TEKNISKA HÖGSKOLAN

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Volvo Logistics Corporation Returnable Packaging System

a model for analysing cost savings when switching packaging system

Jacob Beselin Hallberg

Per Uhrbom

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ÄMNE LOGISTIK

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Volvo Logistics Corporations Emballagesystem

en modell för att räkna på kostnadsbesparing vid emballagesystems byte

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Handledare: Malin Löfving

Omfattning: 15 poäng (C-nivå)
Datum: 080608

Arkiveringsnummer:

Postadress:
Box 1026
551 11 Jönköping

Besöksadress:
Gjuterigatan 5

Telefon:
036-10 10 00 (vx)

Abstract

This thesis is a study for analysing costs affected by packaging in a producing industry. The purpose is to develop a model that will calculate and present possible cost savings for the customer by using Volvo Logistics Corporations, VLC's, returnable packaging instead of other packaging solutions.

The thesis is based on qualitative data gained from both theoretical and empirical studies. The methodology for gaining information has been to study theoretical sources such as course literature and articles, as well as through interviews and consolidation with staff at Volvo Logistics Corporations office in Gothenburg.

The model is constructed in Microsoft Excel and consists of six different sheets. The first sheet is a front page that summarises the costs calculated in the other sheets and presents the possible cost savings. After the front page there are three sheets with calculations for the costs in different scenarios, Today's Situation, VLC Packaging Solution (Pre implementation) and VLC Packaging Solution (Post implementation). The first sheet, Today's Situation, presents the result of the model that will calculate the customers' current costs that are associated with packaging. The different costs presented in the model are costs for unloading, repacking, today's cost for an internal packaging solution, quality related costs, one-way packaging costs and the costs for other packaging solutions. The next sheet, VLC Packaging Solution (Pre), presents an estimation of the cost for the customer when using VLC's returnable packaging system. The estimation will serve as an investment tool, for calculating possible cost savings compared to the present situation. The different costs that will be discussed are handling costs, quality related costs, distribution cost, transaction cost, and investment cost. The third and final calculation sheet, VLC Packaging Solution (Post), presents the actual costs for the customer after the implementation. When the costs have been calculated they will be used to evaluate the actual cost savings for the customer. The last two sheets are a data sheet, which consists of data needed for the calculations in the previous sheets, and an instruction sheet where there are instructions to the different calculations in the model.

The conclusion shows that the objective to create a model for calculating the costs for different packaging systems and present possible cost savings is fulfilled.

Sammanfattning

Detta examensarbete är gjort som en undersökning för att se vilka kostnader som är länkade till förpackningslogistik i olika tillverkande industrier. Syftet är att skapa en modell för att räkna på och presentera kostnadsbesparingar som uppstår när kunden byter från ett annat emballagesystem till Volvo Logistics Corporations, VLC's, emballagesystem.

Denna rapport är baserad på kvalitativa data samlade från både empiriska och teoretiska studier. Metoden som använts för att samla fakta har varit att studera teoretiska källor så som kurslitteratur och artiklar. Intervjuer och diskussioner med anställda på VLC har också förekommit.

Modellen är framtagen i Microsoft Excel och innehåller sex olika kalkylblad. Det första kalkylbladet är en framsida som sammanställer de olika kostnader som blivit uträknade i de andra kalkylbladen, här redovisas också de möjliga kostnadsbesparingarna. Efter framsidan kommer tre kalkylblad innehållande beräkningar för emballagerelaterade kostnader i olika scenarion, Dagens situation, VLC's Emballagelösning (Före implementering) och VLC's Emballagelösning (Efter implementering). Det första bladet av dessa, Dagens Situation, är ett hjälpmedel för att beräkna kundens nuvarande emballagerelaterade kostnader. De olika kostnader som är inkluderade i Dagens Situation är kostnader för lossning, ompaketering, kostnaden för kundens nuvarande interna emballagesystem, kvalitetsrelaterade kostnader, engångsemballagerelaterade kostnader och kostnaden för ett annat returemballagesystem. Nästa kalkylblad, VLC's Emballagelösning (Före Implementering), skall uppskatta kostnaderna för kunden när denne använder VLC's emballagesystem. Denna uppskattning kommer fungera som ett investeringshjälpmedel som räknar ut möjliga kostnadsbesparingar jämfört med nuvarande situation. Detta kalkylblad kommer innehålla beräkningar för att beräkna hanteringskostnad, kvalitetsrelaterade kostnader, distributionskostnad, transaktionskostnad och investeringskostnad. Det tredje och sista kalkylbladet innehållande beräkningar, VLC Emballagelösning (Efter implementering), presenterar utfallet av emballagebytet, så som kostnaderna blev. När kostnaderna har blivit beräknade används de till att utvärdera hur stora kostnadsbesparingarna blev för kunden. Detta kommer även fungera som ett projektutvärderingsverktyg. De två sista kalkylbladen består av ett datablad innehållande priser och data som används i beräkningsbladen och ett instruktionsblad där det finns instruktioner till alla beräkningar i modellen.

Sammanfattningsvis kan det sägas att målet med att skapa en modell för att räkna på kostnader för olika emballagesystem samt presentera möjliga kostnadsbesparingar kan ses som uppfyllt.

Index

1 Introduction

In this section there will be an introduction to the thesis, with a brief presentation of Volvo Logistics Corporation and a background to objects for this thesis. After the background the purpose and objectives of the thesis are presented as well as the restrictions, confidentially and disposition.

1.1 Presentation of Volvo Logistics Corporation

Volvo Logistics Corporation, VLC, is a wholly owned subsidiary company within the Volvo Group that develops, designs and administrates logistics systems for the automotive industry. VLC have three main areas: inbound, outbound and emballage (packaging). Inbound refers to the incoming material flows, both physical handling and administration. Outbound is the process of getting undamaged vehicles to the customer on the promised date. Emballage refers to packaging logistics, with maintaining and further development of VLC's packaging system as the biggest task (Volvo Logistics, 2007).
VLC was founded for over 50 years ago and currently have turnover of around 750 million USD a year and over 1000 employees globally (Volvo Logistics Company Brochure, 2007). Among the customers there are companies such as Volvo Cars, GM, Land Rover, Jaguar, Aston Martin, the Volvo Group and many automotive suppliers (Volvo Logistics, 2007).

1.2 Background

The main purpose of a packaging is to protect the product. If the packaging is developed and used in a smart way it can also lead to a significant cost decrease compared to different one-way packaging and other developed packaging solutions. Thus a manufacturing company that use packaging in a smart way can gain a competitive advantage via the cost decrease.
One year ago Volvo Logistics Corporation, VLC, noticed that several customers had steadily growing demand for packaging development and met this by offering them a complete packaging logistics solution. The service is based on packaging development and consists mainly of two parts, *Packaging design* and *Packaging engineering*. Volvo Logistics started to offer this service within the department of Product development who offer the services on a consultancy basis to customers that have a need for improving their packaging solutions.

1.2.1 Packaging Engineering

The process of implementing returnable packaging can be complex. Different types of production strategies, volumes, transport setups and space are all parameters that are crucial in order to make the right choice of packaging and unit load. The need for Packaging engineering is also often connected to a new platform or model. A need has also been identified that has to do with the fact that many sites have not worked with packaging as a strategic issue before, but now started to see the potential cost savings and thereby ask for this service.

1.2.2 Packaging Design

One important area within the manufacturing industry is the development of standardised packaging. The development of the packaging most often occurs when there is an introduction of new platform or product, and therefore a need to change the current packaging. Other reasons for development of new packaging that can be identified are quality problems or increased economic benefits form improving the packaging. Normally companies handle the development of new packages themselves. However developments in this field are not made on a regular basis by companies, in fact a considerable lag exits between the developments of packaging. This has lead to a lack of knowledge and experience because the frequency of the developments is not high enough. Therefore Volvo Logistics has established a "*competence centre"* for packaging development in order to centralize the resources and knowledge within the Volvo group. This has been done in order to help companies with packaging so that they can concentrate on their core business. The Volvo group will through these synergies receive a better product to a lower cost.

1.3 Purpose and Objectives

The purpose of this thesis is to develop a model that calculates the possible cost savings by using Volvo Logistics Corporation returnable packaging instead of one-way packaging or other packaging solutions. The model has to be applicable on a vide range of companies in different market segments and countries. In order for the model to give a better cost estimation, it is essential to identify all the relevant key performance indicators, KPI, which will affect the company's logistics cost.
The specific objectives for this thesis are:

- Create a model that calculates possible cost saving of using VLC's returnable packaging system.
- Search for relevant parameters in a production plant that are measurable and affected by packaging
- The model should be able to calculate and present different costs affected by packaging in a pre and post scenario.
- The staff at VLC should be able to use the model without any training.
- The model should be developed in such a way that it can be used in different cases.
- Investigate possible environmental effects when changing from one-way packaging to returnable packaging.

1.4 Restrictions

- This thesis will not consider changing the design of VLC's packaging.

- When calculating the cost of using VLC's solution it is assumed that the customer follows the directives set by VLC and therefore possible fines are not included in the model.

- To construct the model, Microsoft Excel will be used, since it is a commonly used program in today's business world.

1.5 Confidentiality

Pricelist provided by VLC are confidential and therefore the data sheet from the model has been excluded from the report.

1.6 Disposition

The thesis begins with a theoretical background about packaging logistics, costs affected by packaging and a review of VLC's packaging system. The theoretical background section should be regarded as the foundation for the rest of the report. References are done according to the Harvard system, thus the reference list can be found in the last part of the thesis. In the method section the authors will describe how the research for the thesis has been conducted. Furthermore the issues: Validity, Reliability and source criticism as well as how the authors have approached the material will be dealt with in the method section. After the method section the result of the thesis is presented. All parts of the model and the calculations are presented in the results, and print screens of the model can be viewed in appendixes in the back of the thesis. After the result there will be a section where we will have a discussion over the findings as well as display our conclusions.

2 Theoretical Background

In this section the reports theoretical background will be presented. First there will be definitions of some terms used in the thesis, and then the theory will focus on five main areas. They are Packaging Logistics, Returnable Packaging System, Packaging Costs, Environmental Factors and VLC's Packaging System.

2.1 Definitions

2.1.1 Packaging

Packaging can be defined as "all products made of any materials of any nature to be used for the containment, protection, handling, delivery and preservation of goods from the producer to the user or consumer (EHSNI, 2008)"
Packaging can be further divided into following three types (Chan et al, 2005):

Primary packaging – mainly used for consumer package.
Secondary packaging – mainly used for outer/retail packaging.
Tertiary packaging – mainly used for transportation package.

In this thesis packaging will be regarded as tertiary packaging also known as transport packaging. It can be of various types such as containers and pallets, and made out of various materials such as cardboard, plastic, wood, steel and aluminium. The term packaging will be used irrespective of the type or material of packaging.

2.1.2 Returnable Packaging

The returnable packaging should by definition be able to be reused a certain number of times before it is discarded (Kroon and Vrijens, 1994). Returnable packaging may be of different types, such as plastic containers, pallets, or slipsheets we will use the term returnable packaging, irrespective of the actual type of packaging.

Figure 2.1 Example of returnable packaging (Schoellerarcasystems, 2008)

2.1.3 One-way Packaging

Traditionally, cardboard boxes are used as secondary packaging material. Since cardboard boxes can be used only once, they are defined as one-way packaging material (Kroon and Vrijens, 1994). One-way packaging can be made out of other materials than cardboard, for example wood, the common denominator for one-way packaging is that it is usually discarded after it has been used once.

Figure 2.2 Example of one-way packaging (Ecolignor and Geocities, 2008)

2.2 Packaging Logistics

Packaging logistics is defined as an approach with the purpose of developing packaging and packaging systems that support the logistics process and meet the customer/user demand (Packforsk, 2000). It should be regarded as an integrated part of the supply chain and not as an isolated part (Lumsden, 2006). A traditional view on packaging is that its focus and purpose is to protect the product while it is being shipped and stored (Gourdin, 2001). Too much protection will increase costs while too little protecting can result in lack of quality. No other component in the distribution chain is exposed to as many requirements as packaging (Packforsk, 2000). A new philosophy of packaging has however emerged in recent years. The core of this new philosophy is to encourage the improvement of packaging design and use to meet the demands of all partners. Packaging is a vital

component in the supply chain and it can help to increase the effectiveness of the total system, and improve distribution efficiency (Chan et al. 2005). In *Chan (2005)* the authors have replicated Porter's value chain model[1] and applied their view on packaging, see figure 2.3.

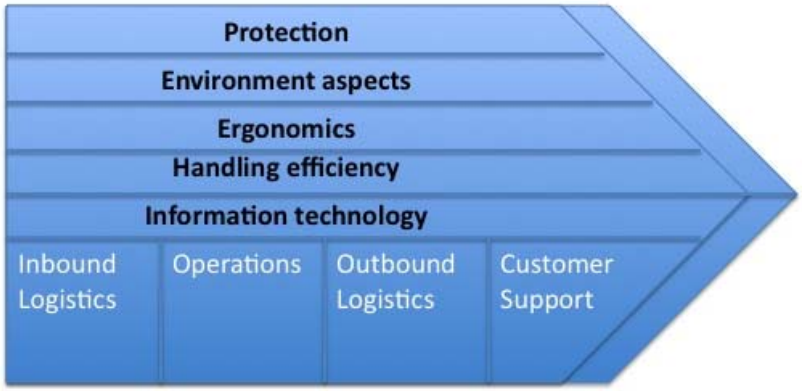

Figure 2.3 Value chain model for packaging (Chan et al. 2005)

There are five requirements, in the upper part of figure 2.3, which should be met in order to create better packaging logistics. The five requirements support the four primary activities in the value chain, figure 2.3. Every primary activity must be analyzed from a protective perspective, a handling efficiency perspective, and an ergonomic perspective, an information perspective and an environmental perspective (Chan et al. 2005). The demands on packaging are derived from both the product and its surroundings. From a birds-eye perspective the main demands can be divided into three different groups, see figure 2.4 (Packforsk, 2000). The *flow demands* aim to satisfy the characteristics for packaging, which contribute to improve the handling of the product. The *environmental demands*, aims to reduce the environmental impact of packaging. The *market demands* meet characteristics of the packaging that, in some part of the distribution chain, are value adding, for the user of the packaging (Packforsk, 2000).

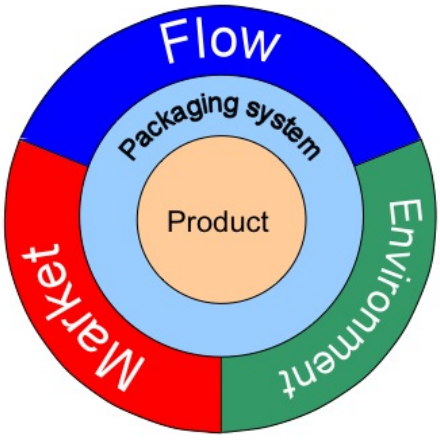

Figure 2.4 The main demands on packaging (Packforsk, 2000)

[1] Porter's value chain model – A systematic way of examine all the activities a firm performs and how they interact. The model consists of primary and support activities.

2.3 Returnable Packaging System

Besides the environmental benefits with reusing packaging, many companies have discovered that returnable packaging can also be commercially rewarding (Kroon and Vrijens, 1994). However the economical benefit depends on various factors. The use of returnable packaging is not always rewarding, however in order to analyse which system, one-way or returnable packaging that is the most rewarding system to use. A number of factors must be considered. Two of the most important factors are the transport distance and season variation, figure 2.5. If there is a long transport distance and the season variation is high then one-way packaging is the most suitable packaging type. This is due to the fact that the cost for the return transport of empty returnable packaging would be too high (Packforsk, 2000).

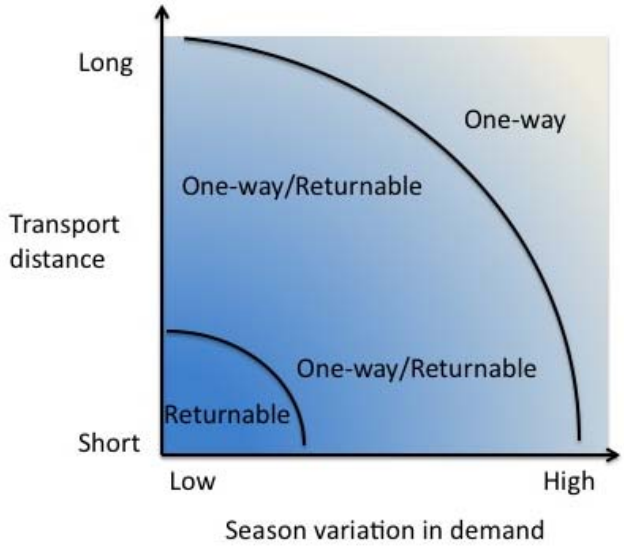

Figure 2.5 Transport distance and Season variation are two factors that will affect the choice between one-way or returnable packaging (Packforsk, 2000)

In order to further analyse which system is most suitable, Packforsk (2000) have found that following factors should be considered:

- Tied up capital
- Transport cost
- Return handling
- Loss
- Environment
- Ergonomics

The *tied up capital* is essentially affected by the packaging turnover rate. With a fast turnover rate the total number of packages in the system will be less. Fewer packages contribute to less tied up capital and also lower warehousing cost since the space requirements are less. The *transport costs* can be divided into two parts, transport to market and return transport. The cost for transportation to market will further be discussed under the section *Packaging Costs*. The costs for the return

transport or lay-off cost of empty containers are mainly affected by the following factors (Packforsk, 2000):

- The transport distance from one's plant to the packaging central where all the empty packages are gathered.
- Possibility to take advantage of unbalance in transport flow and thereby use joint loading when returning the packages.
- If the packaging are collapsible and/or nestable which help to maximize empty packaging for return transport.

The *return handling* and administration are other factors that will affect the economical result. Some factors are (Packforsk, 2000):

- Compressibility – If the returnable packaging is collapsible and nestable then the area needed for storage and handling will be less.
- Number of steps in return handling – The fewer steps there are the more economically beneficial the system is.
- Demands on cleaning – Cleaning of returnable packaging is often an essential cost in return handling.
- Administration – In order to increase turnover rate and keep track of packaging to minimise loss and the number of packaging in the total return system a control system is needed. The maintenance of this system is an administration cost.
- Disposal Cost – When the packaging is worn down and it is time to discard the packaging then there is a disposal cost.

The cost for *loss of packaging* can have a big impact on the economical result for the return system. In many cases, the loss of packaging controls how many times a packaging can be used more than the technical life span. The main *environmental* factor that has to be considered when introducing a returnable packaging system is the elimination of waste caused by one-way packaging. Further (and more detailed) discussion will be held in the next chapter. The *Ergonomic* benefits with returnable packaging compared to one-way packaging are that returnable packages often are easier to handle and therefore contributes to a better workflow (Packforsk, 2000).

A consequence of using returnable packaging is that, after a container has been used for carrying products from a sender to a recipient, the packaging has to be transported again to the next sender or back to its origin as an empty package (Kroon and Vrijens, 1994). In addition, a returnable packaging system also involves cleaning, maintenance, storage and administration of the packaging. There are three basic types of systems for handling returnable packaging; switch pool system, system with return logistics, and system without return logistics. In a *switch pool system* each member has its own number of packaging, which they are responsible for. They are also responsible for cleaning, maintenance, storage and administration of its allotment of packaging. There are two variants of a switch pool system. In the first variant only the senders and recipients have an allotment of packaging. The sender delivers packaging filled with goods and the recipient sends back empty packaging. The sender has to guarantee that the number of

return packaging equals the number of packaging that has been sent out. In the second variant the carrier also has a number of packaging. When the carrier picks up a load of packaging from the sender, the carrier gives the sender a corresponding number of empty packaging (Kroon and Vrijens, 1994). In this variant the sender has no responsibility for managing the return flow of packaging. In a *system with return logistics* the packaging are owned by a central agency, it is this type of system that VLC use. In this type of system it is the agency that is responsible for the return of the containers. However they can charge the recipient with the transport cost for the packaging from the recipient to the agency's depot. Further differentiation of a system with return logistics in following way (Kroon and Vrijens, 1994):

- *Transfer system*. In this system the sender always uses the same packaging. The transfer system is only involved in the returning of packagings from the recipient to the sender. The sender is responsible for maintaining the system.
- *Depot system*. The essence of this system is that the packagings that are not used are stored at packaging depots. From the depot the sender is provided with the number of packaging that he needs. When the recipient have received and emptied the packaging from the sender they are collected and returned to a packaging depot. The depot system can either consist of a *book system* or a *deposit system*. In the *book system* the sender has an account with the agency and the account is debited or credited depending if the sender receives or sends packaging. In a *deposit system* the sender is charged with a deposit fee for the packaging, which he in return charges the receiver who in return charges the next participant in the chain and so on until the packages returns to the agency.

Systems without return logistics. In this system the packaging are owned by an agency and the sender rents the packaging from the agency. When the sender no longer needs the packaging, they are returned to the agency. By renting the packaging the sender reduces his fixed costs, however the sender is responsible for maintaining the system. The agency is just leasing the packaging it does not run the logistics (Kroon and Virjens, 1994).

2.4 Packaging Costs

In this section the different costs that packaging affects will be presented. There are additional costs for managing a return system, as mentioned previously in section *2.3 Returnable Packaging System*, for administration, warehousing, return transport and cleaning/maintenance (Jonsson and Mattsson, 2005). These costs are already handled by VLC and therefore not relevant for this case study.

2.4.1 Distribution

Costs related to distribution depend on how well the packaging is filled and how well it uses the space in the vessel transporting the packages. One important feature for both one-way packages and returnable packaging is that it must be possible to stack them vertically on each other so that the loading volume of the transport vessel is used to its full potential. In general the load factor of the transportation vessel will be higher with one-way packaging if it's possible to load them on each other. This is due to the fact that one-way packages often are more weight/volume efficient than returnable packages. This is because returnable packages are built in order to withstand more usage and is therefore sturdier and heavier. However if the one-way packaging is not stackable they will have a lower load factor, since the full volume of the vessel is not fully utilised. Volume and weight efficiency is an important aspect when trying to reduce logistic costs. Volume efficiency is defined as the utilisation of volume through the whole supply chain, from supplier to customer. In other words, how well the space available is used, this is measured in fill rate. The fill rate is divided into inner fill rate and outer fill rate. Inner fill rate is defined as the relation between the packaging's outer volume and the volume of the product, see figure 2.6 (Packforsk, 2000).

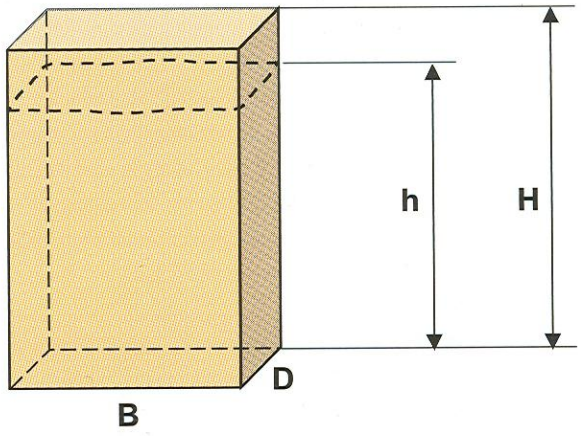

Figure 2.6 Example of inner fill rate (Packforsk, 2000)

Outer fill rate is defined as the relation between the volume of the packaging and the pallet, for example if it uses the whole pallet space, see figure 2.7.

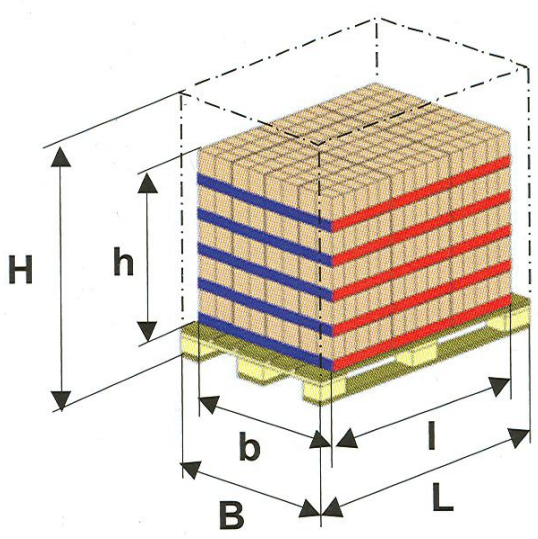

Figure 2.7 Example of outer fill rate (Packforsk, 2000)

Weight efficiency is defined as the utilisation of the container in contraction with product weight. A general requirement on the packaging is that it should weigh as little as possible. Even though the volume for the most part is the limiting factor it is not always the case. High-density goods for example have the weight as a limitation. When this is the case it will be possible to load more goods if the packaging is lighter. Low volume and weight efficiency have the following consequences (Packforsk, 2000):

- Increased transport costs
- Increased handling costs
- Increased warehousing costs

2.4.2 Handling

A large part of the costs that originates from handling the packaging comes from repacking the goods. A production plant often uses some sort of durable packaging in production and not one-way packaging. The repacking is carried out for different reasons. There are often less handling time when eliminating one-way packaging, and therefore there will be operational benefits for the company (Chan et al, 2005). Further more one-way packaging is not as ergonomic as a standardized returnable packaging therefore changing the packaging system will ease the strain on the employees. It also requires more space at the production line than a returnable packaging system would need, and it is also a lot more efficient to dimension the production for a uniform packaging system, such as returnable packaging (Lumsden, 2006).

2.4.3 Waste

The disposal of the waste is a cost for the company, and therefore it is possible to see the waste as hidden resource for the company. Independently of industry it can be economical rewarding to analyse the waste. Everything that is thrown away as garbage, has ones been purchased and transported to the company. There is also another possibly significant cost for the disposal service. If the amount of waste can be reduced, by for example minimising one-way packaging, there will be cost savings in two parts of the company's business, purchasing and disposal (Nyström, 2006).

2.4.4 Quality (Product Protection)

The cost for packaging is directly related to the degree of protection it provides In other words, the more protection the packaging provides the more expensive it gets. In figure 2.8 it can be concluded that the amount of damaged goods increase when little resources are spent on packaging (Gourdin, 2001).

Figure 2.8 Graph showing the trade-off between packaging expenses and damage (Gourdin, 2001)

There is also a trade-off between packaging costs and transportation costs (external damages), see figure 2.9. Less expensive transportation modes, such as rail and road are generally rougher on the packaging and therefore more resources are required to keep the damaged goods at acceptable levels (Gourdin, 2001). The type of transport with the highest amount of damaged goods are border-crossing transports, where there are up to three times more transport damages than a regional or national transport (Lumsden, 2006).

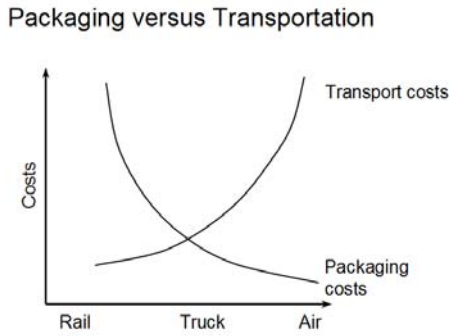

Figure 2.9 Graph showing the trade-off between packaging cost and transport costs (Gourdin, 2001)

Internal damages have a similar trade-off to that of transportation, see figure 2.10. Goods that are moved through manual flows are generally handled more roughly and damages are more likely to occur. It is therefore necessary that more resources are spent on packaging than if the same goods would go through an automatic flow (Gourdin, 2001).

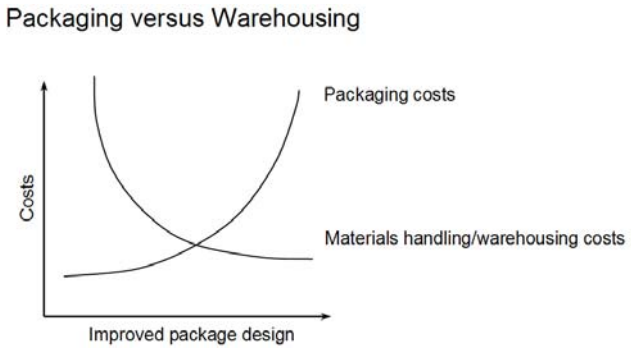

Figure 2.10 Graph showing the trade-off between packaging costs and materials handling/warehousing costs (Gourdin, 2001)

From figure 2.8 – 2.10 it can be concluded that the level of protection the packaging should provide is difficult to estimate, as it is important to not make the packaging to weak nor to strong, thus a difficult trade-off unfolds. Using too much material in the packaging will lead to higher costs, not only the packaging cost, but also for distribution. However packaging that does not have sufficient protection will lead to a higher cost for the company because of more damaged goods, increased service and delays. Between these two factors there is actually a breakeven point or minimum level of protection that is often hard to define. The most economically efficient is the minimum state and it occurs when the total cost is as low as possible. Returnable packaging is by definition more robust than one-way packaging since it has to withstand repeated use (Lumsden, 2006).

2.5 Environmental factors

The use and dispose mentality of the western and to some extent the east-Asian societies have led to severe problems according to Kroon and Vrijens (1994). The

days when we could say, not in my backyard thus not my problem, are over. Dumping grounds are overfilled and the amount of garbage is at the same time increasing. Emissions from traffic and industries cause smog in the urban areas that have lead to serious health problems for the young and elderly. Recycling and the reusing of products and materials is a way to reduce the emissions caused by packaging (Kroon and Vrijens, 1994). Lately environmental issues have become more important. Directives have been created, by the European Union, to minimise packaging waste and to emphasise a more responsible handling of packaging materials. EU also restrict usage of "noxious and other hazardous substances and materials" in materials used for packaging in order to lower emissions (Millar et al, 2007). Directive *2004/12/EC* has the following recycling levels as a goal until Dec. 31, 2008:

"60% overall recovery of packaging waste; and 55% minimum and 80% maximum recycling of packaging waste"

Packaging, one-way and returnable, developed and manufactured today have different environmental requirements, for example (Packforsk, 2000):

- Resource efficiency – Efforts should be made to decrease the amount of material required to manufacture the packaging.
- Dangerous substances – The amount used should be minimal.
- Minimise waste – Recycling should be made easier by for example making it collapsible. Returnable packaging should be used when it is possible.

One-way packaging is for the most part made out of cardboard or wood, in some cases even plastic. The biggest impact of the one-way packaging is the excess waste it causes (Packforsk, 2000). Furthermore it is necessary to transport the waste to an incineration centre or some other kind of disposal centre.
Returnable packaging can be made out of a wide range of materials but the most common is plastic, wood or metal. It is necessary to weigh the need for maintenance, cleaning and reverse logistics against the reduction in material and waste gained by switching from one-way to returnable packaging (Packforsk, 2000). A returnable packaging will be more beneficial than one-way packaging if used a certain minimum number of times during its lifetime. The number of times it has to be used, in order to more beneficial than one-way packaging, can be based on the four following criteria (Kroon and Vrijens, 1994):

- Energy consumption,
- Emission to the atmosphere,
- Water consumption, and
- Pollution and solid waste.

The environmental impact from packaging can be hard to estimate because often the effects are not immediate, and the environmental impacts are not direct (Jonsson and Mattsson, 2005). Packaging systems that use returnable packaging can play a vital role in order to minimise the waste and ease the environmental impact (Kroon et al, 1994). For returnable packaging to be environmental friendly

it is essential that the total impact on the environment is less harmful than that of the one-way packaging system (Packforsk, 2000).

3 Volvo Logistics Corporation

This section describes VLC's returnable packaging system.

3.1 An overview of VLC's packaging system

From one of VLC central warehouses a pre-ordered number of bundled packaging are shipped to the first user, from now on called the supplier, hence they will provide the final customer with material. When the packaging is delivered, the suppliers register the shipment in an Internet application called VEMS. The transportation from VLC to the supplier is included in the transaction cost. The customer can keep the packaging in stock for three weeks without any extra charge. The supplier then packs its finished goods in VLC's returnable packaging and ships the pallet to its next location, see figure 2.11. Both the shipping and the delivery have to be registered in VEMS. When the packages have reached its final customer they have to ship the empty packaging back to one of VLC's distribution centrals where it will be cleaned and stored until the next shipment (Lakobrija, 2008).

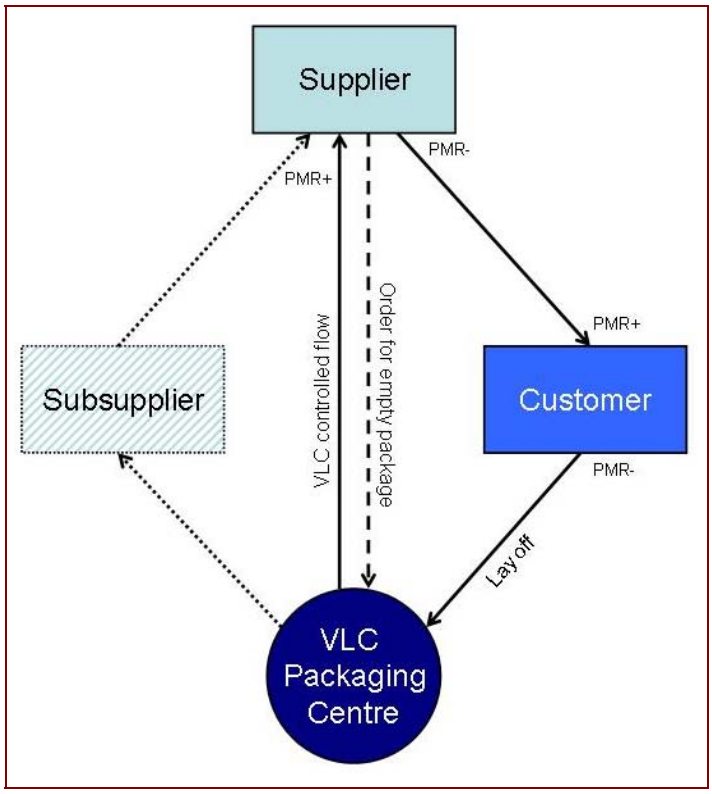

Figure 3.1 Flow chart over the VLC packaging system (Beselin-Hallberg and Uhrbom, 2008)

3.2 VEMS

VLC's tool for coordinating their packaging system is called VEMS. 95 percent of the users (suppliers and customers) use a web-based application of VEMS. In the application they register and create a packaging material receipt (PMR), order new packaging from the VLC packaging centres, and also handles the inventory counting throughout the year. When ordering new packaging from a VLC terminal the user orders 4-5 weeks in advance. If the order is placed before 12 am on a Tuesday the packages will arrive sometime during the following week. A specific date for the delivery is not set because VLC would like to exploit the benefits of joint loading. The users are required to do an inventory count a number of times every year. The inventory frequency is two times for Volvo owned companies (in January and September) and three times for other users (January, April and September). The inventory count takes place simultaneously for all users; it is carried out over a two-week period. Under this time the users are required to count their own stock of packaging and report it in VEMS (Lakobrija, 2008).

3.3 Transaction cost

The transaction cost is a fixed cost that occurs when a filled package is shipped, the receiving part is then charged with a fee based upon a specific pricelist. However there's a new method for calculating the transaction cost that will be implemented in 2009. The new method will include a zone-based pricelist (Lakobrija, 2008).

3.4 Leasing cost

Each user, supplier or final customer, are allowed to hold the packages at his location for three weeks, in other words the throughput time have to be less than three weeks. If a user chooses to hold the packages in storage for more than three weeks they are charged with a leasing cost. VLC charges this fee in order to help speed up the movement of the packaging. A faster throughput time will reduce the number of packages needed in the entire system. In some cases a user might prefer to keep the packages for more than three weeks because it's more suitable for their manufacturing strategy (Mällo, 2008).

A new method is under development and the implementation is scheduled late spring 2008. This method is based on a daily-based cost, DBR.

3.5 Replacement cost

If there are any packaging missing when there is an inventory count or if some packages are stolen the user can be charged with a replacement cost for the missing package. After each inventory count Volvo Logistics further investigates every user that have a certain number of packaging missing. Each user is then given the chance to explain why there is an inventory variance. Some examples of acceptable explanations to why they should not be charged with a replacement cost are (Mällo, 2008):

- A user might incorrectly been debited a PMR that they have never received.
- Wrong stock on hand, the user is charged with a leasing cost for the corresponding difference.
- The possibility to register PMR's that have not been registered.

4 Method

This section will describe how the research for this thesis has been conducted and what method the authors have chosen to work with.

4.1 The study – Quantitative or Qualitative

When gathering data for a study, the method can be divided into qualitative and quantitative data (Davis, 2007). Qualitative data can be described as non-numerical data or soft data (Wallén, 1993). In order to explore a question it relies on interviews and observations rather than surveys (Davis, 2007). Quantitative data is expressed numerically, which is processed with the help of mathematical formulas and statistics (Dahmström, 2005). Our study is based on qualitative data, since we have not been able to study any statistics from previous cases done by VLC. The object of the thesis is to create a model for calculating cost savings when switching to VLC returnable packaging system, not to collect and process data. The VLC packaging engineers will gather the quantitative data when they are using the model.

4.2 Methodology

This thesis is based on theoretical and empirical studies. The theoretical studies have been concentrated on packaging logistics. The data collection has been conducted in libraries, on the Internet, and by searching in scientific databases. All of the data is secondary data, which is the type of data that have already been collected by other persons or researchers. Interviews with employees at VLC have also been held; the interviews have been conducted in an unstructured way. The interview technique used has been qualitative interviews, since we believe it to be the best method for gathering data in this case. A qualitative interview is an in-depth interview where the interviewer can ask resulting questions, the interview is not conducted by using standardised questions or surveys (Wallén, 1993). A great help for the research work has been the possibility to stay and work at VLC's office in Gothenburg, where all the interviews have taken place.

4.3 Validity

Validity is a test to establish the quality of an empirical research (Yin, 1994). Eriksson and Wiedersheim-Paul (2001) define validity as measuring instruments ability to measure what one intends to measure. The validity can further be divided into two different aspects, internal and external validity. The internal validity refers to the consistency between the conception and the measurable definitions of them. It is when an investigator is trying to determine whether event x led to event y (Yin, 1994). External validity refers to the consistency between the value one get and the reality (Eriksson and Wiedersheim-Paul, 2001). In order to secure the validity of this thesis, the data have been gathered from many different sources, such as course literature, articles and interviews. We have tried to use as up to date sources as possible and crosschecked the data between different sources. In order to further secure the information, we have had continuous contacts with our supervisor at Volvo Logistics Corporation. Both

authors of this thesis have been present during the data collection and the interviews. One criticism on the validity of the thesis is that the model has not yet been tested in a case. However the model have been tested with figures from one historical case in order to establish a good validity.

4.4 Reliability

The reliability indicates if a measuring instrument gives stable and correct values (Ejvegård, 1996). The reliability demonstrates that the operations of a study, such as the data collection procedures can be repeated, with the same results (Yin, 1994). Good reliability is a requirement in order to have a good validity, however it is not enough with only a good reliability to create a good validity (Ejvegård, 1996). In order to affect the reliability we have clearly defined the variables and units in the model. To further ensure the reliability there is also an instruction sheet in the model, which cover every part where the user should input data.

5 Result

This chapter will present the model created for Volvo Logistics Corporation. The model is created to enable calculations of possible cost savings for VLC customers when implementing VLC's returnable packaging system. First *General Information* about the model will be presented, and then a detailed explanation of the results will be presented in the sections *Analysis of the present situation* and *Implementing VLC's packaging system*.

5.1 General information

The model consists of six different sheets; a *Front Page*, *Today's situation*, *VLC Packaging Solution (Pre)*, *VLC Packaging Solution (Post)*, *Data* and *Instructions*. The Front Page is a compilation of the different costs that are calculated in the other sheets, appendix 1. It gives an overview of the possible cost savings when the customer switches to VLC's packaging system. The Front Page is followed by the sheets; *Today's Situation*, *VLC Packaging Solution (Pre)*, and VLC *Packaging Solution* (Post), all of which will be described more in-depth in the following sections. The *Data* sheet consists of data needed for the calculations in the previous sheets. There is also a currency converter that will convert the transaction cost pricelists to any wanted currency. In the *Instructions* sheet there are instructions to the different calculations in the model, see appendix 5. After every calculation there is a link to the corresponding instruction in the *Instructions* sheet.

5.2 Analysis of the present situation

This section presents the result of the model that will calculate the customers current costs that are associated with packaging, see appendix 2.

5.2.1 Handling

Our investigation has identified three areas that are possible to measure and are affected when changing from one-way packaging to returnable packaging. They are unloading, repacking and today's cost for internal packaging solution.

5.2.1.1 Unloading

Unloading goods from trucks are considered as a handling related cost. In general returnable packaging will take considerably less time to unload than one-way packaging because of the way it can be packed. Returnable packaging will for the most part be loaded on pallets and secured so there is not anything sticking out from the side that can get hooked in other packages. One-way packaging on the other is often loaded with large differences in size onto the pallets, thus making the loading on pallets more difficult, and in some cases the one-way packaging may not even be loaded on pallets. This causes problems when unloading trucks since it is time consuming for the forklift drivers to stop their work and handpick the packages on to pallets or the forks so that they can be unloaded. In western companies this might not be a problem since the level of development is generally

very high but in eastern countries and other developing countries this can be a big issue that costs a lot of time, according to staff at VLC.

In the model there are two different options available to estimate the costs for unloading. The first alternative is to calculate the cost based on how many employees there are working with the task. The number of employees multiplied with the yearly cost per employee. The second alternative is based on the number of lifts per week multiplied with time per lift, cost per man-hour and number of working weeks per year.

5.2.1.2 Repacking

When goods arrive in one-way packaging they are moved to a repacking area where they are repacked into new packaging more suitable to handle in production. The lay-out and work method may differ from customer to customer, some might have fulltime staff working with only repacking while others have repacking as a sideline work in their daily work tasks. To deal with this discrepancy in work method amongst customers we have created three different alternatives for calculating the repacking cost.

Alternative 1: Number of fulltime employments needed for repacking, multiplied with the yearly cost for an employee.

Alternative 2: Time spent on repacking. The time spent on repacking is measured in hours per week, and then multiplied with cost per hour and number of working weeks per year. This will give an estimation of the repacking cost. However if there is a seasonal variation the calculated value will be misleading. This can be corrected by calculating with a weekly average over a longer period of time.

Alternative 3: Time spent repacking one packaging, multiplied with number packaging per year and cost per hour. The time is measured in minutes and the model will convert the data to the corresponding number of hours. Most customers will most likely have different types of one-way packaging with various quantities and therefore it is important that the inputted data is a weighted average. If the data inputted is not a weighted average the calculation will be misleading. When weighted average is used however the calculation will give a good estimation of the cost for repacking. Another important aspect that should be considered is if the number of packaging per year is correct. Factors like seasonal variation should also be taken in consideration.

5.2.1.3 Internal packaging setup

When the repacking is done the goods have been packed in to some other kind of packaging used for internal handling, for example Schaefer[2] packaging. The boxes are either leased or owned by the customer in either case there will be a yearly cost for the internal packaging system. The cost is inputted into the model without any

[2] Schaefer Systems International, Inc. is a manufacturer of a complete line of Returnable/Reusable Packaging Solutions (SSI Schaefer, 2008).

calculation, since the customer should have the cost documented. Maintenance, cleaning, and capital or leasing cost are all included in the total cost that is inputted into the model. If the customer owns the current internal packaging system the packaging might have market value. If this is the case the packaging can be sold and generate an income for the customer, this value is inputted in to the model.

5.2.2 Quality related costs (product protection)

As mentioned in the theory, one-way packaging is not as protective as returnable packaging therefore it will probably be less damaged goods after implementing a returnable packaging system, hence the cost incurred by delivering damaged goods will be lower. The quality related cost is separated into transport related and handling related damages. This differentiation is done because after conferring with staff at VLC, we have concluded that most customers already have these costs separated.

5.2.3 One-way packaging costs

The cost for the one-way packaging is often included in the article price and therefore not visible for the customer even though he still pays for it. Therefore it is included as a cost in the model, since when eliminating one-way packaging the company should be able to lower their purchase prices. As mentioned in the theory one-way packaging creates extra handling because of the need for disposal of the used packaging. In order to rationally take care of the packaging waste, a garbage press is usually needed, as the physical volume of the waste would be unnecessary high otherwise. The garbage press as well as the service of picking up the waste will incur additional costs. If eliminating one-way packaging the amount of waste can be minimised and the garbage press may no longer be required, thus the company will save these yearly capital costs. Even if the company keeps their garbage press the cost will be lowered, hence the total amount of waste will be significantly lowered when eliminating the one-way packaging.

5.2.4 Other packaging solutions

In some cases the customer might use some other type of returnable packaging for some of their material flows. In these cases the customer will have a cost for using the returnable packaging system. We have located four cost factors that should be taken in consideration when evaluating the cost for other packaging solutions. They are:

- Purchase or Leasing cost,
- Loss of Packaging,
- Sorting and Maintenance cost, and
- Distribution cost

Purchase or Leasing cost. The current returnable packaging system will either have been bought by the customer or leased from an agency. In the model there are two different options to find and input the cost; 1. The yearly cost is already known 2. The cost has to be calculated using the current returnable packaging flows to input into the model. If the cost is known then the value is simply inputted into the model. If it is unknown then it is calculated by multiplying the number of returnable packaging with the cost per packaging. The model can handle up to 10 different flows if various types of returnable packaging are used when calculating this cost, after inputted the model will add up the total cost.

Loss of Packaging. In every system there will be some loss, either by human errors or due to theft. The cost is calculated by multiplying the value of the returnable packaging with a risk percentage. The risk percentage must be estimated in cooperation with the customer.

Sorting and Maintenance cost. The handling cost refers to the sorting and in some cases cleaning of the used returnable packaging. This can be done in different ways; the customer can sort the packaging himself or outsource the task. If the customer have chosen to sort the returnable packaging and included it in the everyday workflow the cost can be minimised, compared to outsourcing the sorting or by having the sorting as a separate work task. If the sorting is done internally the cost will be difficult to estimate, therefore there is only one option for calculating the cost if the sorting and/or cleaning are outsourced to an external company. The cost is calculated by multiplying the yearly number of packaging and the cost per packaging that is charged by the service provider, or if the yearly cost is already known then it is simply inputted into the model.

Distribution cost. This refers to the cost for distributing the returnable packaging to the customer. This can be done in various ways depending on the return packaging system (*switch pool system*, *system with return logistics* or *system without return logistics*). However the calculation of the cost is similar in all cases, the number of packaging per year is multiplied with the transport cost.

5.3 Implementing VLC's packaging system

This section will present the results for implementing VLC packaging system. The implementation is divided in a Pre and a Post scenario.

5.3.1 Implementing VLC's packaging system (Pre scenario)

This section presents an estimation of the cost for the customer when using VLC's returnable packaging system, see appendix 3. The estimation will serve as an investment tool, as it will be used for calculating possible cost saving compared to the present situation. The different costs that will be discussed are distribution cost, transaction cost, handling cost and investment cost.

5.3.1.1 Handling costs

Through research we have identified three factors that still will be valid when switching to VLC's returnable packaging system. The factors are unloading, repacking and cost for sorting service and they will be described further in the following section.

Unloading. As mentioned previously there can be benefits when unloading returnable packaging instead of one-way packaging. However it is difficult to give a good estimation of the improvements. This is due to the lack of information from case studies where a packaging change has been made. In order give a good estimation of the cost savings a common denominator for the different cases has to be found. When a few cases has been done the VLC packaging engineer will hopefully have an rough estimate on how much time the customer will save from unloading returnable packaging instead of one-way packaging. If a common denominator is found, then the percent deduction is inputted in to the model. Currently the model can only indicate that there will be a possible cost saving from speeding up the unloading procedure and not calculate one due to, as mentioned above, a lack of reliable information.

Repacking. After a packaging switch from one-way packaging to VLC's returnable packaging there should hopefully not be any need for repacking. However if the customer for some reason still will have the need for repacking, it will be possible to input the cost for the repacking into the model.

Cost for sorting service. When the returnable packaging has been used, it has to be sorted and prepared for the return transport. This work and the cost for it can, as mentioned previously be minimised by implementing the task into the everyday workflow. However if it is outsourced there will a significantly larger cost. The cost is calculated by multiplying the number of packaging per year with the cost per packaging. There will also be an alternative to input the yearly cost directly in the model.

5.3.1.2 Quality related costs (product protection)

In order to estimate the cost for damaged goods in the *Pre Scenario*, the cost from the current situation is multiplied with a improvement percentage. Before a known improvement percentage can be found, through documentation of future cases, the cost for damaged goods will be the same in both the *Pre Scenario* and for *Today's Situation*.

5.3.1.3 Distribution costs

The cost for distribution, when using VLC's returnable packaging system, is the cost for the return transport. After conferring with staff at VLC we have assumed that every customer will have large enough goods flows to send filled lorries when returning the packaging. The cost is calculated by multiplying the number of packaging with the transport price per packaging, charged by the customer's transporters.

5.3.1.4 Transaction cost

The transaction cost in the pre scenario will be an estimation of the transaction cost. In order to give a good estimation it is important that the VLC packaging engineers will define what type of packaging that will be used most after the implementation. To calculate the transaction costs the VLC packaging engineer will specify how many of each specific packaging type that the customer will use. The model will then calculate the total transaction cost based upon pricelists, provided by VLC. Except the method mentioned above, there is also a more simplified alternative that can be used in the scenario when the VLC packaging engineer does not know what types of packages the customer will use. The simplified alternative is calculated by multiplying the number of packaging with an average transaction cost. The VLC packaging engineers sets the average transaction cost so that it corresponds to the customers' need.

5.3.1.5 Investment cost

When changing the customers packaging solution there will most likely be a need for modifications on the pallet racks and the production line so that they are dimensioned for VLC's returnable packaging. When the modifications are done, the returnable packaging can be transferred directly to the production line without any need for repacking. The cost for this will be a one-time cost for the customer.

5.3.2 Implementing VLC's packaging system (Post)

This part of the model presents the actual costs for the customer after implementing the VLC packaging system, see appendix 4. When the costs have been calculated they will be used to evaluate the actual cost savings for the customer. The calculations are the same as in the pre scenario except the calculations concerning unloading, transaction cost and quality. The unloading cost is different since it is possible to measure the time needed for unloading in the post scenario, the calculations are the same as in the ones for today's situation, which where based on how many employees there are working with the task or the number of lifts per week. The transaction cost in the post scenario is gathered from VEMS, where the customers' invoice can be seen. The cost for the damaged goods is simply inputted into the model as in the case for today's situation.
The results of the calculation will probably differ from the "pre scenario" since then they were only estimations and not based on actual figures. When gathering data for the post scenario it is essential to keep in mind factors that can affect the result, such as implementation time, learning factors, and possible seasonal variation. If the customer could gather data for a longer period of time, the final result would be more accurate.

6 Discussion and Conclusion

In this section we display our conclusions and answer if the purpose of the thesis has been achieved. First the purpose and objectives of the thesis will be answered, and then we will discuss the result from Today's analysis, Implementation of VLC packaging system (Pre and Post) as well as an overall reflection of the thesis.

6.1 Discussion

In this section we will further discuss some parts of the result that we think need further information to why they are included in the model.

6.1.1 Present situation

Unloading. For calculating the unloading we believe that the first alternative is the easiest one and it is the one that most people will use. However it might be difficult for some customers to estimate how many fulltime employees they have working with unloading and therefore we had to have a second option to calculate the cost. The second alternative is calculated by measuring the number of lift and the time it takes to unload the packaging. A problem with this alternative is that it is time consuming to gather the data needed for the calculation as well as reliability of data. If the number of lifts is only measured during a busy day it may not reflect the workload trough out the rest of the week, and it will be even less accurate for the whole year. These issues suggest a lack of a really reliable alternative thus further research and discussion on this topic is needed.

Repacking. For calculating the repacking cost we think that the two first alternatives will give the best estimation of the cost. Either the customer knows how many fulltime employees there are working with repackaging or the number of hours per week they will spend on repackaging. The second alternative is better to use when the repackaging task is a sideline work and therefore difficult to estimate how many fulltime employees there are working with the task. The third alternative is not as good, in our opinion, as it implies a hard and time-consuming process of data gathering for calculation, as mentioned previously. If however the customer has that information available, alternative three will prove to be a quick way to estimate the cost of repacking, thus we chose to include, but we recommend not using alternative three unless the information is readily available.

Quality (Product Protection). The only issue with this cost is if the customer has kept track of their costs for damaged goods or not. If they cannot provide the information needed the cost have to be excluded from the calculation and the total cost estimation will not be as accurate.

6.1.2 Volvo Logistics Corporation packaging system

For the implementation of VLC's packaging system there are the same issues with unloading, repacking and quality at for the present situation. Further more we think that there can be more improvements for the customers that are difficult to calculate, in example there will most likely be less internal transport of packaging. This is due to the fact that the VLC returnable packaging can be transported directly to the production line instead of first being transported to a repacking area and then to the production line.

Another important aspect that should be taken in consideration is if that even if the unloading time in theory should be lowered it may not be shown in the customers costs. The reason for this can be that the employees will start to work at a slower tempo or they will not make use of the extra time created by switching to returnable packaging. Therefore it is important for the VLC packing engineers to mention for the customer that they has to make sure that all the benefits with using VLC's returnable packaging is used to its full potential.

6.2 Conclusion

In this section we will answer to how the objectives of the thesis have been achieved. The objectives for the thesis where:

i. Create a model that calculates possible cost savings of using VLC's returnable packaging system.
ii. Search for relevant parameters in a production plant that are measurable and affected by packaging.
iii. The model should be able to calculate and present different costs affected by packaging in a pre and post scenario.
iv. The staff at VLC should be able to use the model without any training.
v. The model should be developed in such a way that it can be used in different cases.
vi. Investigate possible environmental effects when changing from one-way packaging to returnable packaging.

i. The objective has been achieved, we have created a working model in Microsoft Excel that will calculate the costs for different packaging systems and give an estimation of the cost savings when switching to VLC's returnable packaging.

ii. By theoretical studies and by consulting the staff at VLC we believe that we have found the relevant parameters for calculating the costs for different packaging systems.

iii. In the model there are three separate sheets for calculating the costs for the current system as well as for VLC's packaging system, before and after implementation.

iv. We have only tested the model on our supervisor at VLC and therefore we do not know if every staff member would be able to use the model without any training. However we have written instructions for every field in order simplify the usage of the model, and with the use of the instructions our supervisor where able to use the model, which indicates that the model is sufficiently easy to use. However without the model being used on a larger scale these questions is, as said, hard to answer. Therefore we regard the objective as partly fulfilled.

v. The model has only been tested, as mentioned previously in the validity, on one old case and therefore we cannot ensure that it will work on different business cases. Even though the model has not been tested on different cases it is developed in such a way that different customer conditions have been taken in consideration. This has been done by including different alternatives to calculate the costs, parameters such as the wage for an employee and the number of working weeks per year is changeable since they will most likely differ between different customers. The model is also not locked to any currency, which further ease the usage of the model in different cases.

vi. There may be environmental benefits when switching from one-way packaging to returnable packaging. In order for the returnable packaging system to be environmental friendly it has to fulfil certain criteria's that are mentioned previously in the theory.

The model has its issues such as those mentioned above, and more will probably occur as the model is used more frequently, but this is to be expected due to the many uses of the model as it can impossibly work perfectly for each area. However by keeping the model fairly general we believe that we have allowed room for adjustments to the model, which can partly help offset future issues. Overall we are however satisfied with the model as we believe we have to a larger extent been able to meet the trade-off between keeping the model generic and giving it depth.

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8 Appendix

Appendix 1 Front Page
Appendix 2 Today's Situation
Appendix 3 VLC Packaging Solution (Pre)
Appendix 4 VLC Packaging Solution (Post)
Appendix 5 Data
Appendix 6 Instructions

Appendix 1: Front Page

VOLVO

Volvo Logistics Corporation

VLC Returnable Packaging System Vs One-way Packaging and Other Packaging Systems

a model for analysing possible cost savings

This is a model that will show possible cost savings when switching from one-way packaging or some other kind of returnable packaging system to VLC's returnable packaging system

ATTENTION!

BE CONSISTENT WITH THE TYPE OF CURRENCY USED THROUGHOUT THE MODEL, I.E DO NOT MIX EUR AND SEK

BEFORE USING THE MODEL CHECK THE DATA SHEET SO THAT THE NUMBER OF WEEKS AND THE CURRENCY USED IS CORRESPONDING TO WHAT THE CUSTOMER IS USING

WHEN FACED WITH DIFFERENT ALTERNATIVES ON HOW TO CALCULATE IN A SPECICIFC SECTION IT IS CRUCIAL THAT ONLY ONE OF THE ALTERNATIVES IS USED, OTHERWISE THEY WILL BE ADDED TO EACH OTHER AND THE END RESULT WILL BE INACCURATE

Compilation of the Cost Savings

Today		Pre		Post	
Handling Cost	0	Handling Cost	0	Handling Cost	0
Quality Related Costs	0	Quality Related Costs	0	Quality Related Costs	0
One-way Packaging Costs	0	Distribution Cost	0	Distribution Cost	0
Other Returnable Packaging System Costs	0	Transaction Cost	0	Transaction Cost	0
Yearly Runnig Cost	0	Yearly Runnig Cost	0	Yearly Runnig Cost	0
Market Value	0	Investment Cost	0	Investment Cost	0

Cost Savings

Todays situation Vs VLC Packaging Solution (Pre) - Potential Cost Savings

	Today	Pre	Possible Savings	
Yearly Cost Savings (Today - Pre) =	0,00	0,00	0,00	
	Investment Cost (Pre)	Market Value Old Packaging	Investment Needed	Payback time (in Years)
Investment Needed	0,00	0,00	0,00	

Todays situation Vs VLC Packaging Situation (Post) - Verified Cost Savings

	Today	Post	Savings	
Yearly Cost Savings (Today - Post) =	0,00	0,00	0,00	
			Actual Investment	Payback time (in Years)
Actual Investment			0,00	

Appendix 2: Today's Situation

Today's Situation

Handling Costs

Unloadning

	No of Employees	Yearly Cost / Employee				Tot. Cost / Year
Alternative 1						0,00
	Number of lifts / Week	Time/Lift	Cost/hr	Working Weeks / Year		
Alternative 2						0,00

Repacking

	No. Of Fulltime Employments	Yearly cost / Employee				
Alternative 1						0,00
	Tot. Time For Repacking (Hours/Week)	Cost/hr	Working Weeks / Year			
Alternative 2						0,00
	Minutes per Packaging	No of packaging / Year	Cost/hr			
Alternative 3						0,00

	Market Value		Yearly Cost			
Cost for internal packaging system		*and / or*				0,00
					Sum:	0,00

Quality Related Costs (Product Protection)

	Cost/Year					Tot. Cost / Year
Transport related damages						0,00
	Cost/Year					
Handling related damages						0,00
					Sum:	0,00

One-way Packaging Costs

	No of packaging / Year	Average Price / One-way packaging				Tot. Cost / Year
Purchase cost						0,00
Garbage cost						
	Cost / Year					
Cost for waste disposal service						0,00
	Cost / Year					
Garbage press or similar waste disposal machine						0,00
(This cost is only relevant if the customer will get rid of the machine)						
					Sum:	0,00

Costs for Other Packaging Solutions

		Sum from data sheet		Yearly Cost		Tot. Cost / Year
Purchase / Leasing cost	Click Here	0	*or*			0,00
	Percentage of Loosed Packaging	Value of the Returnable Packaging System		Yearly Cost		
Loss of packaging			*or*			0,00
	No of packaging / Year	Handling Cost / Packaging		Yearly Cost		
Sorting and Maintenance Cost			*or*			0,00
	No of packaging / Year	Cost / Packaging				
Distribution Cost						0,00
					Sum:	0,00

Total Cost

Yearly Running Cost	0,00
Market Value of the Current Internal Packaging System	0,00

Appendix 3: VLC Packaging Solution (Pre)

Volvo Logistics Corporation Packaging Solution (Pre)

Handling Costs

	Unloading cost / Year	Reduction in Unloading time in percent			Tot. Cost / Year
Unloading					0,00

Repacking (If still applicable)

	No. Of Fulltime Employments	Yearly cost / Employee			
Alternative 1					0,00
	Tot. Time For Repacking (Hours/Week)	Cost/hr	Working Weeks / Year		
Alternative 2					0,00
	Minutes / Packaging	No of Packaging / Year	Cost/hr		
Alternative 3					0,00

Cost for sorting service (If applicable)

	No of Packaging / Year	Cost / Packaging			
Alternative 1					0,00
	Fixed Yearly Cost				
Alternative 2					0,00
				Sum:	0,00

Quality Related Costs (Product Protection)

	Improvement in Percent	Cost from Todays Situation			Tot. Cost / Year
Transport related damages	0,00%	0,00			0,00
	Improvement in Percent	Cost from Todays Situation			
Handling related damages	0,00%	0,00			0,00
Note that this percentage does not excist at the current data, it will have to be calculated when there excists data from more business cases				Sum:	0,00

Distribution Costs

	Number of Packaging / Year	Transport price / Packaging		Yearly Cost		Tot. Cost / Year
Return transport cost			or			0,00

Transaction Cost

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	No of Packaging / Year	Average Cost / Packaging			
Simplified Transaction Cost Calculation					0,00
				Sum:	0,00

Investment Cost

	Cost			Tot. Cost / Year
Investment Cost				0,00

Total Cost

Yearly Cost	0,00
Investment Cost	0,00

Appendix 4: VLC Packaging Solution (Post)

Volvo Logistics Corporation Packaging Solution (Post)

Handling Costs

Unloading

	No of Employees	Yearly Cost / Employee				Tot. Cost / Year
Alternative 1						0,00
	Number of lifts / Week	Time/Lift	Cost/hr	Working Weeks / Year		
Alternative 2						0,00
	Unloading cost / Year	Reduction in Unloading time in percent				
Alternative 3	0,00					0,00

Repacking (If still applicable)

	No. Of Fulltime Employments	Yearly cost / Employee				
Alternative 1						0,00
	Tot. Time For Repacking (Hours/Week)	Cost/hr	Working Weeks / Year			
Alternative 2						0,00
	Minutes / Packaging	No of Packaging / Year	Cost/hr			
Alternative 3						0,00

Cost for sorting service (If applicable)

	No of Packaging / Year	Cost / Packaging				
Alternative 1						0,00
	Fixed Yearly Cost					
Alternative 2						0,00
					Sum:	0,00

Quality Related Costs (Product Protection)

	Cost/Year					Tot. Cost / Year
Transport related damages						0,00
	Cost/Year					
Handling related damages						0,00
					Sum:	0,00

Distribution Costs

	Number of Packaging / Year	Transport price / Packaging		Yearly Cost		Tot. Cost / Year
Return transport cost			*or*			0,00

Transaction Cost

	Average Transaction Cost / Month					Tot. Cost / Year
Transaction Cost Statistics Gathered from VEMS						0,00

Investment Cost

	Cost					
Investment Cost						0,00

Total Cost

Yearly Running Cost	0,00
Investment Cost	0,00

Appendix 5: Instructions

Instructions

Today Situation

General Information

This section shows the customers current costs that are associated with

Unloading

In general returnable packaging will take considerably less time to unload than one-way packaging because of the way it can be packed. Returnable packaging will for the most part be loaded on pallets, secured so there is not anything sticking out from the side that can get hooked in other packages. One-way packaging on the other hand have a tendency to be loaded with differing sizes on the pallets, in some cases it might not even be loaded on pallets. This causes problems when unloading trucks since it is time consuming for the forklift drivers to stop their work and handpick the packages on to pallets or the forks so that they can be unloaded. In modern western companies this might not be a problem since the level of development is generally very high but in eastern countries and other developing countries this can be a big issue that costs a lot of time.

In the model there are two options to estimate the costs for unloading. The first alternative is to calculate the cost based on how many employees there are working with the task. The number of employees multiplied by the yearly cost per employee. The second alternative is based on the number of lifts per week multiplied with time per lift, cost per man-hour and number of working weeks per

Repacking

When goods arrive in one-way packaging they are for the most part moved to a repacking area where it is repacked into new packaging more suitable to handle in production. The lay-out and work method may differ from company to company, some companies might have fulltime staff working with only repacking while others have repacking as a sideline work in their daily work tasks. Therefore there are three alternatives in model for calculating the repacking cost.

Alternative 1: Number of fulltime employments needed for repacking, multiplied with the yearly cost for an employee. If the customer have one full-time and one half-time employee, then input 1.5 number of employees.

Alternative 2: Time spent on repacking. The time spent on repacking is measured in hours per week and then multiplied with cost per hour and number of working weeks per year.This will give an estimation of the repacking costs. However if there is a seasonal variation the calculated value will be misleading. This can be corrected by calculating with a weekly average over a longer period of time.

Alternative 3: Time spent repacking one packaging, multiplied with number of packaging per year and cost per hour. The time is measured in minutes and the model will convert the data to the corresponding number of hours. Most customers will probably have different types of one-way packaging with various quantities and therefore it is important that the inputted data is a weighted average. If this is not the case the calculation will be misleading, with as a correct input as possible the calculation will give a good estimation of the cost for repacking. Another important aspect that should be considered is if the number of packaging per year is correct. Factors like seasonal variation should be taken in

Cost for internal packaging system

When the repacking is done the goods have been packed in to some other kind of packaging used for internal handling, for example schäfer boxes. Either the boxes are owned or leased by the customer in either case there will be a yearly cost for the internal packaging system. The yearly cost is inputted into the model without any calculation, since the customer should have the cost documented. Maintenance, cleaning, and capital or leasing cost are all included in the total cost that is inputted into the model. If the customer owns the current internal packaging system they might have a market value. If this is the case the packaging can be sold and generate an income for the customer, this value is

Quality Related Costs (Product Protection)

Since one-way packaging usually is not as protective as returnable packaging there will probably be less damaged goods after implementing a returnable packaging system, hence the cost will be lower. The cost is separated into transport related and handling related damages. If the customer do not have the costs separated then type in the cost into to either one of them.

One-way Packaging Cost

The cost for the one-way packaging is often included in the article price and therefore not visible for the customer even though he still pays for it. Therefore it is included as a cost in the model, since when eliminating one-way packaging the company should be able to lower their purchase prices. In earlier cases 2,5 € has been used as a packaging price. One-way packaging also creates extra handling because of the need for disposal of the used packaging. In order to rationally take care of the packaging waste, a garbage press is needed otherwise the volume of waste will be unnecessary high. There will be a yearly cost for the garbage press as well as for the service for picking up the waste. If the amount of waste can be minimised then the garbage press may no longer be required, and the company will save the yearly capital cost. Even if the company keeps their garbage press their cost will be lowered, hence the total amount of waste will be significantly lowered when eliminating the one-way packaging.

Other Returnable Packaging System Costs

In some cases the customer might use some other type of returnable packaging for some of their material flows. In these cases there will be costs for using the returnable packaging system

Purchase or Leasing Cost. The current returnable packaging system will either have been bought by the customer or leased from an agency. In the model there are two ways to input the cost, either the yearly cost is known or the cost have to be calculated by analysing the current returnable packaging flows. If the cost is known then the value is simply inputted into the model. If it is unknown then it is calculated by multiplying the number of returnable packaging with the cost per packaging. This can be done with up to 10 different flows, and then the model will add up the total cost.

Loss of packaging. In every system there will be some loss, either by human errors or due to theft. The cost is calculated by multiplying the value of the returnable packaging system with a risk percentage. If statistics excist on this the yearly cost can simply be put in to the model. The risk percentage must be estimated in consideration with the customer.

Sorting and Maintenance Cost. The handling cost refers to the sorting and in some cases cleaning of the used returnable packaging. This can be done in different ways; the customer can sort the packaging himself or outsource the task. If the customer have chosen to sort the returnable packaging and included it in the everyday workflow the cost can be minimised, compared to outsourcing the sorting or by having the sorting as a separate work task. If the sorting is done internally the cost will be difficult to estimate, therefore there is only an option for calculating the cost if the sorting and/or cleaning are outsourced to an external company. The cost is calculated by multiplying the yearly number of packaging with the cost per packaging that is charged by the service provider, or if the yearly cost is already known then it is simply inputted into the model.

Distribution Cost. This refers to the cost for distributing the returnable packaging to the customer. This can be done in various ways depending on the return packaging system (switch pool system, system with return logistics or system without return logistics). However the calculation of the cost is similar in all cases, the number of packaging per year is multiplied with the transport cost.

VLC Packaging Solution (Pre)

General Information

This part of the model will present the estimated packaging related costs for the customer after a packaging switch to VLC returnable packaging. It will work as an investment tool to see possible cost savings compared to today's situation.

Unloading

If there is a known reduction for unloading then the reduction measured in percent can be inputted into the model, if there is no known improvement then just type in 0%.

Repacking

After a packaging switch from one-way to VLC returnable packaging there should hopefully not be any need for repacking. However if the customer for some reason still will have the need for repacking, it will still be possible to input the repacking cost into the model. See Repacking under Today's Situation for more

Cost for sorting service

When the returnable packaging has been used, it has to be sorted and prepared for the return transport. The cost is calculated by multiplying the number of packaging per year with the cost per packaging. There will also be an alternative to input the yearly cost directly into the model when for example this task might be outsourced.

Quality Related Costs(Product Protection)

In order to estimate the cost for damaged goods in the Pre Scenario, the Cost from Today's Situation is multiplied with a Improvement Percentage. Before a known improvement percentage can be found, through documentation of future cases, the cost for damaged goods will be the same in both the Pre Scenario and for Today's Situation.

Transaction Cost

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packaging engineer does not know exactly what types of packaging the customer will use. The simplified alternative is calculated by multiplying the estimated number of packaging per year with an average transaction cost. The VLC packaging engineers sets the average transaction cost so that it corresponds to the customer's need.

Investment

When changing the customers packaging solution there will probably be a need for modifications on the pallet racks and the production line so that they are dimensioned for VLC's returnable packaging. The cost for this will be a one time cost for the customer.

VLC Packaging Solution (Post)

General Information

This part of the model will show the actual packaging related costs for the customer after switching to VLC's packaging system and also act as a tool to

Unloading

In the model there are three options to estimate the costs for unloading. The first alternative is to calculate the cost based on how many employees there are working with the task. The number of employees multiplied by the yearly cost per employee. The second alternative is based on the number of lifts per week multiplied with time per lift, cost per man-hour and working weeks per year. The third alternative is if there is a known reduction for unloading then the reduction measured in percent can be inputted into the model. It is important that the improvement is collected and documented in the coming business cases.

Repacking

After a packaging switch from one-way to VLC returnable packaging there should hopefully not be any need for repacking. However if the customer for some reason still have the need for repacking, it will still be possible to input the repacking cost into the model. See Repacking under Today's Situation for more

Cost for sorting service

When the returnable packaging has been used, it has to be sorted and prepared for the return transport. The cost is calculated by multiplying the number of packaging per year with the cost per packaging. There will also be an alternative to input the yearly cost directly into the model when for example this task might be outsourced.

Quality Related Costs (Product Protection)

The cost is separated into transport related and handling related damages. Simply type in the new figures for Quality Related Costs after the implementation of the VLC Packaging Solution.

Distribution Cost (Return Transport Cost)

The cost for distribution, when using VLC's returnable packaging system, is the cost for the return transport. The cost is calculated by multiplying the number of packaging with the transport price per packaging, charged by the customer's

Transaction Cost

The transaction cost is here gathered from VEMS, where the customers invoice

Investment

When changing the customers packaging solution there will probably be a need for modifications on the pallet racks and the production line so that they are dimensioned for VLC's returnable packaging. Here the actual cost for the