Transport packaging of perishable goods, a case study of distribution of tomatoes

Nilsson, Carl-Henric; Ekelund, Lena

2000

Document Version:
Publisher's PDF, also known as Version of record

Transport packaging of perishable goods

Case study of the cost of distribution of tomatoes in corrugated cardboard boxes and in returnable plastic crates: Bergstrand's Handelsträdgård HB

Lena Ekelund Axelson
Carl-Henric Nilsson

KunskapsPartner AB
IDEON Science & Research Park
SE-223 70 LUND

Tel: +46 46-286 58 00
Fax: +46 46-286 58 01

www.kunskapspartner.se

ISSN 1404 – 8884

University Press, Lund
Printed in Sweden

First edition, June 2000

Summary

BACKGROUND AND AIMS

Food is usually transported from the producer via wholesalers to the retailer is some form of transport packaging. Corrugated cardboard boxes have been used for over 100 years. Recently, the issue of introducing a system involving returnable plastic crates has come under discussion in Sweden. A changeover to such a system would have different effects on the producers, the wholesalers and the retailers. The aim of this study was to compare the financial consequences for the actors in the trade of perishable goods regarding the choice of transport packaging.

METHOD

An abductive basis has been used in the study, which means that a combination of theoretical and empirical data has been used together with practical experience. The report is designed as a case study of Bergstrand's Handelsträdgård, which produces tomatoes in Billeberga, southern Sweden. The empirical data were collected through interviews with representatives from the sector. Comparative material was collected during visits to companies in England, Germany and Austria. The analysis is based on the difference in cost, i.e. the excess cost arising from the plastic crate system compared with the existing system.

RESULTS

The study showed that the returnable plastic crate system would generate an excess cost in all parts of the supply chain. The total excess cost for the producer, the wholesaler and the retailer would be about SEK 2.70 per kg tomatoes, or just over SEK 16.00 per crate.

The producer would take the greatest risk by bearing the greatest cost, through considerable initial investments, and would thus commit himself to the system for a relatively long period of time. The flexibility of the producer to adapt to new developments in the market would thus be limited. The degree of filling of the plastic crates is lower, which means that the demand for transportation would increase by 44%. The increased transportation cost would affect mainly the wholesaler. More transport by road would also have negative effects on the environment.

The extra work involved in administration would affect all parts of the supply chain, but the retailer would be affected most. Routines must be established for checking, sorting and stacking the crates. Few retailers today have the capacity to cope with this extra work with existing storage space and current levels of staffing. Retailers would also be forced to implement systems for controlling the flow of crates so that losses due to theft could be kept to a minimum. Representatives for shop personnel also warn of the negative ergonomic consequences of daily handling of heavy plastic crates. Attritional injuries are already a considerable problem, and more heavy lifting is undesirable.

Producers find themselves in a situation of small profit margins and falling prices for their goods. Even small increases in cost can have disastrous consequences for many producers, and only a few could bear the excess cost generated by the introduction of the returnable crate system. This indicates that the cost will gradually be passed on to the consumer.

Foreword

In a previous study, the economic consequences of the introduction of a system involving returnable plastic crates, for those involved in trading of perishable goods in Sweden, were analysed. The results showed that all parts of the supply chain incurred an increase in cost[1]. As the study was carried out on perishable goods in general, there is reason to pursue more detailed studies of specific branches and products.

The objective of this study was to define, more exactly, the costs involved for a specific product, namely tomatoes. Results are presented from Bergstrand's Handelsträdgård, in Billeberga. Jörgen Bergstrand gave us full insight into the workings of the company, and has reviewed and approved the publication of the data. The study was made possible by support from SWIF (Svenska Wellpappföreningen/*The Swedish Corrugated Board Association*).

This study is one in a series of financial analyses of various products in segments of the trade of perishable goods in Sweden. The series includes case studies of tomatoes, cucumbers, lettuce, carrots, apples, meat and cooked meats and bread. The methodology employed is that of a case study of a product from a particular producer, and the flow of the product from the growers, via the wholesaler, to the retailer. The validity and reliability of the background material have been verified by various producers' organisations, wholesalers and retailers.

Apart from the authors, the studies have been carried out by the following employees of KunskapsPartner:

Jörgen Andersson, MA, econ.
Johan Axelson, MA, econ.
Jennie Bengtsson, MA, econ.
Christina Lindskog MA, econ.
Johan Nilsson, MA, econ.
Magnus Remvall, MA, econ.

We would like to thank all those who were interviewed, and all the representatives of growers, wholesalers and retailers who gave their valuable comments on the results.

Lund, June 2000

Lena Ekelund Axelson *Carl-Henric Nilsson*

[1] Nilsson (1999)

Contents

1 Introduction

1.1 Background and aims

Corrugated cardboard has been used for transport packaging for over 100 years. One of the greatest advantages of corrugated cardboard is that packages can be tailor-made to suit the product, and that it is made from a renewable raw material. Recently, a debate has started in Sweden on a system involving returnable plastic crates for the transportation of foodstuffs. A changeover to such a system would have effects on all parts of the supply chain – the producer, the wholesaler and the retailer.

Three aspects are of greatest interest in the choice of transport packaging for perishable goods: economics, ergonomics and the environment. Broad analyses in each sector have shown that detailed studies are necessary to elucidate the consequences for the logistics of specific products in relation to transport packaging. The aim of this study was to compare the financial consequences for the actors in the supply chain of perishables with regard to the choice of transport packaging: cardboard boxes or plastic crates.

1.2 Method

An abductive basis has been used in the study, which means that a combination of theoretical and empirical data has been used together with practical experience[2]. The report is designed as a case study of Bergstrand's Handelsträdgård, which produces tomatoes in Billeberga, southern Sweden.

The intention is that other producers, wholesalers and retailers will be able to get some idea of the consequences of the introduction of the returnable crate system in their own companies or sector by critical scrutiny of the reports and the use of their own data in the calculations.

The empirical data were mainly collected through interviews with representatives from the various parts of the supply chain of perishable goods, and from searches on the Internet. Comparative material was collected during visits to companies in England, Germany and Austria.

The analysis is based on the difference in cost, i.e. the excess cost, expressed in terms of SEK per kg product, arising from the plastic crate system compared with the existing system. The results show that the introduction of a returnable plastic crate system would lead to extra costs.

[2] Definition of abduction

2 The design of the case study

The model below illustrates the design of the case study (Figure 1). The first four chapters provide the background to the area being studied and the assumptions on which the study is based. Initiated readers may therefore skip these chapters and start at Chapter 5, where the results of the case study are presented.

Figure 1. The design of the case study

Chapter 3 describes the actors and the flow of products in each system. The principle of analysis used in the study, and the conditions and assumptions made are presented in Chapter 4. The results of the study are presented in Chapter 5. Traceable costs for the various parts of the supply chain resulting from the introduction of the returnable plastic crate system are presented for each part of the chain and a total for the whole supply chain. The appendix contains the calculations of the actual costs of the returnable plastic crate system.

3 Transport packaging

The transportation of people or materials often demands some form of surrounding protection to ensure that transport takes place safely. A car, for example, is made of sheet metal, and has deformation zones to protect its occupants in the case of an accident. Goods are protected in similar ways by various kinds of packaging in order to prevent damage, which might otherwise arise from being transported.

The trade of perishable goods in Sweden is facing the decision of whether to continue to use corrugated cardboard boxes for the transportation of produce, or introduce a system of returnable plastic crates. Let us consider these two types of packaging a little closer.

3.1 Corrugated cardboard – a renewable packaging material

Sweden has five large corrugated paperboard manufacturers: AssiDomän Förenade Well AB, Dalwell AB, Munksjö Förpackningar AB, SCA Packaging Sweden AB and Stora Enso Packaging AB. These companies are organised in a trade association, Svenska Wellpappföreningen, SWIF (*The Swedish Corrugated Board Association*), which spreads information on corrugated board and safeguards the interests of its members[3].

Figure 2. Corrugated cardboard boxes

Corrugated board consists of a number of layers of corrugated paper, glued to one or more flat layers of board. Corrugated board absorbs shock and affords the package stability so that boxes can be stacked one on top of the other, while the flat sheets of paper give the package tenacity, resistance to moisture and strength. The combined characteristics of corrugated and flat paper make corrugated board an effective packaging material, which can be made into packages tailor-made to suit the needs of individual products. In Sweden alone, there are over 100,000 different kinds of corrugated cardboard packages[4].

Many people think that corrugated cardboard boxes are disposable packages; that they do their job and then end up on the rubbish tip. However, according to Swedish legislation, those who manufacture, import of sell packaging are responsible for recovery of the corrugated board. The ”polluter pay principle” means that manufacturers must make sure that suitable procedures are in place so that consumers and other users can sort this kind of packaging and deposit it at suitable stations for collection (Figure 3). Manufacturers are also obliged to ensure that the packaging left at collection stations is removed and that material or energy is recovered from it, or that it is dealt with in some other way[5].

[3] Svenska Wellpappföreningen, Svensk wellpapp
[4] Svenska Wellpappföreningen, Det naturliga förpackningsmaterialet
[5] Returwell AB, Wellpapp i ett naturligt kretslopp

Swedish companies for the recycling of paper have, during the past 20-30 years, developed systems for collection, transport and processing of corrugated paperboard. Waste paper in the form of corrugated board is a valuable raw material and producers pay the market value per ton of paper collected for recycling. In Sweden, about 98% of all corrugated cardboard packaging is recycled, and of this, 85% is made into new packaging material.[6]

The cost of transport in paper recycling is high, as the consumption of corrugated board is greatest in central and southern Sweden, while most of the recovery takes place in the northern part of the country. The recovery of corrugated board does not, thus, pay its own way. The deficit is financed by a packaging charge. Returwell AB (RAB) is an association of individual companies. The trade association SWIF owns 40% of the organisation. The other 60% is owned equally by the paper producers (SCA Packaging, AssiDomän Packaging and Munksjö Lagamill), those that fill the packages (The Swedish Association of Convenience Goods Suppliers and The Federation of Swedish Food Industries) and retailers (The Development Council for The Swedish Association of Convenience Goods Suppliers and The Swedish Federation of Trade and Services). Apart from administering the packaging charges, RWA also works towards increased recovery of material and energy[7].

Figure 3. The flow of corrugated board for recovery

3.2 The returnable plastic crate system

Use

The main operators in the trade of perishable goods have cooperated to create a joint system employing returnable plastic crates as an alternative to packaging made of corrugated paperboard or solid paperboard. The system is based on deposits and will be operated by Svenska Retursystem AB (SRS). SRS is owned equally by DLF Service AB (The Swedish Association of Convenience Goods Suppliers) and DUR (The Development Council for The Swedish Association of Convenience Goods Suppliers). The Development Council consists of ICA, KF, D&D and SSLF (The Swedish Food Retail Association). Suppliers and wholesalers can join the system by entering into an agreement with SRS[8].

The system of returnable plastic crates is to be financed by deposits and service charges. A deposit is charged on each kind of plastic crate, which is transferred from one part of the supply chain to the next, regardless of the direction. The deposit is charged to the supplier or the wholesaler together with the goods delivered. In the opposite direction, the deposit is credited as returned goods[9].

Most of the empty crates should be transported in the same vehicles as those making deliveries, i.e. a supplier delivering goods to a supermarket should take the empty crates with him. Empty crates can be returned along two pathways, depending on whether the producer has his own washing plant or will use SRS's (Figure 4). The producers, i.e. those who fill the crates with produce, will be charged a co-called service charge, which will cover SRS's costs in connection with the return service. Those making use of SRS's washing plants and return transportation will also be charged a logistics charge.[10]

Figure 4. Alternative transport paths for plastic crates

[6] Returwell AB, Wellpapp i ett naturligt kretslopp
[7] Returwell AB, Wellpapp i ett naturligt kretslopp
[8] Svenska Retursystem AB, Snart är dom här
[9] Svenska Retursystem AB, Snart är dom här
[10] Svenska Retursystem AB, Snart är dom här

Four different crates will be available, with two different base dimensions[11]. In the financial analysis carried out here, the extra cost associated with the crate most like the currently used corrugated paperboard box or solid board box has been calculated (Figure 5).

Figure 5. Specification of the plastic crates (the photos illustrate what the crates will look like)

[11] Tomas Ringström, Svenska Retursystem AB

4 Analysis principle and assumptions for the case study

The case study is based on the assumption that the supply chain for the returnable crate system can be divided into five stages: washing, filling, storing, handling and return transportation, which can in turn be divided into a number of main activities. In the analysis, the excess cost had been calculated for the main activities of each participant (Figure 6):

- SRS – washing transportation, administration
- *Producer* – filling, transportation, administration
- *Wholesaler* – transportation, administration
- *Retailer* – handling, administration

Administrative costs can be broken down into a number of items which differ between the various parts of the supply chain; sorting, stacking and checking/counting of crates, invoicing of deposits and charges, and inserting product information cards into holders on the crates.

Apart from these main activities, there are other costs which affect the whole supply chain: capital tied up in deposits, loss due to theft and loss of revenue due to lost opportunity to expose trademarks.

Figure 6. Main processes and activities of the participants in the returnable plastic crate system.

The analysis is based on the difference in cost, i.e. the excess cost, of the new system employing plastic crates compared with the existing packaging system. This means that the costs that are the same, regardless of whether plastic crates or cardboard boxes are used, are not calculated explicitly, but are defined as a fictitious value of zero. The cost associated with each system can therefore be calculated, and thus the difference in costs. The results of the analysis show that the introduction of a returnable plastic crate system would mean an excess cost. The method can be illustrated with the aid of an example of the increase in transport cost (Figure 7).

Figure 7. Illustration of the excess cost

Assume that the degree of filling of a plastic crate is 80% of that of the equivalent corrugated cardboard box. Due to this, the increase in transportation will be 25%, which means that 5 vans would have to be used instead of 4. According to the principle of the excess cost, we calculate the extra cost of this transport, i.e. only the cost of the 5th van. The cost of the first 4 vans is the same, regardless of the transport packaging system, and need not be calculated.

The data on which the calculations are based have been collected mainly through interviews with the various participants in the supply chain. The material collected empirically has been complemented with values from other studies; Svenska Logistikbyråns förstudie, *Produktionssystem för returemballage* and Svenska Retursystem AB - *Sammanfattning för användare*.

In other respects, a reasonability check has been performed on all values by comparison with systems in operation in other countries. In cases of uncertainty, values to the advantage of the plastic crate system have been used. According to previous calculations, the service charge

tendered by SRS, for example, will not cover the total cost of washing, return transportation and administration of the system, but has nonetheless been used in the analysis[12].

[12] Appendix

5 Consequences for the participants in the supply chain

A changeover to the returnable crate system would have consequences for all parts of the supply chain. This chapter starts with a general description of these consequences and what they may mean for the various participants. Following this, the specific excess costs are calculated for the producer, the wholesaler and the retailer. Finally, a summary is presented for the whole supply chain. This summary provides a clear picture of the total excess cost associated with the implementation of a returnable plastic crate system.

The premise on which the analysis is based is that a decision will have to be made regarding whether or not to change from the existing packaging transport system to one employing returnable crates. The calculations thus demonstrate which excess costs would arise from the transition to such a system, so-called changeover costs.

The basic principle employed in investment calculations is to study the actual payments originating from the investment, and not the profits and costs used in accounting. The value of existing equipment is thus not based on the original purchase price, but its value on the market at the time of sale. The original price and the derived book value are so-called sunk costs, which have no relevance in this situation.

In the calculation of the excess cost associated with the returnable crate system, costs, which disappear in connection with the changeover to the new system, must also be taken into account. The cost, for example, of purchasing and recycling the corrugated cardboard boxes, has thus been deducted. In the comparison of the two systems, it has been assumed that the operating costs are the same.

It is important to bear in mind in the discussion on a returnable plastic crate system, that the distribution network in Sweden differs from that, say, in England, where a returnable crate system is already in effective operation. The English distribution network consists of completely integrated companies, which means that a particular company has control over all parts of the supply chain. Decisions are made centrally, and all goods are delivered to the store by their own wholesaler. The wholesaler, who makes deliveries to many stores, provides the washing plant with a sufficient number of crates to exploit the entire capacity of the plant. In such a system, there is a high degree of control of the flow of crates.

In Sweden, on the other hand, most stores receive goods from a number of wholesalers and individual suppliers. Washing plants in Sweden would have to take crates from several wholesalers, and under such circumstances it would be difficult for all parts of the supply chain to control the flow of crates.

Capital tied up in deposits

All parts of the supply chain would have to bind capital in deposits in a returnable plastic crate system. The producer's bound capital lies in the store of washed crates waiting to be filled. In order to be able to guarantee delivery of his products, and to be able to cope with variations in demand, the producer must have a reserve stock of plastic crates. Some goods, for example, fruit and vegetables, are dependent on the season, which increases the need for a reserve stock. Wholesalers bind their capital in the period during which the crates are transported to and from the producer, the retailer and the washing plant. Retailers' capital is bound in the empty crates awaiting collection and in crates used to store goods in the

warehouse and to display goods in the store. Capital bound in deposits may cause problems of liquidity, even for large companies.

Loss due to theft

Investments in a returnable crate system mean that all the participants are exposed to the risk of theft of the crates or loss due to damage. Retailers already have problems with the theft of pallets. Plastic crates are easier to handle and have a greater value (by volume) than pallets. There are also many more areas of use for plastic crates than for pallets, and crates are easier to steal.

It is difficult to calculate the cost associated with such losses, and costs may differ considerably for different parts of the supply chain, and for different kinds of retailers. Theft may also vary with time. All in all, the returnable plastic crate system involves a financial risk for the supply chain that is not present today.

In England, the supermarket chain Tesco use the same kind of plastic crates intended for use in the Swedish system. Loss due to theft and damage amounts to about 2%. The English system is completely integrated, in contrast to that in Sweden, which means that it would be more difficult to control the flow of crates in the Swedish system. This indicates that the loss for Swedish producers, wholesalers and retailers would probably be considerably higher than that in England. Natural wastage for Swedish retailers is about 2%, and Swedish producers with their own plastic crates on which there is no deposit, estimate the annual loss to be about 5-10%.

There is also a loss involved in the existing system employing corrugated cardboard boxes. Producers are forced to discard a number of boxes each season because they are damaged or because the design or shape of the box has been changed. These costs must be deducted in the calculation of the excess cost upon the changeover to plastic crates. The net effect, i.e. the cost of loss, corrected for cassation and obsolescence of corrugated cardboard boxes, should be somewhere around 2%.

Filling

Packing of goods in plastic crates would require new packing lines. It is probable that not all retailers would be able to handle the returnable plastic crates, and in many cases, producers would be forced to continue to pack their products in corrugated cardboard boxes as well. This means that new packing lines must be installed in parallel with the existing ones for corrugated cardboard boxes. Both investment and operating costs are associated with packing plants. Some producers would also have to invest in new premises in order to be able to house the new equipment. Depending on the degree of use, the cost of packing a plastic crate may be very high; several SEK per crate.

Transport

A system employing returnable plastic crates requires more transport. The increase in transportation cost will be especially felt by the producer and wholesaler. Stacked, empty plastic crates take up about five times as much volume as flattened corrugated cardboard boxes, which means that a greater number of movements would be necessary to transport the same number of crates as boxes. The plastic crates are also heavier. The difference in weight between an average cardboard box (600 * 400 mm) and the corresponding crate is about 1.1 kg, which also generates a greater transportation cost.

The amount of material that can be transported in a truck or delivery van may be limited by weight or volume. The theoretical degree of filling of crates is about 25-30% lower than that of cardboard boxes, bearing in mind wall thickness and shape. The degree of filling differs, however, significantly between different products.

For products with a low density, for example, iceberg lettuce, the volume will be the limiting factor. The lower degree of filling for these products means that more transportation will be needed to deliver the same quantity of goods. For products with a high density, for example, apples, the weight will be the limiting factor in the delivery vans. The cost of transportation for this type of product will increase due to the fact that the weight of the plastic crates will take up part of the loading capacity.

During transport, products may suffer damage. The corrugated layer in corrugated cardboard boxes affords protection against impact, and boxes may be tailor-made to provide the best protection to the product. Few studies have been performed on the risk of damage to products transported in plastic crates, and the cost that may be involved.

Administration

The cost of administration consists of a number of items, which differ for the various participants in the supply chain. The largest items are:

- Checking of the crates, including sorting, stacking and counting
- Insertion of product information cards in holders on the crates
- Warehousing
- Invoicing of deposits and charges

Checking the crates

A deposit-based returnable crate system involves extra work in sorting stacking and counting the crates. For some participants, this also involves removing the remnants of products from the crates, and checking that the crates are not damaged. Many of the shop managers interviewed thought that this would require the employment of new personnel.

Inserting product information cards

There is a small holder on the end of the crate designed to take a card. It is possible to print information and codes related to the product, e.g. the quality and origin, producer or grower, and other information that is useful or required by legislation on this card. Producers will suffer an extra cost in connection with filling the crates through the insertion of this card, whether it is done manually or automatically.

Warehousing

Having to store the crates leads to an extra cost in the form of investments in storage space, loss due to damage of the goods, fire-prevention systems and insurance premiums. These costs will affect all participants in the system, and may thus have a substantial effect on the total cost within the whole supply chain.

As the plastic crates are prone to theft, it is desirable to be able to lock the storage area. As the empty crates take up a greater volume than flattened cardboard boxes, the need for storage space will increase. Retailers must store the crates in a suitable way while awaiting collection. Most of the retailers interviewed did not have enough storage space today, but would be forced to either expand their stores or ”make room” for the crates in the shop. As crates of several sizes will be used, it will also be necessary for the shop to have room for separate

stacks of different crates. This will have the greatest effect on small shops that have relatively small areas of space. It is doubtful, both financially and spatially, whether the smallest shops, e.g. convenience stores, will be able to participate in the system at all. Even the larger stores and supermarkets would require more storage space as they handle large volumes of goods. The initial cost for these stores may thus be high.

Flattened corrugated cardboard boxes which are to be recycled also require storage space. The need varies, depending on whether the store has its own compactor or not. Regardless of the recycling system used, the cardboard and compactor can be stored out of doors, thus requiring no expensive space inside the store.

Storing produce in plastic crates increases the risk of damage to goods such as fruit and vegetables, while bread, meat and cooked meat products are not affected. If only one tomato in a plastic crate is squashed, the others will quickly deteriorate. From a hygienic point of view, it is also doubtful whether empty crates can be stored at the shop for several days. Crates used to transport meat and cooked meat products may constitute a danger to health, and the storage of these crates together with fresh produce would probably not be allowed.

Figure 8. Tomatoes in a plastic crate

Invoicing of deposits and other charges

A deposit is paid on each crate, which is transferred when it changes hands from one part of the supply chain to another, regardless of the direction. The deposit is charged directly by SRS when the empty crates are delivered, and by the supplier or wholesaler together with the delivered goods. In the other direction, the deposit is credited in the same way as returned goods. Invoicing causes extra work for all the participants in the supply chain.

The service charge

The system employing returnable plastic crates would be financed with the aid of a service charge. In the long run, this charge should just cover the entire cost involved in introducing and operating the system, as SRS is to be a non-profit-making organisation. The service charge is debited to the first link in the supply chain, i.e. the producer.

In the systems currently in operation in Europe, the service charge varies from SEK 1.61 to 4.38. SRS have tendered an initial service charge of SEK 2.00-3.00. The infrastructure and geography of Sweden, together with the density of population, mean that the service charge in Sweden may be considerably higher than in any of the European countries in which such systems are already in operation. The Swedish distribution network also differs from that in, for example, England. Previous studies have shown that the charge should be higher[13], but the charge tendered by SRS has been used in the calculations.

[13] Appendix

Return transportation

The corrugated cardboard packaging is stored at the shop prior to collection and recycling. Large stores and supermarkets have their own compactors, while small shops store the flattened cardboard boxes in roll-cages or skips. The retailers have agreements with companies that regularly collect the cardboard and transport it to a recovery plant. The retailer usually pays for this service and in return, receives reimbursement for the corrugated cardboard accepted by the recovery plant. The producer pays a packaging charge, which contributes to the financing of the recycling of corrugated cardboard (Figure 9).

Figure 9. Return transportation of corrugated cardboard for recycling

The system of returnable plastic crates is based on return transportation taking place in the vans and lorries used to deliver the fresh produce. The idea is that pallets will be filled with empty plastic crates as the vehicle is emptied of its goods (Figure 10). The question is, whether this is a reasonable premise.

I. In the first place, it is not clear, from a hygienic point of view, whether contaminated, empty crates may be transported in the same vehicle as fresh produce. Although it is not very likely that a meat crate would have been allowed to stand for a week in store at a supermarket during which time any blood remaining in the crate would have gone off, even moderately contaminated crates may pose health problems.
II. In the second place, a degree of rearrangement would be necessary to bring the fresh produce to the front of the vehicle and move the empty crates to the back.
III. In the third place, a system of returnable plastic crates would require more transportation as SRS considers that long-distance trucks are the only kind of transportation feasible for collecting crates from hypermarkets. Other shops and convenience stores are often located in urban areas, which means that deliveries are made with delivery vans. In these cases, the empty crates must be collected and transported to a reloading centre, where they are then loaded onto long-distance lorries for transport to the washing plant.

Figure 10. Return transportation of plastic crates

If empty crates cannot be transported in the same vehicles as those delivering the fresh goods, the cost of transportation will be very much higher. The cost of return transportation is included in SRS's service charge.

Exposure of trademark

Research in the field of strategy theory indicates increasing competition in the perishable goods sector. The importance of trademarks will thus increase for all kinds of products. The returnable crate system is based on identical crates being used for different types of foodstuffs. The opportunity to expose one's trademark is thus reduced to a small label or card, which can be inserted into a holder, or stuck onto the end of the crate. The introduction of anonymous crates would thus lead to a risk of the producer losing control of his trademark. The communication of product information, e.g. origin, is thus handed over to the wholesaler and the retailer. The producer therefore runs the risk of not being paid for his trademark. In the long run, there is the risk that the value of the Swedish trademark will be reduced, or be completely eliminated if transport packaging were to become anonymous.

Corrugated cardboard boxes offer the possibility of marketing products, partly through the design of packaging especially for a specific product, and partly due to the possibility of printing information and advertisements on the outside. It is difficult to estimate the value of this, and the opportunities are used to varying degrees, depending on the product. The added

value of being able to expose trademark on corrugated cardboard boxes is highest for products that are exposed to the consumer in their transport packaging, which is the case for fruit and vegetables.

In Sweden, fruit and vegetables are almost exclusively sold unpackaged directly from the box, while in the UK, for example, most goods are packed in plastic bags on which the trademark and the price can be printed. For Swedish producers, transport packaging is thus an important means of communicating the trademark and product information. Trademarks are also important for Swedish wholesalers as the price of imported products is often based on the price of domestic products.

Flexibility

A deposit-based, returnable, transport packaging system employing plastic crates means that all the participants in the supply chain must bind a certain amount of capital, in the form of investments, for a considerable period. It is reasonable to assume that the new system would have to be used for at least five years to be profitable. When comparing the excess cost involved in introducing the new returnable crate system, it is thus important to consider the aspect of time, i.e. the fact that the various participants must commit themselves to that system for a number of years. This means that they have limited flexibility regarding changes in transportation system and adaptation to the market.

5.1 The producer – Bergstrand's Handelsträdgård, Billeberga

Bergstrand's Handelsträdgård is located in Billeberga, some 10 km east of Landskrona, in southern Sweden. The company has over 9000 m^2 greenhouse growing area. Jörgen Bergstrand is a trained horticulturist and has been running the business, together with his family, since 1982. During the harvesting season, a total of eight people are employed at the plant. The main product grown is tomatoes, but since 1995, Bergstrand's have also been growing melons.

Figure 11. Jörgen Bergstrand beside the sorting machine

The tomatoes are harvested from the end of March until the beginning of November, which is about 7 months, or 30 weeks. The total production is about 350 tonnes per year. During each season, the tomatoes are harvested about 100 times, which means that each harvest generates 3.5 tonnes tomatoes. The tomatoes are picked manually and put into plastic crates that circulate in an internal system. The crates are transported to a large sorting and packing machine, which sorts the tomatoes into 12 different fractions, depending on size and colour.

Beside the sorting and packing machine, is a tray erector. The filled boxes are weighed to ensure that they contain the correct amount of tomatoes. Every week during the season, an average of 1,900 corrugated cardboard boxes are filled, which leads to an annual demand of 57,000 boxes.

Figure 12. Tomatoes in cardboard boxes

The entire harvest is today packed in corrugated cardboard boxes that hold 6 kg tomatoes. Bergstrand's pay SEK 2.60 per box, including an environmental surcharge. Plastic crate no. 4 is the one that would replace the cardboard boxes if Bergstrand's should decide to go over to the returnable plastic crate system. This crate is taller than the cardboard boxes currently used, and it would therefore be possible to pack more tomatoes in each crate. However, the standard set within the sector is 6 kg per box, and the degree of filling would therefore be less (44%) in the crates. The main effect of this is on transportation and warehousing. The maximum height of a fully loaded pallet is 2 m, ensuring that it will fit into the refrigerator and the delivery trucks. Each pallet would thus hold 72 plastic crates, compared with 104 corrugated cardboard boxes (Tables 1 and 2).

Dimensions	400 * 300 * 135 mm
Weight	0.2378 kg
Annual demand	57,000 pcs
Cost per box	2.60 SEK (incl. environmental surcharge)
Number of filled boxes per pallet	104
Weight of tomatoes per box	6 kg
Total height of pallet	1,899 mm

Table 1. Specification of the corrugated cardboard box

Type of crate	No. 4
Dimensions	400 * 300 * 199 mm
Annual demand	57,000 pcs
Cost per crate	32 SEK
Deposit per crate	40 SEK
No. empty crates per pallet	384
No. filled crates per pallet	72
Weight of tomatoes per crate	6 kg
Total height of pallet	1,935 mm

Table 2. Specification of the plastic crate

Bergstrand's Handelsträdgård is a member of SydGrönt Ekonomisk Förening, Sweden's largest producer's cooperative. Bergstrand's deliver all their tomatoes directly to SydGrönt, who then administer their sale. Most of the harvest is sold to wholesalers, who deliver the tomatoes to retailers via smaller wholesalers or their own distribution centres. A small fraction of Bergstrand's produce is sold and distributed directly to shops in the area by SydGrönt. SydGrönt charge the grower an administrative cost of 3.5-5% of the sales price. The wholesaler in the first part of the supply chain adds an extra 8-10% onto the purchase price, while the total mark-up of the second wholesaler and the retailer is between 20 and 100%, depending on the product and the time of the season (Figure 13).

Figure 13. Illustration of the distribution chain for Bergstrand's Handelsträdgård

The average time taken for a crate containing tomatoes to complete a whole cycle in the supply chain, i.e. from the producer to the wholesaler, to the retailer and the washing plant, and back to the producer is 13.1 days. The rate of turnover will thus be 27.86 times per year, which means that each crate completes almost 28 cycles in a year (Table 3).

		Source
Total cycle time	13.1 d	
Svenska Retursystem AB	2.6 d	Nilsson, 1999
Producent	6.5 d	Bergstrand's Handelsträdgård
Grossist	2 d	SydGrönt
Detaljist	1 d	OBS! Burlöv
Returtransport	1 d	Own estimate
Rate of turnover (times/år)	27.86 (365 dgr / 13.1 d)	

Table 3. The cycle time and rate of turnover of the plastic crate

The discount rate used in the calculations was 8%, which means that the results are corrected for inflation (Table 4).

Discount rate	8%

Table 4. Discount rate

5.1.1 Consequences of introducing the plastic crate system

Production and storage

The tomatoes must be harvested as they ripen, and this cannot be delayed. Bergstrand's Handelsträdgård can thus not risk a delivery of crates being late, and it will be necessary for them to have a reserve supply in stock, equivalent to 2-3 days' demand. At a normal rate of use, this means that there must be storage space to accommodate 7 pallets of empty crates at the plant. This means that, on average, plastic crates valued at SEK 70,000 must be stored in the greenhouses, if it is assumed that crates are delivered once per week, and they are used uniformly throughout the week. Because there is a deposit on each crate, capital will be tied up in the crates. Handling and warehousing of the crates also leads to extra work. Due to the lower degree of filling of the crates, it would also be necessary for Bergstrand's to invest in an extension of their refrigerated storage space.

Bergstrand's will keep the machine for erecting corrugated cardboard boxes as a reserve system. New scales, which can be calibrated for both cardboard boxes and plastic crates, will have to be purchased, as will a new stacker which feeds the crates into the sorting machine.

As the plastic crates weigh more than the cardboard boxes in use today, the risk of occupational injury due to having to lift the heavier crates will increase. Jörgen Bergstrand thus foresees the need to invest in some kind of lifting gear to facilitate packing.

Trademark

The returnable plastic crate system is based on identical crates being used for various kinds of foodstuffs. Therefore, the crates are anonymous, apart from a card-holder on the end of the crate in which a card carrying product information can be inserted. As the crates are anonymous, the producer loses control over his trademark. Attempts have previously been made to communicate the trademark using labels on pallets, but experience has shown that the information is not used to any high degree. According to Jörgen Bergstrand, one cannot compare the printed name on corrugated cardboard boxes with loose material accompanying the product. High-quality printed information on the box guarantees that the trademark follows the product, as long as it is in the box. In some cases, the trademark is only of interest to the purchaser in the producer-wholesaler and wholesaler-retailer relations, but the trademark is often important along the whole supply chain to the consumer. The importance of the trademark is greater for products grown and sold on the local market.

Figure 14. Tomatoes on the loading platform

Transport

As the number of crates on a pallet is less than the number of boxes, the number of deliveries will increase from 18 to 26 pallets per week, which means an increase in transportation of 44%. Today, the tomatoes are collected three times per week, and six pallets are collected on each occasion. The delivery vans can accommodate the extra pallets, but the loading and unloading times are 15-20 minutes longer for each van.

5.1.2 Cost analysis

Calculations of the excess cost of the returnable plastic crate system are specified in terms of SEK per kg for each item. In Section 5.1.3, a summary is provided of the various costs. The final result shows an increase in cost for the returnable crate system for Bergstrand's Handelsträdgård. Finally, the total annual excess cost is presented.

Cost involved with corrugated cardboard boxes

The corrugated cardboard boxes used by Jörgen Bergstrand cost SEK 2.55 each. Producers must also pay an environmental surcharge of SEK 0.20 per kg of packaging material, which in this case is equivalent to a cost of SEK 0.05 per box. The total cost of each cardboard box is thus SEK 2.60. In the calculation of the excess cost upon a changeover to the returnable plastic crate system, the cost of purchasing cardboard boxes has been subtracted (i.e. it is a negative item), see Table 19, which gives the total excess cost for the producer.

Purchase price of cardboard box	2.55 SEK
Environmental surcharge/kg packing material	0.20 SEK
Weight of the box	0.2378 kg
Environmental surcharge/box	0.05 kr (0.20 SEK * 0.2378 kg)
Weight of tomatoes per box	6 kg
Cost per kg	**0.4333 kr** ((2.55 + 0.05)SEK / 6 kg)

Tabell 5. Specification of the cost of purchasing cardboard boxes

Binding of capital in deposits

The amount of capital bound in deposits depends on how often empty crates are delivered. The average requirement of plastic crates will be 1,900 per week. Bergstrand's Handelsträdgård must, however, have a reserve stock to cover 3 days' harvest. Capital is also tied up in the service charge, which is to be paid within 30 days of receiving the invoice. According to the settlement agreement with SydGrönt, Bergstrand's are paid for delivered goods, including the service charge on the crate, when the goods are delivered. Bearing in mind these terms, Bergstrand's thus have a credit revenue for the service charge, which is deducted from the excess cost of capital bound in the crates, which will be SEK 0.0079 per kg.

Number of crates delivered per week	1,900
Reserve stock (3 days)	815
Deposit per crate	40 SEK
Deliveries per week	1
Discount rate	8%
Weight of tomatoes per crate	6 kg
Aveerage capital tied up in delivered crates	38,000 SEK (1,900 * 40 SEK / 2)
Aveerage capital tied up in reserve stock	32,571 SEK (1 900 * 40 SEK * 3/7 d)
Capital tied up per kg tomatoes	0.0095 SEK ((38 000 SEK + 32.571 SEK) * 0.08 / 52 weeks) / (1 900 * 6 kg))
Service charge per crate	2.00 SEK
Terms of payment	30 days net

Average credit	20.46 SEK (1 900 * 2.00 SEK) * 3.5 weeks * (0.08 / 52 weeks)
Average capital cost per week for reserve stock	2.51 SEK (1,900 * 2.00 SEK * 3/7 d * 0.08 / 52 weeks)
Capital cost per kg for reserve stock	0.0002 SEK (2.51 SEK / (1 900 * 6 kg))
Credit revenue service charge	0.0016 SEK (20.46 SEK / (1 900 * 6 kg) – 0.0002 SEK)
Excess cost per kg	**0.0079 SEK** (0.0095 SEK – 0.0016 SEK)

Table 6. Specification of the excess cost due to capital tied up in the deposit on the plastic crates

Bergstrand's Handelsträdgård also have capital tied up in the existing system employing cardboard boxes. The total consumption of boxes is 57,000 per year, or 1,900 per week. The boxes are delivered about 5 times each season (which is about 30 weeks long). This means that Bergstrand's Handelsträdgård takes delivery of boxes once every 6 weeks. It has also been assumed in this case that they have a reserve stock equivalent to 3 days' demand.

Each cardboard box costs SEK 2.60, including the environmental surcharge. Payment is made with one month's credit, i.e. 30 days net. These easy terms mean that Bergstrand's Handelsträdgård actually has a credit revenue of SEK 0.0005 per kg tomatoes, i.e. a negative cost (see Table 8, which gives the total excess charge for capital tied up in crate deposits).

No. of boxes used in one season	57,000
Weight of tomatoes in each box	6 kg
Length of season	30 weeks
No. of deliveries per season	5 (1 every 6 weeks)
No. of boxes per delivery	11,400
Price per box incl. environ. surcharge	2.60 SEK
Discount rate	8%
Terms of payment	5 times per season, 30 days net
Credit	60.80 SEK ((11,400 * 2,60 SEK / 2) * (4 weeks / 6 weeks) * (0.08 / 52 weeks) * 4 weeks)
Credit charge	15.20 SEK ((11,400 * 2.60 SEK / 2) * (2 weeks / 6 weeks) * (0.08 / 52 weeks) * 2 weeks)
Difference: credit – credit charge	45.60 SEK (60.80 SEK – 15.20 SEK)
Average capital cost per week for reserve stock	3.2569 SEK (1,900 * 2.60 SEK *3 / 7 d * 0.08 / 52 weeks)
Capital cost per kg for reserve stock	0.0002 SEK (3.2569 / (1900 * 6 kg))
Revenue per kg	**0.0005 kr** (45.60 SEK / (11,400 * 6 kg) – 0.0002 SEK)

Table 7. Specification of the cost of capital tied up in corrugated cardboard boxes

For Bergstrand's Handelsträdgård, the excess cost of capital tied up in deposits in the new returnable crate system is the sum of the costs of capital tied up in the plastic crates plus the lost credit revenue for the corrugated cardboard boxes. The total excess cost is SEK 0.0100 per kg tomatoes.

Cost of capital tied up in plastic crates per kg tomatoes	0.0079 SEK
Lost credit revenue for cardboard boxes per kg tomatoes	0.0005 SEK
Excess cost per kg	**0.0084 SEK** (0.0079 SEK + 0.0005 SEK)

Table 8. Specification of the excess cost of capital tied up in deposits

Loss due to theft

Bergstrand's Handelsträdgård already has problems with the theft of tomato crates at the plant. These thefts occur once or twice per season, and it is probable that they will continue. The deposit on the plastic crates thus means that the loss due to theft will increase.

A conservative estimate of the magnitude of this cost based on previous experience is 2% per year. With a rate of turnover of 27.86 times per year, this would mean that a crate would disappear after 1393 trips. As the risk of theft is greatest at the producer and the retailer, the cost has been divided equally between the two. The cost to the producer will thus be SEK 0.0024 per kg tomatoes.

Rate of turnover of each crate per year	27.86
Annual loss due to theft	2%
No. of trips before a crate is stolen	1393 (27.86 / 0.02)
Deposit per crate	40 SEK
Weight of tomatoes per crate	6 kg
Producer's share of the cost	50%
Excess cost per kg	**0.0024 SEK** (40 SEK / (1393 trips * 6 kg) * 0.50)

Table 9. Specification of the excess cost of loss due to theft

Filling

The need to handle both plastic crates and corrugated cardboard boxes means that Bergstrand's Handelsträdgård must equip the sorting and packing machine used today with new scales, which can be easily calibrated according to the type of packaging. Scales cost about SEK 2,000-3,000 each and are written off after 5 years. Jörgen Bergstrand must procure 9 new scales. The total investment cost of this would be about SEK 22,500.

The internal picking and collection system will not be affected by the introduction of the returnable plastic crate system as the tomatoes are transported to the sorting and packing machine in an internal plastic crate system. On the other hand, new conveyors or stackers will have to be purchased to transport the plastic crates to the sorting machine. Jörgen estimates the cost of this to be SEK 50,000-60,000. The lifetime of such an investment is estimated to be 10 years. Based on 57,000 crates per season, containing 6 kg tomatoes, this means an excess cost of SEK 0.0383 per kg tomatoes.

Discount rate	8%
Cost of new scales	2.500 SEK each
No. of scales	9
Total cost of new scales	22,500 SEK (2,500 SEK * 9)
Economic lifetime of the scales	5 y

Annuity 8%, 5 y	0.2505
Cost of stacker	50,000 SEK
Economic lifetime of stacker	10 y
Annuity 8%, 10 y	0.1490
No. of crates used per season	57,000
Weight of tomatoes per crate	6 kg
Excess cost per kg	**0.0383 SEK** ((22,500 SEK * 0.2505) + (50,000 SEK * 0.1490)) / (57,000 *6 kg)

Table 10. Specification of the excess cost of filling

Transport

One hundred and four corrugated cardboard boxes containing tomatoes can be loaded onto a pallet at Bergstrand's Handelsträdgård. The height of this load is 1,755 mm, excluding the height of the pallet, which is 144 mm. The height of the refrigerated store limits the height of the loaded pallet to 2 m, which means that only 72 plastic crates can be loaded onto each pallet. The height of this load is 1,792 mm excluding the pallet. The number of pallets to be transported thus increases due to the lower degree of filling.

If 1,900 crates are required each week, and 72 can be loaded onto a pallet, the number of pallets leaving the plant will be 26, compared with 18 per week at present. This means that the need for transportation would increase by 44%. The cost of transporting a pallet between Billeberga and Helsingborg, one way, is about SEK 60 today, which would mean an increase in transportation cost of SEK 480 per week, or SEK 0.0421 per kg tomatoes

No. of cardboard boxes per pallet	104
No. of plastic crates per pallet	72
Weekly requirement of boxes/crates	1,900
No. of pallets loaded with boxes per week	18 (1,900 / 104)
No. of pallets loaded with crates per week	26 (1,900 / 72)
Transport cost per pallet (Billeberga-Helsingborg)	60 SEK
Increase in transport cost for 8 extra pallets per week	480 SEK ((26 – 18) * 60 SEK)
Weight of tomatoes per crate	6 kg
Excess cost per kg	**0.0421 SEK** (480 SEK / (1,900 * 6 kg))

Table 11. Specification of the excess cost of transport

Administration

Product information

Jörgen Bergstrand estimates that the extra work involved in inserting product information cards into the crates will take about 1½ hours per week. This estimate is based on the use of ready-printed cards. If the cards have to be printed out and separated from sheets or rolls, 1½ hours would be a low estimate.

Each week, Bergstrand's Handelsträdgård would use 1,900 plastic crates. The information cards would cost about SEK 0.30 each, including printing[14], which means that the excess cost of handling product information would be SEK 570 per week, or SEK 0.0689 per kg tomatoes.

SRS have indicated that self-adhesive labels could be used instead of cards. The labels are expected to cost about the same as the cards, and take the same amount of time to affix onto the crates.

Time to affix label to crate	3 s
No. of crates used per week	1,900
Weight of tomatoes per crate	6 kg
Cost of card, incl. printing	0.30 SEK
Time per week to affix labels	1.6 h (1 900 / 60 min / 60 s * 3 s)
Estimated wage per hour	135 SEK
Wage cost per week	216 SEK (1.6 h * 135 SEK)
Cost of cards per week	570 (0.30 * 1900)
Excess cost per kg	**0.0689 SEK** ((216+570) SEK / (1 900 * 6 kg))

Table 12. Specification of the excess cost of affixing product information to the crates

Checking and counting the plastic crates

If plastic crates were to be introduced, time would be gained through not having to erect cardboard boxes. For Bergstrand's Handelsträdgård, this would result in a saving of several hours. On the other hand, the checking and counting of the plastic crates would generate extra work, and the cost would increase due to increased transportation within the plant. Jörgen Bergstrand estimates that the aforementioned saving and the excess cost would cancel out.

Excess cost per kg	**0.00 SEK**

Table 13. Specification of the excess cost of checking and counting plastic crates

Warehousing – in and out

Bergstrand's refrigerated store has room for 9 pallets. Due to the increase in the number of filled pallets per week, it would be necessary to increase this space to accommodate at least a further 5 pallets. The cost of this investment is estimated by Jörgen Bergstrand to be SEK 15,000 to 20,000, which would generate an excess cost of SEK 0.0065 per kg tomatoes.

[14] Rahms tryckeri AB (2000)

Investment in extended refrigerator	15,000 SEK
No. of crates used per season	57,000
Weight of tomatoes per crate	6 kg
Discount rate	8%
Economic lifetime	10 y
Annuity 8%, 10 y	0.1490
Excess cost per kg	**0.0065 SEK** (15,000 SEK * 0.1490 / (57 000 * 6 kg))

Tabell 14. Specification of the excess cost of warehousing – in and out

Invoicing of deposits and other charges

The deposit on the plastic crates is transferred to the next part of the supply chain. After counting the number of crates, the deposit is invoiced together with the cost of the goods. According to Jörgen Bergstrand, this would take about an hour per week. The excess cost would thus be SEK 0.0118 per kg tomatoes.

Time spent on invoicing per week	1 h
Hourly wage	135 SEK
No. of crates used per week	1,900
Weight of tommatoes per crate	6 kg
Excess cost per kg	**0.0118 SEK** (135 SEK / (1900 * 6 kg))

Table 15. Specification of the excess cost of invoicing of deposits and other charges

If we add up the various costs, we arrive at a total excess cost of SEK 0.0872 per kg tomatoes for the administration associated with the returnable crate system.

Affixing product information	0.0689 SEK
Checking and counting of crates	0 SEK
Warehousing – in and out	0.0065 SEK
Invoicing of deposits and other charges	0.0118 SEK
Excess cost per kg	**0.0872 kr** (0.0689 + 0 + 0.0065 + 0.0118) SEK

Table 16. Specification of the total excess cost of administration

Service charge

The service charge that SRS will debit the producers includes remuneration for washing, return transportation and administration of the system. SRS have tendered a total service charge of SEK 2.00 per crate to Bergstrand's Handelsträdgård. By way of precaution, we have used this charge, despite the fact that previous studies have shown that the charge will probably be higher[15]. SRS have also announced an increase of SEK 0.20 per crate. This increase, which will compensate for the excess cost to the retailer, has not been included in these calculations. Bergstrand's excess cost for the service charges is SEK 0.3333 per kg tomatoes.

[15] Appendix

Trademark

Jörgen Bergstrand estimates that Swedish tomatoes are worth up to SEK 3.5 more per kg in relation to the wholesaler. Of this, at least 50% is attributed to the communication of the trademark on the box. The value of the loss of opportunity to print trademarks on the crates is estimated to be SEK 1.75 per kg tomatoes.

Extra value of Swedish tomatoes/kg	3.50 SEK
Proportion communicated by printing trademarks on the box	50%
Excess cost per kg	**1.75 SEK** (3.50 SEK * 0.50)

Table 17. Specification of the excess cost due to loss of opportunity to expose trademarks

5.1.3 Summary of the consequences for the producer

The calculations show that Bergstrand's Handelsträdgård would suffer an excess cost of just over SEK 1.80 per kg tomatoes upon changing from cardboard boxes to the returnable crate system (Table 19). The cost is affected considerably by the lower degree of filling of the crates, which in turn affects the cost of both transportation and warehousing. The extra work involved in administration, including checking and counting the crates and affixing product information, constitutes another significant source of cost.

The lost value of the trademark constitutes the greatest part of the excess cost. Although it is difficult to estimate the value of loss of trademark exposure, trademarks play an important role in creating a good reputation for quality. It is thus important for the grower not to lose control of his trademark.

The entire cost of the returnable crate system is imposed on the producer, in the form of a service charge. Initially, SRS have tendered a relatively low charge. There is, however, some degree of uncertainty as to how high this cost would have to be in order to cover all the costs involved in the returnable crate system. The producer should thus be aware that the charge would probably increase in the long run. Retailers have already indicated that they want compensation for their costs in association with the system, and that this cost may be passed on to the producer.

Annual volume (kg) 342,000	Excess cost of crate system (SEK / kg)	Total annual excess cost of crate system (SEK)
Cost of purchasing and recycling corrugated cardboard boxes	-0.4333	-148,189
Capital tied up in deposit system	0.0084	2,873
Losses	0.0024	821
Fillning	0.0383	13,099
Transport	0.0421	14,398
Administration	0.0872	29, 822
Service charge	0.3333	113,989
Company name exposure	1.7500	598,500
Total for the producer	**1.8284**	**625,313**

Table 18. Summary of the total excess cost for the producer

5.2 The wholesaler – SydGrönt Cooperative, Helsingborg

The SydGrönt Cooperative is one of Sweden's largest producer's cooperatives, with about 200 members. Through a special environmental programme, involving product and quality development, quality control and a prognosis system, the organisation is working towards promoting environmentally friendly cultivation techniques, and safeguarding biological diversity. They are also taking steps to ensure that products have a high, uniform quality and they are involved in marketing the growers' products[16].

Figure 15. SydGrönt

5.2.1 Consequences of introducing a returnable crate system

Transport

As the wholesaler, SydGrönt would be most affected by the increase in transportation cost. The new plastic crates are taller than the boxes used today by Bergstrand's Handelsträdgård for their tomatoes. The degree of filling of the crates is thus lower, which means that a larger number of filled pallets must be transported per week. Transportation is thus increased by 44%.

Figure 16. Tomatoes

[16] www.sydgront.se

Administration
The deposit on the crates is transferred from one part of the supply chain to the next when goods are delivered or empty crates collected. As the wholesaler, SydGrönt will administer the handling of the crates and will invoice both the producer and the wholesaler/retailer. There is also some extra work involved in checking that the crates are not damaged.

Trademark
As the trademark is transferred from the producer to the wholesaler, SydGrönt will also be affected by the loss of opportunity to expose their trademark on the plastic crates. If the grower is paid less for his tomatoes, the revenue of the wholesaler also decreases as his mark-up is a certain percent of the purchase price. This would lead to an excess cost for SydGrönt in the form of lost revenue.

Figure 17. Per Nordmark, Chairman of SydGrönt

5.2.2 Cost analysis

The costs of the various consequences for SydGrönt have been calculated in terms of SEK/kg and are specified for each item. In Section 5.2.3 a summary is presented of all the items, together with the total annual excess cost of the returnable crate system.

Capital tied up in deposits
For SydGrönt, just as for other participants in the supply chain, the returnable plastic crate system means an excess cost in bound capital. A crate containing tomatoes is at the wholesaler's, either in storage or in a truck, for an average of 2 days. The deposit on the crate is SEK 40. If there are 6 kg tomatoes in the crate, the excess cost of capital tied up in the deposit will be SEK 0.0030 per kg.

Deposit per crate	40 SEK
Discount rate	8%
Weight of tomatoes per crate	6 kg
Time	2 d
Excess cost per kg	**0.0030 SEK** (0.08 * 40 SEK * (2 / 365 d) / 6 kg)

Table 19. Specification of the excess cost of capital tied up in deposits

Losses
Previous studies and experience show that the risk of loss due to the theft of crates is greatest at the producer and the retailer, while the wholesaler is essentially spared this cost.

Excess cost per kg	**0.00 SEK**

Table 20. Specification of the excess cost due to theft

Transport
SydGrönt's warehouse is in Helsingborg. Many products are transported to Stockholm (800 km north) and Stockholm was thus chosen as the main city in the case study. The cost of transporting a pallet from Helsingborg to Stockholm is about SEK 200. The transportation cost from a central warehouse in Stockholm to the retailer is about SEK 100 per pallet. Due to

the lower degree of filling of the plastic crates, the number of filled pallets to be transported will increase by 44%, which means a corresponding increase in transportation to deliver the same amount of tomatoes. With a weekly production of 1,900 crates, the excess cost for transportation would be about SEK 0.21 per kg tomatoes

Weekly production, crates	1,900
Weight of tomatoes per crate	6 kg
No. of pallets loaded with boxes per week	18 (1,900 / 104)
No. of pallets loaded with crates per week	26 (1,900 / 72)
Transport cost per pallet (Helsingborg - Stockholm)	250 SEK
Transport cost per pallet in Stockholm	100 SEK
Increase in cost of transporting 8 extra pallets per week	2 800 SEK (26– 18) * (250 + 100) SEK
Excess cost per kg	**0.2456 kr** (2 800 SEK / (1,900 * 6 kg))

Table 21. Specification of the excess cost for transportation

Administration

The extra work involved in the administration of the returnable crate system for SydGrönt lies in checking and counting the crates, warehousing – in and out, and invoicing of the deposit and service charge.

Checking the plastic crates

SydGrönt must check the crates to ensure that they are not damaged. Based on studies of similar activities, the time required for this can be estimated to be 5 seconds per crate. With an hourly wage of 150 SEK, this is equivalent to about SEK 0.10 per crate, or SEK 0.0280 per kg tomatoes.

Time to check each crate	5 s
Hourly wage	150 SEK
Weight of tomatoes per crate	6 kg
Excess cost per kg	**0.0347 SEK** ((150 SEK / 60 min / 60 s * 5 s) / 6 kg)

Table 22. Specification of the excess cost of checking the crates

Warehousing – in and out

The capacity of SydGrönt's warehouse is sufficient to handle the increase in the number of pallets and plastic crates. Thus, no excess cost is generated by the new system, in the form of extending premises or terminals.

Excess cost per kg	**0.00 SEK**

Table 23. Specification of the excess cost of warehousing

Invoicing of deposits and other charges

The deposit on the plastic crates is transferred to the next part of the supply chain upon delivery. After checking and counting the crates, the deposit is invoiced together with the produce delivered. As SydGrönt already has a settlement system in place, the excess cost associated with this is probably negligible.

Excess cost per kg	**0.00 SEK**

Table 24. Specification of the excess cost of invoicing deposits and other charges

The total excess cost for SydGrönt of administration of the returnable plastic crate system is thus SEK 0.0347 per kg tomatoes.

Counting crates	0.0347 SEK
Warehousing	0.00 SEK
Invoicing of deposits & other charges	0.00 SEK
Excess cost per kg	**0.0347 SEK** (0.0347 + 0.00 + 0.00) SEK

Table 25. Specification of the total excess cost of administration

Trademark

The trademarks of the individual growers are important to SydGrönt in their marketing, and the growers expose their trademarks by printing them on the cardboard boxes. This form of communication acts as both marketing and quality assurance. If growers receive less for their produce, due to the lack of opportunity to expose their trademarks, this will also have negative effects on the wholesaler. In this case, Jörgen Bergstrand estimated the value of his trademark to be SEK 1.75 per kg tomatoes. The wholesaler's mark-up is about 10-15% of the purchase price. In the calculations presented here, the lower value has been used by way of precaution. The excess cost due to a decrease in revenue is thus SEK 1.75 per kg tomatoes.

Wholesaler's mark-up	10%
Value of trademark to the grower /kg	1.75 SEK
Excess cost per kg	**0.175 SEK** (1.75 * 0.10) SEK

Table 26. Specification of the excess cost due to the loss of opportunity to expose trade name

5.2.3 Summary of the consequences for the wholesaler

The total annual excess cost to the wholesaler upon the introduction of the returnable crate system would be about SEK 157,000, which is equivalent to just over SEK 0.45 per kg tomatoes. The greatest part of the cost arises from the increase in transportation cost. Due to the lower degree of filling of the plastic crates, fewer crates can be loaded onto each pallet. The increase in transportation is 44%. Reduced revenue due to the lack of opportunity to expose trademarks also makes a significant contribution to the total excess cost.

Annual volume (kg) 342,000	Excess cost of crate system (SEK / kg)	Total annual excess cost of crate system (SEK)
Cost of purchasing and recycling corrugated cardboard boxes	--	--
Capital tied up in deposit system	0.0030	1,026
Losses	0	0
Fillning	--	--
Transport	0.2456	83,995
Administration	0.0347	11,867
Service charge	--	--
Company name exposure	0.1750	59,850
Total for the producer	**0.4583**	**156,739**

Table 27. Summary of the total excess cost to the wholesaler

5.3 The retailer – OBS! in Burlöv

OBS! in Burlöv, which is one the five largest hypermarkets in Sweden with regard to perishable goods, is a member of KF (*The Swedish Cooperative Wholesale Society*). OBS! in Burlöv represents the retailer in this study. As local variations may arise between retailers, the material has been verified by ICA Maxi (another large supermarket) in Kalmar (SE Sweden). ICA Maxi has also made valuable contributions to discussions on the consequences of various types of transport packaging.

5.3.1 Consequences of introducing the returnable crate system

Administration

The most noticeable consequence for OBS! in Burlöv would be the extra work involved in handling the plastic crates. The deposit system would result in extra work, i.e. checking the crates and counting them at the time of delivery, and sorting, stacking and counting the empty crates prior to collection.

Capital tied up in deposits and loss due to theft

The deposit on the crates will bind capital for the store, with regard to both crates containing produce on display in the store, and empty crates awaiting collection. In order to reduce this capital cost, Ingvar Lindqvist, at OBS! is of the opinion that the crates should only remain in the store for one day. This may, however, be difficult to effectuate.

Previous studies and experience show that the risk of loss due to the theft of crates is greatest at the producer and the retailer. Peter Aro, at ICA Maxi in Kalmar, believes that loss of crates will generate an excess cost for the stores. Many wholesalers and suppliers visit the stores daily, and more or less take care of themselves. Greater resources would thus be required for the store to gain control of the crates. At ICA Maxi there is not sufficient space to store the empty crates indoors. According to Peter Aro, the store would not be able to administer the

system, and costs would be high, either as a result of losses due to theft, or in the form of investments in new storage space or the extension of existing premises.

Figure 18. Tomatoes in the store

Storage

The plastic crates must be sorted according to size, which means that the store must have sufficient space for at least four pallets. In the long run, it is thus probable that handling of large volumes of crates will mean that large stores will encounter problems with storage space and will be forced to extend their premises.

At ICA Maxi i Kalmar, there is, in principle, no space for storing returnable crates. The store already administers a large amount of returnable packaging, e.g. milk crates, beer crates, returnable bottles, pallets and roll-cages. The lack of space is already so acute that bread suppliers must take their empty crates with them when they make deliveries.

Figure 19. The storage area for returnable packaging at ICA Maxi, Kalmar

Trademarks

Information on, for example, origin and quality, is communicated largely via the transport packaging. Furthermore, some information is required by EU legislation on the labelling of fruit and vegetables. Swedish tomatoes often command a higher price than imported ones. Part of this value is communicated via the transport packaging. The opportunity to expose trademarks on cardboard boxes is great, while it would essentially disappear with the introduction of anonymous returnable plastic crates.

Peter Aro, at ICA Maxi i Kalmar, believes that the trademark is important mainly to the consumer, and that stores can charge more for products with a good name. Ingvar Lindqvist at OBS! in Burlöv agrees that it is sometimes possible to charge more for Swedish-grown produce than imported produce. But he also points out that it is difficult to place a value on the trademark, and to estimate the degree to which this is communicated via the packaging.

5.3.2 Cost analysis

The costs of the various consequences for OBS! in Burlöv have been calculated in terms of SEK/kg, and are specified for each item. In Section 5.3.3 a summary is presented of these costs, together with the total annual excess cost resulting from the introduction of the returnable crate system.

Recycling of corrugated cardboard

The store recycles its corrugated transport packaging. This would not be necessary with a returnable crate system. The average cost of the collection of corrugated packaging material is SEK 0.3266 per kg[17], which leads to a cost of SEK 0.0129 per kg tomatoes. The cost of recycling packaging material has thus been deducted from the excess cost of the new system, i.e. it is a negative cost (see Table 37, which gives a summary of the excess costs to the retailer).

[17] KunskapsPartner AB (2000)

Average cost of paper collection/kg	0.3266 SEK
Weight of cardboard box	0.2378 kg
Weight of tomatoes per box	6 kg
Cost per kg	**0.0129 SEK** (0.3266 * 0.2378 kg / 6 kg) SEK

Table 28. Specification of the cost of recycling corrugated board packaging material

Capital tied up in deposits

OBS! in Burlöv will also be affected by an increase in costs due to capital tied up in deposits. Fifteen to twenty pallets of fruit and vegetables are delivered to the hypermarket, 6 days per week, of which, about 100 boxes contain tomatoes. It is reasonable to assume that the boxes remain in the store, on average, 1½ days, including those displaying goods in the store. Assuming a deposit of SEK 40 per crate, the excess cost due to capital tied up in deposits would be SEK 0.0022 per kg tomatoes.

Deposit per crate	40 SEK
Discount rate	8%
Weight of tomatoes per crate	6 kg
Time	1½ d
Excess cost per kg	**0.0022 SEK** (0.08 * 40 * (1.5 / 365 d) / 6 kg) SEK

Table 29. Specification of the excess cost due to capital tied up in deposits

Losses

OBS! in Burlöv has space to store the volume of crates in question indoors, and Ingvar Lindqvist thus says that loss due to theft of crates should be negligible. From experience, however, he knows that it is not realistic to assume 0% loss. Much of the meat and cooked meat produce is today delivered in plastic crates, and the loss associated with these is about 5%.

Placing a deposit on the crates would mean that they would be better controlled, and Ingvar Lindqvist is thus of the opinion that the loss involved would be lower than this 5%. By way of precaution, the level of loss used in the calculations was 2%, the same as that in England, which means that a crate would, on average, be stolen after 1393 trips. The store pays a deposit of SEK 40 on each crate. If the cost of loss is divided equally between the producer and the retailer, the excess cost due to theft would be SEK 0.0024 per kg tomatoes.

Annual turnover of each crate per year	27.86 times
Loss due to theft	2%
No. of trips after which a crate is stolen	1,393 (27.86 / 0.02)
Deposit per crate	40 SEK
Weight of tomatoes per crate	6 kg
Retailer's share of the loss	50%
Excess cost per kg	**0.0024 SEK** (40 / (1.393 trips * 6 kg) * 0.50) SEK

Table 30. Specification of the excess cost due to theft

Administration

The extra work involved in the administration of the returnable plastic crate system carried out by the store includes checking and counting the crates, warehousing, and invoicing of deposits and other charges.

Checking the plastic crates

The returnable crate system generates more work in sorting, stacking and counting the crates. The crates will be available in at least 4 sizes, and prior to collection they must be sorted and stacked on separate pallets.

Each day, about 100 boxes of tomatoes are delivered to OBS! in Burlöv. In previous studies, shop managers at various hypermarkets have estimated that the extra work involved would be at least 5 hours per week, in a store with a flow of 500 returnable plastic crates per day. This is equivalent to about 5 s per crate. With an hourly wage of SEK 150, this would lead to an excess cost of SEK 0.0347 per kg tomatoes.

Time spent on each crate	5 s
Hourly wage	150 SEK
Weight of tomatoes per crate	6 kg
Excess cost per kg	**0.0347 SEK** ((150 / 60 min / 60 s) * 5 s / 6 kg) SEK

Table 31. Specification of the excess cost associated with checking the crates

Warehousing – in and out

If empty crates are collected every day, only one pallet of empty fruit and vegetable crates will be generated daily. Ingvar Lindqvist does not believe that there will be any problem making space for this in the goods arrival area. OBS! in Burlöv would, therefore, not have to make investments in storage space for the empty crates. If, on the other hand, a large proportion of other goods were also to be delivered in plastic crates, such that the volume of crates exceeded 2-3 pallets per day, Ingvar Lindqvist believes that it would not be possible to administer the system with the existing space.

Both ICA Maxi and OBS! in Burlöv would find it difficult to expand. As premises are expensive, any new space created should be used, in the first place, for selling goods, not as storage space. Thus, neither of the stores is interested, at the moment, in considering extra cost due to investments in expanding their premises.

The used corrugated cardboard boxes and the compactors also lay claim to space. Corrugated cardboard is dealt with continuously and, above all, it can be stored outdoors, as can the compactor. Bearing in mind that the store would have to handle both plastic crates and

Excess cost per kg	**0.00 SEK**

Table 32. Specification of warehousing – in and out

cardboard boxes in the future, the handling of a reduced amount of corrugated cardboard would not lead to any excess cost in the returnable crate system.

Invoicing of deposits and other charges

The deposit on the crates is transferred to the next part of the chain upon delivery. Before the crates are collected from the store, they must be checked, counted, sorted and stacked (see Table 32). The cost of the deposit is credited in the next invoice from the wholesaler. The cost of extra work involved in checking invoices from the wholesaler against the internal control system is considered to be negligible.

Excess cost per kg	**0.00 SEK**

Table 33. Specification of the extra cost associated with invoicing for deposits and other charges

The total increase in cost for the retailer due to extra administration involved in the new system will be SEK 0.0347 per kg tomatoes.

Counting crates	0.0347 SEK
Warehousing – in and out	0.00 SEK
Invoicing of depostits and charges	0.00 SEK
Excess cost per kg	**0.0347** SEK (0.0347 + 0.00 + 0.00) SEK

Table 34. Specification of the extra cost associated with administration

Trademark

Based on the value of the trademark to the grower and the wholesaler's mark-up, it is possible to make a conservative estimate of the value of the trademark to the store.

The vegetable department has the higher margins of all departments in the store. The retailer's mark-up has been estimated to be 20% on fruit and vegetables. Tomato grower, Jörgen Bergstrand, estimated the value of his trademark to be SEK 1.75 per kg, which leads to an excess cost to the retailer of SEK 0.385 per kg.

Value of trademark to the grower/kg	1.75 SEK
Wholesaler's mark-up (10%)	0.175 SEK
Retailer's mark-up	20%
Excess cost per kg	**0.3850 kr** (1.75 + 0.175 * 0.20) SEK

Table 35. Specification of the excess cost due to loss of trademark exposure

5.3.3 Summary of the consequences for the retailer

In the calculation of the excess cost to the retailer, OBS! in Burlöv has been used as the case company. In order to obtain the total annual excess cost for a year's production of Bergstrand's tomatoes, we have assumed that the consequences for OBS! in Burlöv represent those of all retailers who purchase Bergstrand's tomatoes. The total annual excess cost to the retailer has thus been calculated based on Bergstrand's total production of 342,000 kg.

The changeover to a returnable crate system would lead to an excess cost to the retailer of just over SEK 0.40 per kg tomatoes. This is equivalent to a total annual cost of SEK 140,000 for the whole harvest of Bergstrand's tomatoes.

The greatest proportion of the retailer's excess cost arises from administration. Today, the store has no routines in place for dealing with returnable crates. The whole organisation is based on many suppliers who basically take care of themselves. With current levels of staffing, there is no scope for the extra work involved in checking, counting, sorting and stacking returnable crates. Considerable investments would also be required for extra storage space to cope with a large volume of crates, which, bearing in mind the value of the crates, and the number of people around, should preferably be lockable.

Representatives for store personnel also warn of the negative ergonomic effects of daily handling of heavy plastic crates. Attritional injuries already constitute a significant problem in the retail trade, and increasing the amount of heavy lifting is not desirable.

Annual volume (kg) 342,000	Excess cost of crate system (SEK / kg)	Total annual excess cost of crate system (SEK)
Cost of purchasing and recycling corrugated cardboard boxes	-0.0129	-4,412
Capital tied up in deposit system	0.0022	752
Losses	0.0024	821
Fillning	---	--
Transport	--	--
Administration	0.0347	11,867
Service charge	--	--
Company name exposure	0.3850	131,670
Total for the retailer	**0.4114**	**140,699**

Table 36. Summary of the costs to the retailer

5.4 Summary of the consequences for the whole supply chain

The results of the study as a whole show that the introduction of a returnable crate system would lead to excess costs for all parts of the supply chain. The total annual excess cost for the producer, wholesaler and retailer would be about SEK 2.70 per kg tomatoes (Table 38).

The producer would initially take the greatest risk by bearing the larger part of the costs. Investments in new machinery and storage space would be necessary to cope with the new system. In order to make a profit in the new system, with new investments, it is reasonable to assume that the producer would have to commit himself to the new system for at least 5 years, i.e. until the machinery has been written off. During this period, his ability to adapt to new opportunities and needs in the market would be severely limited. When the system is in operation, the producer must also tie up capital in the plastic crates, and is also burdened by the service charge made to cover washing, transportation and administration.

As the degree of filling is lower in the crates, the amount of transportation would have to increase by 44% in order to deliver the same amount of tomatoes. The increase in transportation cost affects the wholesaler most severely. Increased transportation on the roads would also have negative effects on the environment.

Excess cost (SEK / kg)	Producer	Wholesaler	Retailer	Total
Cost of purchasing and recycling corrugated cardboard boxes	-0.4333	--	-0.0129	-0.4462
Capital tied up in deposit system	0.0084	0.0030	0.0022	0.0136
Losses	0.0024	0.00	0.0024	0.0048
Fillning	0.0383	--	--	0.0383
Transport	0.0421	0.2456	--	0.2877
Administration	0.0872	0.0347	0.0347	0.1566
Service charge	0.3333	--	--	0.3333
Company name exposure	1.7500	0.1750	0.3850	2.3100
Total for the supply chain	**1.8284**	**0.4583**	**0.4114**	**2.6981**

Table 37. Summary of the excess cost to the whole supply chain

The administration required for the returnable crate system is considerable. All parts of the supply chain would encounter extra work, but the retailer would be most heavily burdened. Routines must be introduced for checking and counting, sorting and stacking the crates. Today, few stores have the capacity for this with their present workforce. Routines for checking the crates, and settlement and invoicing of deposits will also generate extra work. Retailers would also have to control the flow of crates in order to minimise losses due to theft. This would mean investments in new storage space and personnel. Many stores are unable to expand, and thus run the risk of incurring considerable losses due to the theft of crates.

The total excess cost of the returnable crate system for Bergstrand's total production of 342,000 kg tomatoes would be over SEK 900,000 (Table 39). The producer would bear 70% of this cost, and the wholesaler and retailer 15% each.

Total excess cost (SEK) for an Annual volume of 342,000 kg	Producer	Wholesaler	Retailer	Total
Cost of purchasing and recycling corrugated cardboard boxes	-148,189	--	-4,412	-152,600
Capital tied up in deposit system	2,873	1,026	752	4,651
Losses	821	0.00	821	1,642
Fillning	13,099	--	--	13,099
Transport	14,398	83,995	--	98,393
Administration	29,822	11,867	11,867	53,557
Service,charge	113,989	--	--	113,989
Company,name,exposure	598,500	59,850	131,670	790,020
Total,for,the,supply,chain	**625,313**	**156,739**	**140,699**	**922,750**

Table 38. Summary of the excess cost to the whole supply chain

The standard within the sector is 6 kg tomatoes in each crate or box. Growers therefore use specially designed corrugated cardboard boxes that hold exactly 6 kg tomatoes. The plastic crate, which corresponds most closely to the cardboard box, is taller. Due to this, the degree of filling is lower. As the same weight of tomatoes is packed into both containers, it is interesting to calculate the excess cost per crate. The total excess cost per crate for the whole supply chain is just over SEK 16.00, of which the producer would have to bear about SEK 11.00 (Table 40).

	Producer	Wholesaler	Retailer	Total
Excess cost per crate	**10.97**	**2.75**	**2.47**	**16.19**

Table 39. Summary of excess cost per crate of tomatoes

Producers find themselves in a situation of small profit margins and decreasing prices for their goods. Even small increases in cost can have disastrous consequences for many producers, and only a few could bear the excess cost of almost SEK 2.00 per kg or SEK 11 per crate. This indicates that the cost will gradually be passed on to the consumer.

References cited

Bergheim, E. (1997) *Store Handling Systems - The Packaging Implications*, Kesko Oy.

KunskapsPartner AB (2000) *Förstudie av butikers hantering av wellpapp,* Lund (in Swedish)

Lea, R. (1997) *Valg av transportemballasje - transportmessige konsekvenser*, TØI notat 1080/1997, Transportøkonomiskt institutt, Oslo (in Norwegian)

Nilsson, C-H. (1999) *Supply Chain Costing – Analys av transportförpackningar av well och plast I dagligvaruhandeln*, KunskapsPartner AB, Lund (in Swedish)

Returwell AB (1999) *Wellpapp i ett naturligt kretslopp*, Stockholm (in Swedish)

Svenska Retursystem AB (1997) *Sammanfattning för användare*, Stockholm (in Swedish)

Svenska Retursystem AB (1999) *Snart är dom här*, Stockholm (in Swedish)

Svenska Wellpappföreningen, *Det naturliga förpackningsmaterialet,* Jönköping (in Swedish)

Svenska Wellpappföreningen, *Svensk Wellpapp*, Jönköping (in Swedish)

www.sydgront.se (in Swedish)

References not cited

Cox, A. och Hines, P. (1997) *Advanced Supply Management*, Earlsgate Press, Great Britain.

D'Aveni, R. (1995) *Hypercompetitive Rivalries* - Competing in Highly Dynamic Environments, The Free Press, London.

Jönson, G. (1997) *Corrugated board boxes and plastic crates used in the distribution of food - Theoretical prestudy,* Dept of Engineering Logistics, Lund University.

Lindahl, P. och Notsten, J. (1994) *Retursystem inom svensk grönsakshandel? - En utvärdering av de ergonomiska konsekvenserna*, Institutet för produktions- och arbetsplatsutveckling AB, Beckholmen, Stockholm (in Swedish)

Svenska LogistikByrån AB (1997) *Produktionssystem för returemballage - förstudie*, preliminär version, april, Stockholm (in Swedish)

Interviews

Peter Aro, ICA Maxi Stormarknad, Kalmar, 2000-05-08

Jörgen Bergstrand, Bergstrands Handelsträdgård Billeberga, 2000-01-18

Bengt Håkansson, Institutionen för trädgårdsvetenskap Sveriges Lantbruksuniversitet, Alnarp, 2000-05-17

Ingvar Lindqvist, Färskvaruchef OBS! Burlöv, 2000-02-09

Kenneth Månsson, SydGrönt Helsingborg, 2000-01-26

Per Nordmark, Ordförande SydGrönt, 2000-03-18

Tomas Ringström, Marknadschef Svenska Retursystem AB, 2000-01-18

Presentations and discussions

Axel Johnsson Gruppen, 2000-01-20

Bageriförbundet, Stockholm, 2000-02-09

D & D, Malmö, 2000-05-02

Förenade Frukt, Kivik, 2000-05-02

ICA Frukt & Grönt, Helsingborg, 2000-05-25

Lithells Chark, Örebro, 2000-04-05

Saba, Helsingborg, 2000-04-25

SRS och logistikansvariga för de stora svenska grossisterna, Stockholm, 1998-12-16

SydGrönt, Lund, 2000-03-22

TRF (Trädgårdsnäringens Riksförbund), Stockholm, 2000-01-20

Österlens Fruktodlares Ekonomisk Förening, Vitaby, 2000-05-02

Appendix: Calculation of SRS's costs[18]

Capital tied up in deposits

Svenska retursystem AB (SRS) is assumed to have the crate in its possession 2.6 of the 15.6 days taken for the round trip. SRS thus bears a capital cost of 8% * 32 SEK* 2.6 d / (15.6 d * 23.4 times/y) = 0.018 SEK per crate.

On the other hand, the deposit levied during the remaining 13 days provides capital revenue of 8% * (40 SEK - 32 SEK) * 13 d / (15.6 d * 23.4 times/y)= 0.023 SEK per crate.

Due to variations in the demand for crates, SRS must have a reserve stock of empty crates, which will also lead to an increase in capital cost. A reserve stock of 20% of the average demand for crates would lead to a cost of 8% * 32 SEK * 20% / 23.4 times/y = 0.022 SEK per crate.

Also, certain products, especially fruit and vegetables, are strongly dependent on the season, which means that SRS will have to have a reserve stock to cover variations in the season. This is assumed to be 20% of the average demand, which leads to a cost of a further SEK 0.022 per crate.

The amount of SRS's capital tied up will lead to a total cost of (0.018 - 0.027 + 0.022 + 0.022) = 0.039 SEK, i.e. ~0.04 SEK per crate.

Capital cost	0.018 SEK
Capital revenue	0.023 SEK
Reserve stock – demand	0.022 SEK
Reserve stock – seasonal	0.022 SEK
Excess cost per crate	**0.04 SEK**

Table 40. Specification of the costs associated with capital tied up in deposits

Loss

SRS has received a deposit of SEK 40 for each crate that disappears, and must purchase a new crate in order to maintain a constant stock of crates. However, SRS pay only SEK 32 for each crate, which means that they will make a profit as long as the crate is not stolen from them. Assuming a loss of 2% due to theft, SRS would make a profit of about SEK 0.01 per crate (32 - 40) / 1170 = -0.007 SEK).

Capital revenue	0.01 SEK
Excess cost per crate	**- 0.01 SEK**

Table 41. Specification of the cost due to theft

Loss due to wear

We have no information on which to base a calculation of how long a crate would last in this system. A lifetime of 5 years is equivalent to 117 round trips (5 y * 23.4 times/y). Bearing in mind the properties of the material, and the way in which the crates will be used in the field,

[18] Nilsson (1999)

so to speak, a lifetime of over 10 years is unlikely, especially as they have moveable parts. The British supermarket chain, Tesco, quote a lifetime of 5 years with the same rate of turnover as the Swedish system. A Dutch study gave a lifetime of 70 round trips[19]. We have assumed that a plastic crate has a lifetime of 5 years, i.e. 117 round trips.

The cost of waste due to wear is thus SEK 0.27 per crate (32 SEK/crate / 117 round trips), a cost that is borne by Svenska Retursystem AB.

Cost of each crate	32 SEK
Lifetime	5 y
Rate of turnover	23.4 times per y
No. of trips during lifetime	117 (5 y * 23.4 times)
Excess cost per crate	**0.27 SEK(32 SEK/ 117 trips)**

Table 42. Specification of the cost due to wear

Washing

In SfA, the cost of washing is specified as SEK 0.30 per crate and in PfR, SEK 1 per crate. These values include the cost of storing both soiled and clean crates. The cost of washing crates in other countries is SEK 1.50 for Kisten-pool in Austria, 2.01 for Kesko in Finland[20] and 2.00 for Tesco in England. These costs include unloading the crates from the truck, washing and reloading. The cost of transportation to and from the washing plant is treated as a separate item.

The cost of washing constitutes a considerable item, probably the most important, and that which will govern the cost of the system. There is thus reason to study this cost in more detail. The most interesting system for comparison is Tesco's system in England, in which the same crates are used as those intended for use in SRS's system in Sweden. Tesco owns the delivery vans, wholesaler and stores, and has recently sold the crate system they started, and are now purchasing the washing services of Salvesen Logistics. All Salvesen's costs are reported to and paid by Tesco. Table 44 shows the conditions for the two systems.

	Tesco, England	**SRS, Sweden**
Population[1] (1993)	58,080,000	8,727,000
Density of population (per km^2)	237.9	21.2
Normal delivery to each shop (semi-trailers/dag)	9	2-3
Average distance between wholesaler & washing plant	500 metres	Only 1 plant
No. of washing plants	9	2-3
No. of crates washed per year (1998)	130,000,000	prognosis 20,000,000
No.of crates washed at the plant capacity	14,400,000	10, 000,000
Reason for introducing the system	Environmental surcharge on	Financial

[19] Lea (1997)
[20] Bergheim (1997)

	paper, landfilling charge for deposition of paper	
Activities carried out at the plant	Washing of plastic crates, baling of plastic and corru-gated board, roll-cages and repairs	Washing of plastic crates
Cost structure, fixed & variable costs	50% & 50%	?
Average hourly wage for all shifts, including social security contributions	120 SEK	150 SEK
Investments	SEK ~400 million	?
Washing charge, excluding transport	SEK 2.00	?

Table 43. Conditions for returnable crate systems in England and Sweden

It is worth noting that Tesco's system is an internal one, based on their existing wholesale and retail structure. The washing plants are thus located beside the distribution centres. In SRS's system, washing plants will handle crates from several wholesalers, which makes it impossible to locate the washing plant beside the wholesaler. Also, the number of washing plants is considerably less in Sweden, which will mean greater distances from the wholesalers. The density of population in Sweden is less favourable than in England, where the population is concentrated in the SE of the country. In order to be able to compare Sweden and England, Stockholm and Gothenburg should be amalgamated somewhere in the middle of Småland (county in the southern half of Sweden. A reasonable assumption regarding the distance between the wholesaler and the washing plant in Sweden is about 300 km.

The comparison between conditions for a returnable crate system in Sweden and in England shows that the Swedish system will be associated with higher costs than that in England.

Figur 19 . Tesco's crate-washing cost as a function of annual volume

If we assume that the cost of washing crates in Sweden is in parity with that in Tesco's system, this would be purely the cost of washing, excluding the administration cost of about SEK 1.80 per crate. In the initial phase, washing will be considerably more expensive, probably around SEK 3.00 per crate. With a volume of 7.5 million crates per washing plant per year, the cost would be SEK 2.92 per crate.

Washing cost, excluding administration	1.80 – 2.92 SEK
Excess cost per crate	**1.80 – 2.92 SEK**

Table 44. Specification of the washing cost

Transport

A truck can carry 50 pallets, each loaded with 192 empty crates, i.e. 9,600 crates. The corresponding truck can carry 40 tonnes of corrugated board, equivalent to 57,000 box-boards (40,000 / 0.7) i.e. six times the amount of material. IFCO specifies a cost of SEK 0.70 per unit for this transport. The excess cost of transporting plastic crates would thus be 0.70 * 5/6 = SEK 0.58 per unit.

Transportation cost (per crate)	0.70 SEK
Filling proportion	5/6
Excess cost per crate	**0.58 SEK** (0.70 * 5/6) SEK

Table 45. Specification of the cost of transport

Administration

Checking of crates

For SRS, checking the crates means removing the remnants of products and checking that the crates are not damaged. The time required for this has been estimated to be 2-3 seconds per crate. At an hourly wage of SEK 150, this would lead to a cost of SEK 0.10 per crate.

Hourly wage	150 SEK
Time	2-3 s per crate
Excess cost per crate	**0.10 SEK** (150 / 60 min / 60 s * 2 s) SEK

Table 46. Specification of the cost of checking the crates

Warehousing – in and out

SRS will probably experience problems associated with varying capacity over time. Many customers may want their crates washed at SRS initially, but will later introduce their own washing systems. SRS must, therefore have an initial capacity which will later prove to be too high. There must be enough space to store soiled crates and clean crates, and for the washing machinery itself. For the sake of simplicity, let us assume that the cost of storage space is the same as the cost of renting the equivalent space.

Let us assume that the rent is SEK 500 per m^2 per year. It must be possible to lock the premises. The number of empty crates that can be stacked on a Euro pallet is 192 (PfR 4.1). The area of the base of the pallet is 0.96 m^2. A multiplication factor of 2.5 can be assumed, based on deliveries and reserve stock. The cost of storage per day would then be 2.5 * 0. 96 m^2 * 500 / m^2* y / (192 * 365 d/y) = 0.017 per day.

The total time spent by each crate at SRS is assumed to be 2.6 days, distributed evenly between the storage of soiled and clean crates. Excess capacity is deemed to generate an excess cost of 20%, as is seasonal variation. The cost of storing soiled crates would then be 0.017 * 1.3 d * 1.2 * 1.2 = 0.032 SEK per crate. The cost of storing clean crates would be the same.

Cost of storage per day	0.017 SEK
Time	2.6 d
(distributed equally between storage of soiled and clean crates)	
Excess cost for excess capacity	20%
Excess cost for seasonal variation	20%
Excess cost per crate	**0.06 SEK** (0.017 * 2.6 d * 1.2 * 1.2) SEK

Table 47. Specification of the cost of warehousing – in and out

Total administration cost

Checking/counting crates	0.10 kr
Warehousing	0.06 kr
Excess cost per crate	**0.16 SEK** (0.10 + 0.06) SEK

Table 48. Specification of the total cost of administration

Return transportation

The whole of the excess cost of return transportation must, in the long term, be borne by SRS. Based on the assumptions made in this analysis, the excess cost of return transportation will be in the range of SEK 0.66-0.81 per crate. This cost will be passed on to SRS.

Excess cost per crate	**0.66 – 0.81 SEK**

Table 49. Specification of the cost of return transportation

Service charge

SRS intend to exact a service charge per trip. In the short term, during the implementation of the system, this charge may be low, for strategic reasons and in order to suit the conditions on the market, in order to encourage participants to change from corrugated cardboard boxes to plastic crates. In the long term, however, this service charge is intended to cover the complete cost of implementing and running the returnable crate system. As SRS is to make neither profit nor loss, the entire cost borne by SRS must be compensated for by the service charge.

In the systems currently in operation in Europe, the service charge is SEK 4.38 for IFCO, SEK 2.00 for Tesco, and EURO-pool quote a charge of SEK 1.38 + administration. IFCO's administration charge is stated as being SEK 0.23, which would lead to a total service charge for EURO-pool of SEK 1.61 per crate. The geography and infrastructure of Sweden, together with the lower density of population, would lead to a significantly higher service charge than those currently levied in other European countries.

Based on the assumption made in this study, the service charge, including return transportation, for SRS would be in the range SEK 3.49-4.76 per crate. SRS intend, however, to tender charges of SEK 2.00 for washing, SEK 0.50 for administration and SEK 0.50 for transport, i.e. a service charge of SEK 3.00 per crate, including transport.

SRS's costs	Our calculations (SEK/crate)	Tendered costs (SEK/crate)
Capital tied up in deposits	0.04	
Loss due to theft	-0.01	
Waste due to wear	0.27	
Washing	1.80 – 2.92	2.00
Transport	0.58	
Administration	0.16	0.50
Return transport	0.66 – 0.81	0.50
Total cost	**3.49 – 4.76**	**3.00**

Table 50. Summary of the calculated costs associated with the returnable crate system