on their own. They turn directly to the component supplier when there are quality concerns. In an alternative structure it has to be clarified how the process of quality claims on components should be handled. In case of a quality problem, shall the system supplier turn back to the DC who then has to deal with the problem? If so, the quality department connected to the DC has the possibility to see the overall picture. If more than one system supplier experience problems with the same component supplier the issue is quickly escalated and Tetra Pak can act as one single party towards the component supplier. However, this procedure can be looked upon as ineffective. It can for example induce a time delay and extra administration since an extra party gets involved to solve day-to-day quality problems. It also means that Tetra Pak takes away some of the responsibility from the system suppliers, which is not part of the strategy for the system suppliers.

If Tetra Pak is the company that administrates the DC, a solution like this takes away problems from the system suppliers and gives them to Tetra Pak instead. In the interviews this was one of the reasons why the system suppliers were positive to the alternative structure, which is not so surprising. Therefore Tetra Pak has to be clear on its intent concerning how quality issues shall be handled if the DC structure is implemented. The best way to solve it, as we see it, is to have the system suppliers solve their own quality problems concerning components, but inform Tetra Pak. That way Tetra Pak can take proactive actions and know the system suppliers’ problems when they negotiate the agreements with the component suppliers. This can be achieved without the implementation of a DC structure. If all quality issues would be solved from a centralized claims department connected to a DC it would also require a much larger quality organization than today.
Agreements
Tetra Pak forces the system supplier to deliver on shorter lead-times. However, in the agreements with the component suppliers the lead-times are still quite long, on average 3 weeks. Due to the fact that Tetra Pak’s forecasts always are non-binding the component supplier is reluctant to agree to have an inventory for Tetra Pak and thereby guarantee short lead-times. If Tetra Pak refuses to carry some of the risk of the inventory at the component supplier, the only solution to achieve a short lead-time is to store the component at the DC. However, one must remember that Tetra Pak then owns the component and carries the full risk. The question is then if it would not be better to accept some of the risk at the component suppliers’ inventory.

The most economical place to have an inventory with the components is at the component suppliers. The greatest synergies and portfolio effects is in fact at the component suppliers warehouse, since the demand from all Tetra Pak companies and other companies are pooled, and they share the same safety stock. Thus, Tetra Pak must first of all pressure the component suppliers to agree on shorter lead-times. Some system suppliers have accomplished this by writing sub-agreements with the component suppliers. To prioritize shorter lead-times it can preferably be made a performance index of the purchasing department at Tetra Pak. Today the main focus is price development.

If it is not possible to agree on shorter lead-times the only possible way to achieve it is to store the components in a DC. The components can then be delivered directly to the system suppliers, with a lead-time of a few days. The portfolio effect comes in this case from the aggregated demand of all system suppliers together with the need for components for spare parts. The portfolio effect depends on the commonality between different system suppliers on component level. The commonality between two system suppliers is 25%.

Today, the system suppliers are encouraged to write their own sub-agreements with the component supplier. The number of different agreements connected to Tetra Pak then increases. A component supplier has an agreement with Tetra Pak and a number of other additional agreements with system suppliers, which increases the complexity. This must be seen as a result of the difficulty to capture the needs of the different buyers in one global agreement.

5.2.2 Complexity
The complexity in the supply chain is built up by different factors. Here we will evaluate how a change in the structure will affect the complexity from the following point of views:

- Contacts and relations in the supply chain
- Centralizing warehouses of direct material
- Mixing components for production and aftermarket
Contacts and relations in the supply chain

Is the complexity reduced in the alternative structure where the physical flow and the information flow goes via a hub? For the component supplier and the system supplier the complexity is reduced directly due to the reduction of order locations, but for the component supplier the difference might, however, not be so big. A component supplier already has many customers. Going from 20 to 1 order location related to Tetra Pak probably does not have great impact on their total number of order locations. But it is then easier to see the total need of components to Tetra Pak and the actual orders are larger and not as many.

The process of placing orders is, however, just one part of the relation between the system supplier and the component supplier. The relation as a whole often involves many other contacts as stated by Gadde. Consequently, the suppliers would still have to manage these. For example, in a design process, a contact between the component supplier and system supplier is common.

The complexity can be considered to increase due to the fact that the producer and user of the components lose some of their contact with each other. The value of that contact must be evaluated. When the design of a module is set, the article number of the component is all that the component supplier needs to know to understand the need of the system supplier. Therefore we consider it to be little value in the frequent order placing contact between a system supplier and a component supplier. We see no harm in the DC as a separator when it comes to placing orders, but it has to be remembered that each component has to be handled one extra time, in the DC. In a situation were a problem arises there might however be a purpose of the user and producer speaking directly to each other. As Hill explains, small organizations tend to faster adopt changes in demand, extra layers of bureaucracy slow changes down. Therefore it is very reasonable that the producer and user of the products are speaking directly with each other in order to solve problems that might occur.

Centralized warehouses of direct material

It is a considerable fact that WCM, as Tetra Pak has implemented, strongly recommends not having a central storage of direct material. In fact we found these words, a control question, describing how to implement WCM:

“Q5: Have you eliminated the central storage of direct material and is purchased material supplied to the point of use without routine inspection?”

Moving material from one place to another ads cost but not value, so material should be delivered to the point of use wherever possible. The users of material should be responsible for the storage of that material, including any goods-in checks that cannot be carried out by the supplier. Users should also be able to
check that replacement of stock is underway if stocks get too low. Ideally, the vendor should be responsible for delivery to the point of use and should be able to decide when to replenish material when this is practical (direct material is any material consumed in the manufacture of the product).

If the physical flow is redirected to pass through a hub the level of complexity in the hub itself is high. The hub has to physically keep track of all the orders. Hill\textsuperscript{166} points out: The level of complexity and bureaucracy tend to increase along with the size of a plant and therefore there is a risk that the economies of scope become undermined. Our benchmarking object Alfa Laval had a pronounced strategy to always try to transport the components directly to the production plant since it according to them decreased the complexity and increased the efficiency. As Ellram et al.\textsuperscript{167} explains it is very inefficient to add extra warehouses in the supply chain. Therefore Tetra Pak must be aware of the risk connected to redirecting the components in terms of the increased complexity that it involves and the risk that it would only be an extra warehouse i.e. the inventory at the system supplier is not replaced.

**Mixing components for production and aftermarket**

There is a traditional conflict between the flow of material for spare part and for production. Such conflict could be different requirements concerning packages (size and protection) and concerning priority when there is limited amount of components in stock. Therefore, a warehouse and inventory for both production and inventory requires specific rules for how production and spare part needs should be prioritized in a situation of scarcity. Furthermore it must be investigated which requirements of the packages that spare parts and production needs. Such requirements could be both how much protection that is needed but also how many components each package should contain.

One solution to the problem of which user that should be prioritized is to have a virtual warehouse. That means that the component is stored on the same shelf or in the same box but in the information system they are separated as if they were stored separately, one virtual warehouse for production and one for spare parts. This system creates synergies in the handling but the portfolio effect is missed since the components are handled by different systems that do not share the same safety stock. Therefore we have not evaluated virtual warehouses further.

Many companies choose not to mix spare parts with production flow because they have a very planned and structured flow for production and a more randomized need of spare-parts. Tetra Pak has more of an opposite situation. The need of spare parts for Tetra Pak machines is most of the time easy to forecast since it is caused by a scheduled maintenance or upgrade of the

\textsuperscript{166} Hill (2000), *Manufacturing strategy*, p. 202
\textsuperscript{167} Ellram & Billington. (2001), *Purchasing leverage considerations in the outsourcing decision*, pp. 15-27
The sales and production rate of different Tetra Pak machines is however more difficult to predict. Nevertheless we think that if a DC solution should be implemented, it would be best to mix the components for production with the components for spare parts in order to achieve the portfolio effect and the reduction of safety inventory cost that it involve. In Table 5.10, the advantages and risks with mixing spare parts with components to production are summarized.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio effect</td>
<td>Complexity, more actors</td>
</tr>
<tr>
<td>Economy of scale, expertise in operations</td>
<td>Different requirements on packages</td>
</tr>
<tr>
<td>The possibility to prioritize in case of short supply.</td>
<td>Two organizations with different culture</td>
</tr>
</tbody>
</table>

*Table 5.10 The advantages and risks with merging spare parts with production*

### 5.3 Strategic level

It is important that an alternative structure fits well into the overall strategies. By mainly focusing on direct savings there is a risk of losing the long-term perspective, which is important for the future competitiveness. The strategic decisions must also fit well with the type of products the company sells. Tetra Pak’s packaging machines are complex and the number of machines sold is rather low. Therefore the production of the machines resembles project production. Products with such characteristics suit well into a decentralized production organization, which is found in the system supplier concept.

#### 5.3.1 Strategic fit

Within Tetra Pak there are today a number of strategic objectives set up for the future. Out of these we see that some of them affect or has a connection to an alternative structure of the supply chain. These have to be evaluated:

- Rate production
- Sourcing in China
- The same suppliers for production and the aftermarket
- Component characteristics
- The role of the system suppliers: Make or buy

**Rate production**

Tetra Pak Carton Chilled has started a rate production planning with their suppliers. This means that a system supplier should deliver a module every 6th day for example. The rate is a way to decrease the oscillations in the demand. When all parties in the supply chain know and adjust actions according to the decided rate, the bullwhip effect can be heavily reduced. The planning is made
much easier for the system suppliers since the risk of producing a machine that
is not ordered is minimized. This can also be seen as an exception for Tetra Pak
who normally never guarantees to buy anything from its suppliers except from
the real orders. The level of inventory in the supply chain is decreased with a
rate production since it enables the companies in the supply chain to plan their
production better.

Applying this type of planning and production to the DC structure that we are
investigating is interesting. The risk of building high levels of inventory in the
supply chain is decreased if the rate is used. The delivery of components to the
system supplier can then also be directly coordinated with need of components
according to the rate. That is possible since the lead-time from the DC is just a
few days. With a buffer the system supplier also minimizes the risk of
components being a bottleneck in the production.

On the other hand the rate production has clear influences from the Japanese
production philosophy of lean production. It can be argued that the DC solution
contradicts lean production since it introduces an extra point in the supply chain
that does not add any value to the products. With a DC structure there is also a
risk of higher levels of inventory in the supply chain, which of course
contradicts lean production.

**Sourcing in China**

At the moment Tetra Pak is looking into the possibility of sourcing in China.
First of all it concerns suppliers of drawn components. Many of the big suppliers
of standard components already have some of their production in the Far East
and therefore sourcing in China is already a part of Tetra Pak’s supply chain. In
the future it is possible that also system suppliers can be located in China. Since
a big part of Tetra Pak’s sale of packaging machines belongs to customers in
China it can be considered natural to produce the machines close to the
customers.

This will affect the outcome of an alternative structure. When the geographical
distance, between the system suppliers and the component suppliers, increases
larger savings in transport costs can be made by accumulating transports. Some
system suppliers that need to buy components from Europe can for example be
located in China. The components can then all be sent as one order from the DC,
as a kit. The opposite is true if many component suppliers are located in China
and they need to deliver to system suppliers in Europe.

If both system suppliers and component suppliers are located in China the best
alternative, if a DC structure shall be used, is probably to have one DC in Europe
and one in China. A DC structure is specifically interesting in China if the
system suppliers that are developed there have fewer responsibilities than the
ones in Europe. It is reasonable that the system suppliers in China have a role
more like a contract manufacturer than a system supplier. Hence, it would be
interesting with a DC close to the system suppliers in China. The China DC could then handle the purchase of components from Europe and distribute them to the system suppliers in China.

**The same suppliers for production and the aftermarket**

One of the main objectives for the purchasing organization for components within Tetra Pak is to have the same suppliers of components for production and the aftermarket. It is a strategic objective that together with other actions shall result in big savings. That way the purchasing organization can negotiate agreements on Tetra Pak’s total volumes.

First of all the best practise has to be detected, i.e. find out which suppliers that the system suppliers use today, compare them and then agree on which suppliers to use.

This strategy does not contradict the DC structure. On the contrary, the DC structure would speed up this process since the system suppliers then would buy their components from the same source, the DC, as the aftermarket. There are, however, other ways to accomplish this, which is discussed in the chapter called strategies.

**Component characteristics**

The components have different characteristics. They must therefore be analyzed from different perspectives. First of all the price differ. Secondly the components can be divided according to if they are real standard components or if adjustments have been made so that Tetra Pak is the only customer of that component. It is also useful to make a distinction between the components that only one system supplier is using, and the ones that are used by several.

As described before the components have been divided into three different groups depending on their price: A, B and C. The lower the prices are the larger the purchasing quantity. This behaviour is absolutely normal to minimize the order handling cost and the cost of tied capital in inventory.

Fasteners are an example of when it is reasonable to buy many at time and have a buffer in the production. The buffer is refilled using a kanban-system. In the DC structure the purchasing behaviour of the DC would follow the same pattern with larger purchasing quantities for the components with a lower price.

A factor that has a big influence on whether the alternative structure is profitable or not is the degree of commonality i.e. that a component is used by several system suppliers and as a spare part. If a component is used only by one system supplier the benefits of sourcing it from a DC decreases. The incentive for still sourcing it through the DC is that it keeps the number of operational relations low and it can be transported together with other components resulting in economies of scale.
Many of the standard components must be considered to be non-critical in the Kraljic matrix. The purchase of non-critical components should be made easy. Some system suppliers have applied a VMI system for some of the most non-critical components such as fasteners. For the system suppliers this is an effective solution and we see little reason for not applying it in a DC structure. Who should be offering this service to the system suppliers, the DC or the supplier of fasteners directly? The supplier of fasteners already does this effectively with many of its customers utilizing their own distribution system. Therefore we think they should perform it instead of having a middleman, the DC, performing the same service.

Other components have the characteristic of bottleneck products. That is since once a component is chosen from a supplier’s assortment it is sometimes hard to find an alternative without needing to redesign. Due to the long lifetime of the machines the choice of a supplier often is a long-term decision. When a component is changed today the information must be spread to all the involved parties. The system suppliers using the component and the spare parts inventory might have an inventory of the component. That makes the process of changing the component rather complex. In a DC structure this process can be made easier since the purchasing organization has the control of the flow.

Even though we first of all look at standard components some of them are Tetra Pak unique. These have a longer lead-time from the component supplier. This must be seen as a stronger incentive for sourcing them through a DC if it is the only way to accomplish short lead-times. This reasoning naturally leads into the discussion concerning if the sourcing of the drawn components can benefit in an alternative structure.

Approximately three quarters of the article numbers in a packaging machine are drawn components. To source drawn components through a DC would involve a drastic change in today’s strategy. As described before the system suppliers can choose today whether they should produce these components themselves or from whom they should source them. The alternative structure means that the system suppliers no longer have the freedom to choose. If this is done in full scale, i.e. that all standard and all drawn components for production are sourced from DC the system supplier’s role resembles the one of a contracts manufacturer.

However, from an inventory point of view the drawn components fit rather well into an alternative structure. As they all are Tetra Pak unique components Tetra Pak is the party that has the possibility to benefit from inventory pooling. They often have a longer lead-time and therefore inventory is necessary to have an overall short lead-time of the machine.
The role of the system suppliers: Make or buy

Tetra Pak performed a make or buy analysis which concluded in the system supplier concept. The whole idea with system suppliers was to let the system suppliers handle those operations that were not considered as Tetra Pak’s core competence. Despite this concept Tetra Pak kept its contact to the component suppliers in order to secure the supply of spare parts and to write advantageous global agreements on the aggregated volume.

Tetra Pak plans to increase the responsibilities of the system suppliers to even involve design operations and final assembly and testing. However, to act as one party towards the component suppliers Tetra Pak needs to be well informed of the needs of the system suppliers. Tetra Pak needs to put high demands on the system suppliers on continuous improvements and control that the system suppliers have the ability to produce effectively.

All in all it can be said that Tetra Pak should get involved when they have a greater possibility to perform tasks more efficiently than the system suppliers. Such an issue is for example to get the purchasing leverage by negotiating components on the aggregated volume for all the system suppliers and act as one party towards the component suppliers in cases of serious quality issues.

Tetra Pak does not want to plan the production of the system suppliers. Instead this is left for the system suppliers to do by themselves. On the other hand Tetra Pak wants to facilitate an effective production. This is done by offering education in World Class Manufacturing and auditing supplier’s performance.

Now the question is whether it is favourable to add a DC in the middle of the flow in order to manage the flow of components. In that case it must be only the components and the orders that pass through the DC. The rest of the activities and contacts between the system supplier and component supplier should be handled as before.

The role of the system supplier is something that must be decided by the top management of Tetra Pak. If the DC structure is implemented, the role of the system supplier turns a bit more towards a contract manufacturer. This is due to the fact that Tetra Pak takes a more active role to secure the supply of standard components to the system suppliers. Today they have to manage and optimize this by themselves, and the corporate strategy of Tetra Pak is, as mentioned, to increase the responsibilities of the system suppliers.

The balance of power involve, as Bensaou described, that a strong part in the middle of the supply chain could force the other companies into new solutions. Tetra Pak uses its strength already today by writing global agreements. The balance of power against the system suppliers is also clear. The system suppliers have to carry a lot of risk that Tetra Pak avoided by the system supplier concept. For example the inventory; the system supplier is forced to keep components in
stock in order to meet the short lead-time requirements set by Tetra Pak. When Tetra Pak suddenly does not have any orders on their machines it is the system suppliers that pay the price for tied capital in inventory.
6 Strategies

We found that Tetra Pak is facing a huge challenge in managing their supply chain. Therefore, we decided to construct different strategies, where the suggested DC structure is one of them, and further evaluate how those strategies meet the challenges at Tetra Pak.

The main difference in the strategies is if the physical flow should go via a hub or direct, and if the information (mainly orders and invoices) should go direct or via a hub. That leads us to four different strategies presented in Figure 6.1.

![Figure 6.1 Different strategies for structuring the supply chain](image)

6.1 Optimize current structure

What problems can be solved in the existing supply chain without major changes in the physical and/or the information flow? We see some actions that can be taken already today.

Tetra Pak has made efforts in order to optimize their supply chain for example, by writing global agreements on components. Tetra Pak was, to compare with two of the benchmarking objects, IKEA and Volvo CE, early in this development.

Regarding the lead-times there must be more focus on the lead-time when the global agreements are negotiated with the component suppliers. From the system suppliers’ point of view, most of the relationships with the component suppliers are captive buyer since Tetra Pak has decided which component suppliers that the system supplier should use. Therefore the system supplier does not have a
leverage to negotiate a short lead-time in a sub agreement. However, in some cases they have accomplished this by sharing information on exactly what components they need and in what quantities. Tetra Pak, on the other hand, has in most cases more power in the relationship with the component supplier. Therefore Tetra Pak could negotiate short and correct lead-times with the component suppliers if it is prioritized. A reduction in lead-time from on average 3 weeks to 1 week would reduce the level of safety stock by 43%. If negotiated lead-times in the agreements were part of the Balance scorecard for Tetra Pak’s purchasing organization we would probably see an improvement.

Reduction of the number of suppliers must be prioritized. Some component suppliers argue that some system suppliers and Tetra Pak Parts Supply order small order volumes. This behaviour could be solved in different ways. First of all, fewer suppliers will automatically lead to larger volumes in each relation. However, in many cases as with for example Busak+Shamban, it is just a question of ordering a reasonable quantity of the article. O-rings with a very low price are an example of articles that can be ordered as a bulk product, just as fasteners. Otherwise the administrative cost of handling the order will definitely outweigh the value of the article. IKEA and Volvo CE have solved this by having minimum order quantities in the agreements with the component suppliers.

Tetra Pak has prioritized to negotiate transport agreements with haulers such as Schenker etc. As suppliers of transport services, which must be considered to be their core competence, they have the possibility to optimize the transports. Tetra Pak’s goods are then accumulated and transported together with other customer’s goods. It is not uncommon that a transport distance of 500 km involves one or even two points of cross docking to optimize and transport with full truckloads when a smaller good is being transported with Schenker. However, according to the calculations based on the pricelist from Schenker there is a saving potential in transports, in the whole supply chain, in a DC structure, this saving is of course impossible to achieve with direct deliveries. Lower transport costs could however be achieved with an increased time window instead if that is a main objective. However, transport costs only represent 1% of the cost in a machine, thus the savings in transports in not a big issue.

Today Tetra Pak experiences a lack of control regarding what components that are used in the equipment and in what quantities. Could this problem be solved in today’s supply chain structure? The answer, as we see it, is clearly yes but it requires increased attention in certain areas and new tools:

- The bills of material for the equipment must be continuously updated. Redesign or a change of article must be registered in the bill of material. The bill of material in itself must have a standardized form, i.e. every bill of material must be made after the same templates. To achieve this
there must be a clear ownership of this information. The owner has the responsibility of keeping the information updated.

- The source list of the components must also be continuously updated. The industrialization process of a machine must involve adding the new components and their suppliers to the source list. This requires early involvement of the purchasing function, which already is one of the priorities for the future. The choice of supplier to a component must be a conscious decision involving both commercial and technical competence. The price of the component should be negotiated and preferably added to an existing agreement with the component supplier. To achieve this there must be a clear ownership of this information. The owner has the responsibility of keeping the information updated.

- There must be a guarantee that the system suppliers actually use the right predefined component supplier for all standard components. This can be achieved by adding this into the agreement with the system supplier. To be able to follow this rule the system suppliers need access to the right information. Today they access the global agreements that Tetra Pak has made with the component suppliers through the Supplier Portal. However, a better tool is needed where one can search directly into the continuously updated source list. Naturally the access must be limited to only give information on the components that the system supplier uses, i.e. the bill of material.

- A continuously updated forum stating the actual sales of equipment worldwide and also the forecasts. Apart from giving valuable information that will enable information regarding the quantities of components that are needed it will counteract the bullwhip effect. All the involved parties can base their decisions on the real sale and updated forecasts instead of information passed on from the closest downstream player.

- An automatic tool connecting the bill of material, the source list, the sales and the forecasts will then be able to present dynamic information on what components that are needed, from which suppliers, and in what quantities.

By implementing the addressed factors above the problem consisting of lack of control can be solved. To try to achieve the same thing by redirecting the physical flow in the supply chain must therefore be considered to make a detour to solve that problem. In Table 6.1 the advantages and risks within the optimized structure of today are summarized.
<table>
<thead>
<tr>
<th>Advantages</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low effort, short implementation</td>
<td>Do not reduce the complexity as much as needed.</td>
</tr>
<tr>
<td>Short lead time</td>
<td></td>
</tr>
<tr>
<td>Use inventory at the component supplier.</td>
<td></td>
</tr>
<tr>
<td>Creates control</td>
<td></td>
</tr>
</tbody>
</table>

*Table 6.1 Summary of risks and advantages in the optimized structure of today.*
6.2 E-commerce hub: One point of order and direct deliveries

One possible strategy for the future is that all the orders of components are placed in a central point, such as an e-commerce hub, see Figure 6.2, but direct deliveries are used. One point of order would offer lower administrative costs and collecting purchasing information in one point. By using direct deliveries the possible savings in transport costs by using a DC will of course not be achieved. With direct deliveries, shorter lead-times have to be accomplished through other actions such as requirements that the components are kept in stock at the component suppliers. The total time delay from the component supplier to the system supplier is less with direct deliveries.

![Figure 6.2 An E-hub centralizing the information flow.](image-url)

With an e-commerce tool, all the system suppliers would place their orders at one interface. As a result all the information regarding the purchases is gathered in one point and the administrative costs should be lowered. However, to implement such a tool involves some challenges.

There are three main possibilities to connect the component suppliers to the e-commerce hub.
First of all, many of the component suppliers are big international companies. Many of them already have an Internet based tool where their customers can place orders. Therefore they are probably reluctant to start receiving orders from another tool as well. However, according to Sync it is easier to connect the e-hub to a component supplier that already has a tool to receive orders. Because then all needed information is available in electronically format, left is to convert is to the e-hub for Tetra Pak orders. One problem to solve is how the component suppliers’ tool should acknowledge orders from the Tetra Pak hub and give those orders the special Tetra Pak price. This must be solved with a unique Tetra Pak id.

The component suppliers that do not have a portal for orders on their own could choose to receive their orders automatically with EDI etc, in a web portal, or with fax.

The system suppliers have the same options and it is not a problem that some of them as Løgstrup use automatic fax today. If a system could generate automatic faxes it is no problem to make it send the signals to the e-hub.

The system suppliers have to use the e-hub when they purchase components that are going to be used in equipment sold to Tetra Pak and then use other methods when they purchase components used in other customers’ products. However, often the organization is divided so that separate purchasers handle Tetra Pak’s orders. One possibility with the e-hub is that the global agreement could be connected to the e-hub. Orders on the e-hub then automatically get the right price and the right supplier.

The main objective to implement an e-commerce hub is:

- **Lower the administrative costs.** To have EDI or other automatic connections save a lot of administrative costs. Today the problem is that the frequency is too low to make that investment in most of the relations. However, with an e-hub it is the total frequency of that supplier that is collected in one hub. Therefore it becomes beneficial to invest in an EDI connection in e-hub structure even though it is not in today’s structure.

- **Collect information** Tetra Pak could extract all the information that they need from the e-hub. Furthermore, there are other possibilities such as cross selling (i.e. sharing of orders in cases of scarcity), and visualization of inventory levels at different points in the supply chain.
• **Reduce the complexity** by creating visibility. It further becomes easy to connect a component number to a specific supplier. If Tetra Pak wants to have one supplier in Italy of that component number and one in Sweden that is not a problem. The e-hub could source the component differently depending of which company that places the order.

To set up the tool involves a considerable investment initially. The savings in administration in the supply chain must pay off this investment. However, it is far more effective to implement one common e-commerce tool for all the system suppliers of Tetra Pak than to implement different electronic tools in every unique relation. The risks and advantages with an e-hub are summarized in Table 6.2.

If an e-hub is not implemented for this purpose the information flow can be centralized in an alternative way with drop shipment. The system supplier then places all their orders to an administrator, who forward the orders to the different component suppliers. The system supplier then reduces the number of administrative order locations, but the workload is moved to a third party instead. Therefore this solution can be looked upon as very time consuming and not effective.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces the complexity</td>
<td>Investment</td>
</tr>
<tr>
<td>Creates control</td>
<td>Do not fit with Tetra Pak’s project based structure</td>
</tr>
<tr>
<td>Reduces administrative costs</td>
<td></td>
</tr>
</tbody>
</table>

*Table 6.2 E-hub summarized*

### 6.3 DC

A supply chain structure where the components pass through a distribution centre can be organized in more than one way. This part of the chapter is therefore divided into the different ways to organize the supply chain with a DC and each alternative is evaluated.

#### 6.3.1 System supplier places the orders to a DC

The main advantage with the DC structure compared to the other strategies is the fact that both the system suppliers and the component suppliers get one order location only. As a result there is a decrease in the administrative cost related to orders. The total saving in administration cost is as presented earlier in the analysis 640 MTPK. However, even though the total saving in administrations is ample, the saving per system supplier is not more than 4100 TTPK a year. Tetra Pak has to negotiate lower prices in order to take part of the savings. The
question is also why the system supplier should choose to buy from the DC instead of directly from the component supplier. If they are given this choice it must be more attractive to buy from the DC than directly from the component supplier. The margin in the calculations shows that the maximum mark up at the DC before break even is 3.9%. This mark up should cover: Order administration, goods reception, inventory, possible scrapping cost, packaging and invoice handling. Therefore there is a big potential risk that the prices from the DC are higher than the prices from the component supplier. To be willing to pay that, the system suppliers must find other added values in the DC, such as very short lead times. Therefore Tetra Pak has three options:

1) As IKEA Modul let the system supplier chose whether they want to buy from the DC or the component supplier. They will most probably choose to buy from the DC if the DC is cheaper than the component supplier. This would result in that the system suppliers would choose to buy some components from the DC and others from the component supplier directly. However if the component supplier considers the total cost of ownership, they will probably chose to buy from the DC even though it is a little bit more expensive. But we do not think that there is room for any significant price differences.

2) Make the DC cheaper on all components by not distribute the global agreements to the system suppliers. This would mean that the DC with its favourable agreements is cheaper than the component supplier. By letting the system suppliers chose where to buy it is a guarantee of keeping the DC competitive.

3) Force the system suppliers to buy from the DC.

Even though the number of operational relations is heavily reduced there are other parts of the relation with the component suppliers that the system supplier still has to manage.

The DC takes, as a wholesaler, the control of the supply chain but with that comes big responsibility. The DC requires control if it should work. The DC results in economy of scale, which makes it possible to invest in modern technology for order handling. However, this is also possible with direct deliveries as explained in the strategy with the E-commerce hub.

Considering the inventory levels they are hardly changed even though the system supplier gets a shorter lead-time from the DC than from the component supplier as shown in the section inventory. The only way to significantly lower the inventory levels is to increase the frequency of the deliveries. This would probably not happen if the system suppliers order them selves from the DC since the economic order quantity is not changed dramatically. To lower the inventory levels therefore costs money since the administrative costs are increased.
However, if the full potential of outsourcing should be utilized it is important to detect and remove any double work. A typical double work is when the DC first orders and store the components and pay the invoice to the component supplier, just to let the system supplier do the same work by ordering, storing and then pay the invoice to the DC. The only benefit that the DC really contributes with is that the system supplier gets only one order location for standard components. The price to pay for this benefit is to own the component, package and transport the component that causes double invoices, and a lot of administration. In our opinion to be effective the DC must add some explicit value. Therefore the only course of action that makes sense is to let the DC implement a VMI system towards the system supplier in order to reduce the double workload that the DC creates. In such a system, the system supplier would neither need to place any orders them selves nor pay any invoices for the components. The components would arrive in kits in a rate that fits the system suppliers’ production. This strategy is described and evaluated in a section later in this chapter. In Table 6.3 the strategy described in this chapter is summarized:

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>One order location</td>
<td>Tetra Pak gets no part of the direct savings</td>
</tr>
<tr>
<td>Short lead time from DC to Sys</td>
<td>Double workload: Orders, invoices, packaging</td>
</tr>
<tr>
<td>Economy of scale</td>
<td>Complexity</td>
</tr>
<tr>
<td></td>
<td>The mark up in the DC is more than max 3.9%</td>
</tr>
</tbody>
</table>

Table 6.3 Summarize: DC alternative 1

6.3.2 Distributor versus contract manufacturer:

- The system supplier receives components from a DC, without having to place orders.

In this strategy, the DC takes the role of a VMI master. The distributor has access to the production plan of the system supplier and also to the bill of material of the different machines and their variants. The distributor delivers a box containing the components that the system supplier needs to fulfil their production plans. Possibly there could be a buffer of some cheap components such as fasteners etc at the system supplier. Therefore such a solution with frequent deliveries would decrease the inventory levels at the system supplier. Moreover the benefit of this solution is that the system supplier do not have to place any orders, the box arrives anyway containing all components needed, which means that the double workload described earlier is reduced.
The distributor would require absolute knowledge of the production plan and what components that are needed at every little system supplier in the supply chain in order to perform this task.

In such a solution the DC certainly adds a value. The boxes with components can go more or less directly into the production at the system supplier. It is easy to realize that this type of arrangement puts very high demands on the DC. The administrative workload would be considerable.

A very big problem with this strategy is probably that it will require a very big amount of picked order lines at the DC. If the system supplier has no inventory, they need to receive every component they need every week. A component that the system supplier buys four times a year in bigger quantities today would then have to be sent every week. So apart from very high demands of putting together exactly the correct boxes to the right supplier the number of order lines that have to be picked every week is extremely high. The calculations showed that it would require 3.3 million order lines to be picked every year to cover all the standard components compared to the 978,963 order lines handled today by Tetra Pak Parts Supply. Therefore, it would not be possible with the cost structure of today.

The component suppliers we investigated, delivering to 16 different machines, together delivered 21,377 different components to Tetra Pak Parts Supply. The possible number of different combinations is therefore extremely high and the standardization low. As a result almost no box of components would be alike. To have correct information in the DC is therefore crucial. Furthermore, the picking of the components must be performed correctly every time. In fact, the risk of components missing in production is increasing as the planning function is moved further away from the production. This is a strong argument against such a system.

All in all it must be said that this solution changes the role of the system supplier, which must be analyzed from a strategic point of view. The distributor takes part of the responsibility that the system supplier has today. It turns the system supplier into a contract manufacturer, especially if the drawn components also would be delivered through the distributor. This contradicts the system supplier concept introduced in the 1990’s.
The advantage and risks with this strategy is summarized in Table 6.4.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>The DC adds value, Kits</td>
<td>It is extremely complex to assemble so many different kits</td>
</tr>
<tr>
<td>Low inventory levels at Sys</td>
<td>Enormous amount of order lines has to be picked at the DC</td>
</tr>
<tr>
<td>Economy of scale</td>
<td>Makes the System supplier to a contract supplier</td>
</tr>
</tbody>
</table>

*Table 6.4 Summarize: DC alternative 2*

### 6.3.3 DC selection

The distributor concept has several advantages. However, it makes the system supplier to more of a contract manufacturer. It also involves too high costs in the DC therefore this alternative is neither reasonable nor fit with the strategy. Therefore we conclude that the only reasonable choice among the DC alternatives is to let the system supplier place orders themselves to the DC, i.e. alternative 1.

### 6.4 Cross docking

The fourth strategy set up in the beginning of the chapter is to have a direct information flow between the component supplier and system supplier as today, but have the components transported through a cross-docking point.

As described before the components already today pass through the hauler’s cross-docking points. The difference is therefore that the cross-docking point in this strategy is dedicated to only Tetra Pak components.

In the existing distribution network where the haulers cross-dock components the problem for Tetra Pak is how to take part of that revenue that it creates. If introducing a cross-docking point for only Tetra Pak’s components optimizes the supply chain, a hauler could have done that already. One aspect that prevents them from doing that is that there is more than one hauler so none of them have the whole volume to transport.

Tetra Pak’s suppliers are mostly located in Europe today. This geographic area is well covered in the haulers’ existing distribution network where many of their other customers also distribute goods. Therefore it is hard to find a reason why a cross docking point for only Tetra Pak orders should be more effective.

By choosing a lower number of haulers and thereby giving a higher volume to the remaining there might instead be possibilities to lower the transport costs.
We conclude that there is no need to further evaluate the cross docking concept, since there are cross docking facilities already administrated by the haulers.

### 6.5 Compilation

Now we have evaluated the different strategies against the problems that they should solve. The result of the evaluation is summarized in Table 6.5. We filled in the squares if the strategy solved that specific problem.

<table>
<thead>
<tr>
<th>Impact on problems</th>
<th>OP</th>
<th>EC</th>
<th>DC</th>
<th>CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transports</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 6.5 Strategies versus problems*

As can be seen in Table 6.5, there are several problems that could be solved already in today’s structure. Administrative costs and complexity is further solved with an e-hub. So the only thing that the DC adds further is the transport savings.
7 Conclusion

The thorough analysis has been made with one purpose only: to reach to a conclusion. The conclusion presents the result of our master thesis.

As stated in the problem analysis, we should investigate different aspects of the supply chain:
- Potential savings
- Complexity
- Control
- Strategic fit

The conclusions at those levels of the problem will consequently lead us to our recommendations to Tetra Pak.

7.1 Potential savings

From a strictly economic point of view, the savings in a DC solution is within the margin of uncertainty. It is especially interesting to see which parties in the supply chain that gets a direct share of the saving.

Table 7.1 presents how the DC structure increases the costs at the DC while the system supplier and component supplier saves money.

<table>
<thead>
<tr>
<th>Savings (MTPK)</th>
<th>Administration</th>
<th>Inventory</th>
<th>Transport</th>
<th>Sum:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>880</td>
<td></td>
<td>1120</td>
<td>1990</td>
</tr>
<tr>
<td>TPS/DC</td>
<td>-570</td>
<td>-150</td>
<td>-210</td>
<td>-930</td>
</tr>
<tr>
<td>SyS.</td>
<td>330</td>
<td>190</td>
<td>-210</td>
<td>310</td>
</tr>
<tr>
<td>SUM:</td>
<td>640</td>
<td>40</td>
<td>700</td>
<td>1380</td>
</tr>
</tbody>
</table>

Table 7.1 Distribution of savings and costs in the DC structure

The savings are as presented in the table approximately 1400 MTPK, which is a good result. However, there are two problems:

1. **The distribution of the savings.**
   As can be seen in Table 7.2 the savings are distributed to the component supplier and the system supplier whereas the TPS/DC has to carry increased costs. Therefore Tetra Pak must negotiate better prices with the suppliers in order to get a piece of the earnings. Furthermore the problem is that the savings are dispersed on so many suppliers that it becomes really complex to negotiate better prices with all of them.
The savings are not big compared to the value of the components that has to pass the DC.

We calculated a maximum mark up at the DC by adding the saving of 1380 MTPK with the estimated cost at the DC of 930 MTPK. This is the maximum mark up at the DC before breakeven. This mark up is not much compared to the total value of the added components that should pass through the DC to the system suppliers, which is 59500 MTPK. Therefore there is a risk that the mark up at the DC will exceed the savings. This is presented in Table 7.3.

<table>
<thead>
<tr>
<th>Value of comp. to production (MTPK)</th>
<th>Max mark up at DC in (MTPK)</th>
<th>Max mark up at DC in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>59500</td>
<td>2300</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

We have reached the conclusion that the DC structure involves savings; nevertheless, the savings are small compared to the value of the physical flow through the DC. Hence it is a risk of savings vanishing in the mark up at the DC. No sensitivity analysis of the calculations made will be presented. The reason for this is the content in the overall conclusions, and recommendations, which are presented in the following parts of the report.

- The savings in a DC structure are dispersed on many suppliers.
- The DC will carry increased costs.
- There is a risk that the costs at the DC surpass the aggregated savings at the suppliers.
7.2 Complexity

It is within Tetra Pak’s long term strategy with system supplier that as many problems as possible should be solved directly between the system supplier and the component supplier. Only the serious problems, if any, should be escalated to Tetra Pak. Therefore, the number of interfaces between component supplier and system supplier would not be significantly changed with a DC structure. As a result, we found that the DC structure does not solve the issue with many interfaces between the component supplier and the system supplier, no more than the operative order contact is changed. We further found that an e-hub creates one operative order interface towards each supplier. Therefore there is no real benefit from this point of view with a DC compared to an e-hub.

Instead we consider it important to have organizations with a clear focus and strategy. Therefore, we think that mixing spare parts and parts to production involves a risk since it is two different organizations with different objectives that should be merged. It is important to search for synergies. However, we think Tetra Pak has found the right level of synergies when they negotiate the aggregated volume including both spare parts and production with the component supplier. All the benchmarking objects: IKEA, Volvo CE and Alfa Laval have settled with that level of synergy and they are satisfied with that choice. Furthermore, the realization that the DC would not replace the inventory at the system suppliers made it clear that the DC would add an extra warehouse point in the supply chain of components. Therefore the synergies that the DC solution aimed for would not be achieved.

We have reached the conclusion that the DC structure does not decrease the complexity, whereas the e-hub as well as taking actions in today’s structure will decrease the complexity.

- It involves a risk to mix spare-parts with parts to production.
- The complexity in terms of relations in the supply chain will not decrease with a DC-structure.
- Tetra Pak has found the right level of synergy between spare-parts and components to production in their global agreements.
7.3 Control

We found that the DC structure gives Tetra Pak full control over which component suppliers that are used by the system suppliers. In the DC structure it would also be possible to present information about the total volume needed to production of every component. However, our evaluation showed that most of these problems could be solved already in today’s structure. The administrative costs could further be lowered with an e-hub, which besides this would facilitate further opportunities of increased control.

The DC structure does give Tetra Pak control but there are other strategies that achieve this control easier and cheaper.

7.4 Strategic fit

We found that Tetra Pak has as explicit strategy with the system supplier, which is that the system suppliers should solve their own problems with the component supplier. Furthermore the system suppliers get even more responsibilities such as final testing and some design processes. Therefore, we conclude that the DC structure in some ways contradicts this strategy. A DC structure would fit better if the system suppliers were chosen to be contract manufacturers. Nevertheless we think that the system supplier concept is working well. Tetra Pak has, in a sense, actually managed to outsource several of its problems to the system suppliers. The main problem is how to get the information and control regarding the system suppliers’ purchase of components. We concluded that this problem could be solved already in today’s structure but also with an e-hub or a DC.

- An e-hub and optimized today’s structure do fit with the long-term strategy.
- The DC strategy contradicts the long-term strategy of Tetra Pak.
7.5 **Our recommendations**

In order to make a recommendation regarding the changes that needs to be done at Tetra Pak, we evaluated the effort needed versus the effect of the different strategies, as illustrated in Figure 7.1. The most reasonable thing to do is to first focus on the changes that will have the best effect and at the same time require the least effort, so called low hanging fruit.

![Figure 7.1 Effect versus effort of the three alternative strategies: 1. Optimize today's structure, 2. E-commerce hub and 3. The DC structure.](image)

First of all we find good potential for improvements in today’s structure. By implementing a number of changes and tools a lot of the problems could be eliminated. We consider the following action steps necessary for Tetra Pak:

- **Continuously updated bills of material in standardized formats.**
  To guarantee correct updating there has to be a clear ownership of the bill of materials. The responsibility for correct bills of material has to be clarified. This is very important since it is a condition for control over the components. The bills of material must contain all components, both standard and drawn.
Today the bills of material are mostly presented as lists in Excel. The appearance of the bills varies a lot. A standardized format for the lists is a requirement to be able to make comparisons.

- **Continuously updated source list.** Anyone who is involved in the sourcing of material within Tetra Pak and among system suppliers need to be able to access a correct source list. In the source list one should be able to search for a certain article or commodity and find out which suppliers to choose for each purpose. There is an existing tool today at Tetra Pak, called Product Information Viewer, that resembles what we are searching for but it needs to be improved. It is very difficult to work towards standardization without such a tool. The lack of a correct source list also makes it harder for the system suppliers to follow Tetra Pak’s choice of suppliers. The ownership of the source list must be clear. As soon as a new agreement is negotiated the source list shall be updated. In the design phase of equipment the source shall also be updated with the new components. In this matter it is important that purchasing competence is involved early. We suggest that the purchasing organization shall take responsibility for the correct source list and its distribution.

- **A tool connecting the bullets above.** To find out the volume value and supplier structure of a machine today different bills of material and information from the agreements have to be merged manually in Excel. This is time-consuming and a source of error. If both the source list and the bills of material are standardized the tool does not have to be advanced. It is only a question of automatically merge different lists of information. However, the number of different lists is rather high since every module in a machine shall be in a separate list and every variant of a machine need to be separated.

For the supplier the information that can be found by using the tool must be limited to only comprehend the parts that affect the supplier.

By knowing the forecast and sales of the different machines it is possible to disaggregate these on a components level. As a result, the supply managers will have much better information regarding which components and quantities they shall negotiate. The information about sales and forecasts shall be part of the same tool.

The information that this tool will provide can, in our opinion, be looked upon as a prerequisite to perform effective purchasing and thereby support the production.
These measures can be implemented in the existing supply chain structure. In perspective the effort invested to do this is rather low and the problems solved, i.e. the effect, is nevertheless big. Therefore we consider these changes to be low hanging fruit and strongly recommend their implementation. We consider these actions as a requirement to gain control before making other changes. Without this knowledge the effect of other changes will not be measurable. Apart from these we make two further recommendations to implement in today’s structure.

- **Make lead-time a performance indicator.** Today the price development of the components is being measured quarterly. This is used as an indication of the performance of the Supply Managers in their negotiations with the suppliers. To put focus on decreased lead-time we suggest that also negotiated lead-times are part of the performance indicators. What gets measured gets done. The lead-time is, however, just one example of how we think purchasing within Tetra Pak needs to focus on more holistic measures. That is possible only when there are tools that can show the true costs.

- **Continue and strengthen the work towards a lower number of suppliers.** This is a healthy way of reducing the complexity and must be prioritized more than it is today.

The second change involves implementing an e-commerce hub for the order placing process. As a result the system suppliers would have one virtual order location. The e-commerce hub must be connected to the source list so that the correct suppliers are chosen for different components. The component supplier would receive their orders from this order-placing hub and thereby it would be easier to see Tetra Pak’s aggregated volume. Such a tool for order placing involves an investment and the effort to implement it is higher. Based on the assumption that change number 1 is implemented first, the e-commerce hub has the possibility to further improve the efficiency in the supply chain. The effort needed and the level of extra value added makes it more of a strategic change. From the e-hub Tetra Pak would be able to extract valuable information regarding what components that are actually sold and furthermore see that the right prices are used etc. Apart from this, the efficiency is improved since the fax and invoice procedures are simplified.

The third change, that involves redirecting the physical flow, requires the largest effort. Apart from handling the components in an extra node in the supply chain it also involves great responsibility of the party that handles this point. If the first two changes are implemented first there is little extra that can be achieved by redirecting of the physical flow. We come to the conclusion that having the components passing through a DC increases the complexity. The only additional benefit with the DC would be the transport savings and as mentioned there is a potential risk that the cost of implementing the DC structure will be larger than those savings.
As stated in the purpose of this master thesis we aimed to answer two questions. Here are the questions and summarized answers:

How can Tetra Pak, a company that has a complex supply chain and is characterized by a high level of outsourcing, organize the system suppliers’ purchase of components to gain control and utilize possible synergies?

We think that the strategic and some of the tactical work should be handled centrally in order to create synergies. There is a lot to achieve in the global agreements negotiating the aggregated volume of its system suppliers. However, the operative work should be handled decentralized in order to achieve flexibility and nearness to production.

Crucial is also the correct and fast spreading of information in the supply chain. There are several benefits to achieve by integrating different information systems. We think that initiatives in new information tools should be initiated centrally. The working procedures and responsibilities must be clearly defined in the supply chain to remove any double work.

To Tetra Pak it is our recommendation to first do the proposed action steps in today’s structure. If not satisfied with the results: investigate the e-hub further and possibly implement it. The e-commerce hub involves big investments but this must be measured against the control and positive outcomes of such a solution.

We believe these solutions will give Tetra Pak the control back, decrease the complexity, generate savings and also fit well into the overall strategies for Tetra Pak.
Should Tetra Pak implement a DC solution handling both spare-parts and components to production?

No, mainly because of two reasons:

a. It is impossible to implement a DC structure without first implementing the actions in today’s structure, in order to gain control of the source list etc., and implement an e-commerce hub in order to create control and an efficient order handling system.

b. When the two solutions that we conclude is a prerequisite to the DC solution are implemented, the problems will already be solved and it will therefore not be worth the effort to implement a DC solution.
8 End discussion

This master thesis focusing on Tetra Pak has resulted in several conclusions. The question is to what extent these conclusions can be generalized to other component groups at Tetra Pak (internal generalization) to other companies (external generalization).

8.1 Internal generalization

As mentioned in the introduction part of the master thesis we aimed to generalize the results to the other component group at Tetra Pak i.e. the drawn components. The main difference compared to the standard components that we have focused on is that Tetra Pak is the only customer of those components. Therefore the argument that the portfolio effect is larger in the warehouse of the producer than in the DC is not true for the drawn components. However, it is still cheaper to store the components at the supplier since the price of the components and thereby the tied capital in inventory is less early in the supply chain.

The drawn components are handled differently compared to the standard components. Regarding the drawn components it is up to the system supplier to decide which supplier they want to use. Another possibility is that the system supplier produces those items themselves. In other words, all purchasing activities are handled decentralized today. The system supplier handles both the operative, tactical, and strategic level of purchasing. Our conclusions at standard components imply that the right level of synergies is created by centralized tactical and strategic purchasing, but with decentralized operative purchasing. The same thought goes for drawn components but here the role of the system supplier would be changed dramatically by this strategy. Therefore Tetra Pak has two choices concerning how to handle the purchase of drawn components to the system suppliers depending on the future role of the system supplier:

a. Decide that the system supplier should continue to be responsible for the drawn components since it is the system supplier’s core competence to source drawn components and decide whether to produce the items themselves or source them. Such choice would make it impossible to centralize the tactical and strategic purchase of drawn components.

b. Decide that the system suppliers’ role should be changed so that they should no longer be responsible of the sourcing of drawn components. That would involve a change of the system supplier concept. If such decision was made, our results on the standard components would be valid also at drawn components.
i.e. it is then beneficial to centralize the strategic and tactical purchase of drawn components and keep the operative purchase decentralized. Thereby drawn components could use the same solutions that we suggested for standard components i.e. tool that connects information and eventually an e-hub to handle the orders.

8.2 External generalization

There are several companies that are similar to Tetra Pak in terms of a complex supply chain. Either the company has several dispersed production facilities or the company has out-sourced its production to several system suppliers. The critical aspects are then:

- What should be centrally handled in order to create synergies and what should be decentralized managed in order to get flexibility and focused organizations?

We think that the strategic and some of the tactical work should be handled centrally in order to create synergies. We think that Tetra Pak and several other companies can achieve savings in global agreements negotiating the aggregated volume. However, the operative work should be handled decentralized in order to achieve flexibility and nearness to production.

- How should the information be spread and collected in a supply network with several relations?

We think that it is important that some basic sources of information such as the bills of material and source list are correct and updated. Crucial is also correct information about forecasts and actual sales. Internet and other electronic information tools enable information to be spread and gathered in the supply chain. The benefit is no time delay and less administrative work. There are several benefits to achieve by integrating different information systems. We think that initiatives in new information tools should be initiated centrally. A centrally handled information system collects all information in one place and besides this it is more effective and less expensive than implementing separate electronic links in every relation.

- It is crucial to create efficiency and remove double work.

It is not value adding to have several persons in the same supply chain collect and control the same information. This problem can easily arise in a situation where activities have been outsourced. It is critical that data that has been collected electronically could be spread in the supply chain without any unnecessary manual processes or time delay. New electronic tools open up to
new solutions and are often the key to effective handling. However, no electronic tool fixes non-functioning processes. The electronic tools shall support the processes. The working procedures and responsibilities must be defined clearly in the processes.

- The components should be stored as early in the supply chain as possible.

Short lead-time and accurate information in the supply chain enables decreased inventory levels at the following tiers in the supply chain. It is in the beginning, at the producer, that the components can be stored most effectively. There the portfolio effect is maximized since several customers’ components are pooled together. Early in the supply chain the value of the components is also lower, since every point of handling usually involves a mark up.

- The supply chain should reflect the type of production that is performed.

Tetra Pak produces relatively few machines and there are several variants of each machine. Therefore the production of every machine resembles a project production more than series production. As a result of that, companies like Tetra Pak must have a very flexible organization and more ad hoc behaviour than if they were producing in line organization as the automotive or the mobile phone industry for example. By that means that other companies producing higher volumes probably must prioritize structured information flow even more than companies with project production. As we concluded that information is critical for Tetra Pak it must be even more critical for other, mass-producing companies. Their conditions have forced them to become lean and optimize their information channels. Increased competition now also forces other types of companies to also focus on improved information processes. A supply chain must support the characteristics on which the product is sold.
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