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Utfärdare:
Sten Lindgren
P-O Knöös

ODETTE SWEDEN

# Final Report

# NAF – More Efficient System for Returnable Packaging in the Automotive Industry

# Pilot Study

### *Introduction*

The project ”NAF – More Efficient System for Returnable Packaging in the Automotive Industry” was initiated within NAF Odette Sweden. The project has been financed by the participating companies together with the Swedish Agency for Economic and Regional Growth (Tillväxtverket).

The project work has been performed by:

Sten Lindgren, Odette Sweden, project leader, +46 8 700 41 20 and sten.lindgren@odette.se

Leif Ohlsson, FKG - Fordonskomponentgruppen, project leader, +46 705 83 43 33 and Leif.ohlsson@fkg.se

P-O Knöös, Schenker Consulting, investigator, +46 70 644 72 65 and poknoos@gmail.com

The following companies have participated in this project:

- Volvo Group
- Autoliv Sverige AB
- Bulten AB
- Gestamp Hardtech AB
- IAC Group AB
- Kongsberg Automotive AB
- Leax Mekaniska AB
- Nitator AB
- Scania CV AB
- DB Schenker AB
- SKF AB
- Volvo Car Corporation

***The participating companies have contributed actively to the project work with various kinds of input, but all calculations, cost estimates, recommendations and proposals are done by the investigator and the project management themselves.***.

The intention is that the participating companies (and others who are interested) as the next step will take their stand regarding the recommendations and proposals of this report when it has been published.

***Summary***

Present Situation

In a return system reusable packaging is circulated between releasers, depots and fillers. The packaging may partly be product-specific special packaging, partly more generally usable pool packaging.

Packaging circulation in the return system is managed by a pool operator. The owner of the pool packaging can be the pool operator or his principal.

In Volvo's return system Volvo Group Logistic Services, a unit within Volvo Group, is pool operator and owner of the pool packaging. The pool is used by AB Volvo and its primary suppliers, to some extent also by secondary suppliers and aftermarket operators. In addition, the pool is used by Volvo Car Corporation and its suppliers and aftermarket operators. In the system is also managed special packaging, owned by other units of Volvo Group and Volvo Car Corporation.

Scania CV AB is principal of Scania's system and owner of the pool packaging, but also special packaging is managed in the system regardless of ownership. The pool is used by Scania CV AB and its primary suppliers, to some extent also by secondary suppliers and aftermarket operators. As pool operator is an external contractor engaged.

The depots in both return systems are driven mostly by an external contractor or by the releaser adjacent to the depot.

Even some of the larger primary suppliers in the automotive industry, such as Autoliv and Thule, have return systems of their own. These companies are typically both pool operators and owners of both pool packaging and special packaging in the system.

A survey indicates that approximately 87% of the Swedish suppliers' plants have to handle 2-6 different return systems, in most cases both Volvo's and Scania's. In Germany, the situation is basically the same, but even more complex because of the number of vehicle manufacturers and accordingly several company-specific pools. However, these are considerably larger than the Swedish pools and more efficient thanks to that. The VW Group pool is the largest company pool. Opel and Ford are using a large general pool (Chep).

With a few exceptions, packaging types in the Swedish automotive industry pools are not technically compatible with each other, even disregarded color and company logotype. The Volvo and Scania pools contain 80-90 different types of packaging each. The largest group, regarding number of types as well as capital tied up, is the wooden packaging. The second largest group consists of smaller plastic boxes of different heights and with footprints in half pallet size or smaller.

In Volkswagen's pool, as well as in the other pools in the German automotive industry, there is no wooden packaging. The mostly used carrier is instead a steel or plastic pallet. In addition mainly plastic boxes (KLT) by the German VDA standard are used.

Not only the packaging types, but also the managing principles and business models differ between the pooling systems, in Sweden as well as in Germany.

Trends

- Increasing use of half size pallets instead of full size pallets
- Changeover to plastic boxes instead of wooden pallet collars
- Increasing number of variants of plastic boxes, especially smaller sizes
- Increasing questioning of wood as a material in returnable packaging, the automotive industry in the rest of Europe uses plastic or steel instead
- Increasing use of disposable packaging when transport distances for empty packaging are long
- Increasing number of types of special packaging, not least in the form of product-specific fixtures in general pool packaging
- Increasing demands for collapsibility
- Increasing demands for adaptation of packaging to current means of transport with respect to footprint and height
- Increasing demands for stackability both filled and empty as well as for bearing higher dynamic loads

Cost-cutting Potential in Pool Integration

The following examples give an idea of the cost-cutting potential in the ***integration of two separate pooling systems into one with common packaging***:

***Transportation*** of empty packaging to fillers as well as to and between depots is a dominant cost item in a return system. Simulation of some realistic subset scenarios indicates a possible reduction of this cost with about ***21 %***. Moreover, transport work and thereby ***environmental impact*** will be reduced with approximately ***38 %***.

Smaller buffers of empty packaging, larger flow volumes with more frequent shipments plus more effective handling of the packaging at fillers and in depots will imply faster circulation and thus reduced capital cost.

If the replacement value of packaging in the Volvo and Scania pools together is assumed to be 225 million €, more ***effective utilization*** through an integration will free approximately 29 % or ***65 million €*** of the capital tied up. This represents an increase in circulation rate only by less than 1 cycle per year. The reduction of invested capital will result in a cost saving of ***over 17 million € per year***.

## *Recommendations*

Integration

Major benefits could be gained by integrating existing pooling systems in the Swedish automotive industry. The integration can be done ***gradually*** in several steps with an ***immediate initiation***:

***Step 1:*** Selection or formation of an independent pool provider

***Step 2:*** Adaptation of the administrative system for integrated management of the present Volvo and Scania return systems with joint depot structure and transport co-ordination, while maintaining the ***current***

- users
- types of packaging and packaging stocks
- ownership of the packaging
- commitments for the administration and handling of special packaging
- depots and operational responsibility for these
- business models

This will bring about the following advantages:

- Denser depot structure resulting in shorter transport distances for empty packaging
- Larger transport volumes through co-ordination of the distribution, resulting in lower transport cost and/or more frequent deliveries
- More effective depot operations by co-ordination of cleaning, repair etc.
- Simplified administration for the fillers through a uniform interface

***Step 3:*** Gradual changeover to common packaging types, starting with

- needs for new types of packaging
- acquisition of new packaging concurrently with scrapping the existing, non-compatible packaging types.

This will further ***strengthen*** the above mentioned benefits in ***addition*** to the ones below:

- More efficient use of packaging by faster circulation and thereby reduced capital tied up
- More effective handling and storage of empty packaging by reduced number of packaging types

The ownership of the common packaging types will preferably be taken over by the pool provider.

***Step 4:*** Integration correspondingly with other existing pools in the automotive industry and possibly also in other sectors (e.g. white goods).

***Step 5:*** Transfer of the responsibility for running the depots to the pool provider with an accompanying optimization of the depot structure.

***Step 6:*** Increased uniformity of the return system through gradual adaptation of

- administrative rules for planning, ordering, reporting, inventory etc.
- business models.

## Business Model

In an integrated pooling system the business model is differentiated with respect to the ownership of the packaging. This is already the case today when it comes to special packaging in both Volvo's and Scania's systems. In an integrated pool also the principles of rental and other fees can be differentiated for different categories of users, such as below:

- ***Transportation*** of empty packaging in distribution and collection is booked and paid for by the pool provider
- The pool provider is responsible for and pays for the operation of the ***depots***
- The pool provider charges the respective packaging owner a transaction fee per unit at the delivery of ***company-specific*** pool packaging to a filler
- At the delivery of ***common*** pool packaging to a filler, the principal in question is charged transaction fees in proportion to the number of filled units delivered over a certain period from the current filler to one of the principal's releasers
- The pool provider charges analogically each principal a daily rental fee per utilized unit of the ***common*** pool packaging in proportion to the principal's flow volume of filled packaging
- Each principal can decide if and, if so, in what ways he will ***charge*** his users the corresponding rental and transaction fees

## Structure

An extended pool also increases the need for a qualified ***strategic*** decision model for the assessment of

- optimal number of depots
- optimal location of depots
- dimensioning of premises and other resources at the depots.

On the ***tactical*** process level methods and tools for dimensioning of buffer sizes per packaging type in each depot are required.

On an ***operational*** level a rapid decision tool is needed for selecting the optimal sourcing depot and shipment size for distribution of empty packaging to a certain filler at a given time.

## Administrative System

Regardless of the number of return systems that a filler has to work with, there is need for improvement in the ***existing*** administrative systems. The needs may concern everything from more effective functionality and better accuracy to a more uniform a user friendly interface. The investigation[1)] previously made within NAF also provides guidelines for the ***requirement specification*** of the pool provider's administrative system.

## Packaging

Regardless of the degree of integration in the return systems the aim should be to reduce the number of types and variants of packaging. This applies both to product-specific special packaging and to general pool packaging.

In cases where it is not possible to use the pool packaging, there are methods to ***rationalize*** the design of ***special packaging***, e.g. through modularization.

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[1)] NAF Odette Sweden (2010): ”Improved Packaging Management in the Automotive Industry”

Especially when the transport distances for empty packaging are long, better decision models are needed for the optimal use of ***disposable packaging*** instead of returnable. Such models do exist, taking into account both economic and environmental factors.

Considering a future integration of the return systems the aim should be a ***gradual changeover of the pool packaging to types that can serve as common*** in such a pool. When it comes to plastic boxes the German VDA standard for KLT boxes can possibly serve as a ***common denominator***. KLT boxes are now also available as collapsible.

Further Investigations

When it comes to going on with various suggestions and recommendations the first step is for the major players to decide on these. If this occurs and if there is enough interest in a continuation, some more detailed analyses are probably needed as suggested below:

- Detailed mapping of ***existing return systems*** that may be relevant for integration as above
- Investigation of the ***conditions and detailed procedures*** for an integration as above
- Study of possible ***common packaging types*** and of the conditions for a changeover to these
- Thorough calculations of the potential ***savings in each step*** specified above
- Risk analysis

Workshop

NAF Odette Sweden will invite representatives of the vehicle manufacturers to a workshop in order to provide opportunities for further discussions as a basis for standpoints within their respective companies.

## *Index*

### *Project Organisation*

Project management:

- Sten Lindgren, Odette Sweden AB, Stockholm
- Leif Ohlsson, FKG - Fordonskomponentgruppen AB, Göteborg

Project team:

- Representatives of the above mentioned participating companies
- Jörgen Ljunggren, Altiro Consulting AB, Marstrand
- Niklas Ward, Schenker Consulting AB, Göteborg

Investigator:

- P-O Knöös, Schenker Consulting AB

In addition to the ones named above, the following persons have contributed with information and viewpoints at project meetings or in interviews:

- Jörg Zachmann — Audi AG, Ingolstadt
- Michael Bösl — Audi AG, Ingolstadt
- Anna Hansson — Autoliv Sverige AB, Vårgårda
- Linda Eriksson — Autoliv Sverige AB, Vårgårda
- Silva Edvardsson — Autoliv Sverige AB, Vårgårda
- Henrik Svennberg — Bulten AB, Hallstahammar
- Patrick Fritzell — Bulten AB, Göteborg
- Jan Heehrle — DB Schenker AB Air & Sea, Göteborg
- Rikard Carlsson — Gestamp Hardtech AB, Luleå
- Patrick Rawlings — IAC Group AB, Göteborg
- Kurt Andersson — Kongsberg Automotive AB, Mullsjö
- Mikael Alm — Leax Falun AB, Falun
- Fredrik Stjernberg — Lots Logistiksystem AB, Göteborg
- Mikael Wickberg — Lots Logistiksystem AB, Göteborg
- Henrik Pålsson — Lunds Tekniska Högskola, Lund
- Esbjörn Ljunggren — Nitator AB, Oskarshamn
- Dieter May — Robert Bosch GmbH, Karlsruhe
- Sandra Gränne — Scania CV AB, Södertälje
- Therese Engberg — Scania CV AB, Södertälje
- Thomas Winkler — SKF Logistic Services, Schweinfurt
- Kent Gustavsson — Smart-Carriers Services BV, Södertälje
- Martin Torpling — Smart-Carriers Services BV, Amsterdam
- Carina Kronqvist — Svenska Retursystem AB, Stockholm
- Gert Hägerström — Svenska Retursystem AB, Stockholm
- Hans Frohlund — Volvo Car Corporation, Göteborg
- Lena Borg — Volvo Group, Göteborg
- Per Dalheim — Volvo Group, Göteborg

### *Aim and Method*

The operational objective is to strengthen the international long-term competitiveness and reduce the environmental impact of the Swedish automotive industry by increasing the efficiency and service level of its packaging systems. This is in the mutual interest of both vehicle manufacturers and suppliers.

The purpose of this pilot study has been, regarding the Swedish automotive industry's return systems, to provide a general conception of

- current status, also in comparison with other return systems in Europe in the automotive industry and in other industries
- development trends, technical and administrative
- incentives to and conditions of improvement, economic as well as ergonomic and environmental
- desirable development to achieve the operational objective
- cost-cutting potential in the identified development opportunities
- possible measures to implement the proposed improvements.

The pilot study was initiated in the autumn of 2012 and the work has been in progress from October 2012 to June 2013.

The work has consisted of the following:

- One or more interviews with each of the above-mentioned persons
- 14 visits to vehicle manufacturers and suppliers, including 3 in Germany
- Attending a logistics conference in Germany
- 6 meetings/workshops with the project team
- Processing and analysis of collected information
- Identification of development needs according to the purpose of the pilot study
- Compilation in the form of a report with recommendations

The return systems included in the study belong to Volvo Group, Scania CV AB, Autoliv Sweden AB, Volkswagen AG, Svenska Retursystem AB, Chep and Electrolux Group.

## *Background*

The word packaging refers in this report to transport packaging for the movement of materials and products between different locations for processing, storage or usage. Systems for such packaging are an important and often strikingly expensive part of all industrial operations, particularly in the automotive industry.

In this industry there is a long tradition of working with reusable packaging (return packaging), mainly for economic reasons. The most usual scenario is that each vehicle manufacturer invests in a stock of returnable packaging of various types. In a system for returnable packaging (return system), the packaging is circulated in a more or less controlled manner between the vehicle manufacturer's assembly plants and suppliers and to the aftermarket operators.

A ***return system*** can be designed with different characteristics from several aspects, such as delimitation, control level and generality. (See Figure 1 below).

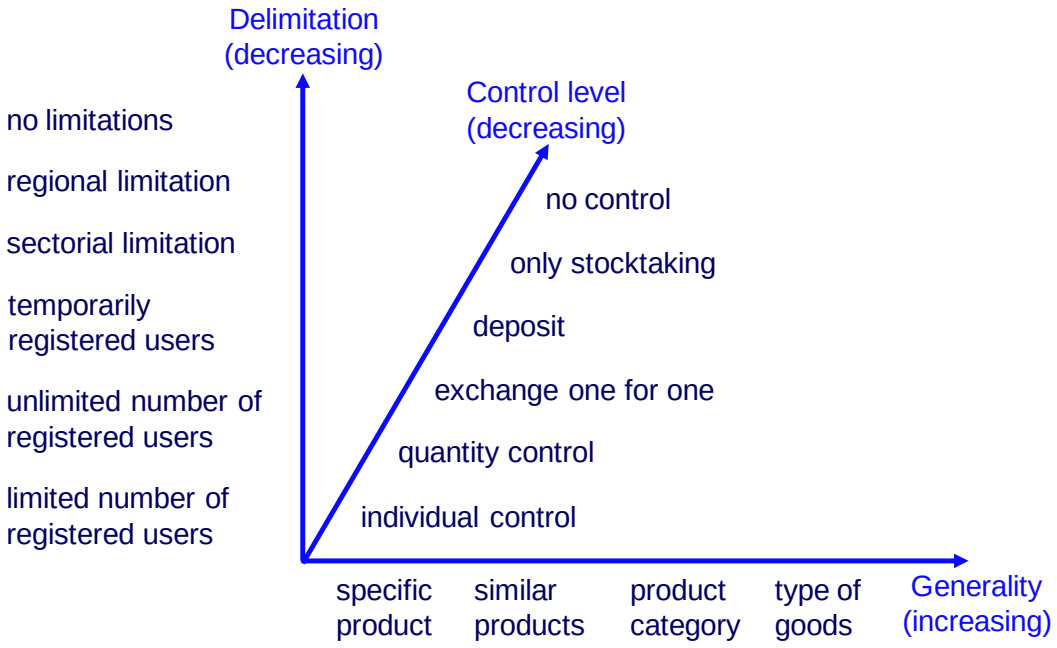



***Figure 1***. *Features of a return system in three dimensions.*

Some of the packaging types in the automotive industry's return systems are designed for a specific product and are named ***special packaging***. (See Figure 2 below). Such packaging circulates mostly in closed flows between the supplier of the product and one or more of the vehicle manufacturer's assembly plants.

***Figure 2**. Examples of special packaging (for engines and body parts respectively).*

In the larger return systems within the automotive industry, however, a greater part of the packaging types are more ***generally designed*** for the product category in question – parts and components for vehicles. (See figure 3 below). Theoretically there is usually no limitation of the number of users, but they have to be registered in the system. ***A return system of this kind is usually called a pooling system*** (return system with a packaging pool). The control level applied in the automotive industry's pooling systems is exclusively ***quantity control***, i.e. the information for control and follow-up contains only the number of units of each packaging type and no individual unit identity. (See Figure 4 below).


***Figure 3**. Examples of general packaging for vehicle components (pool packaging).*

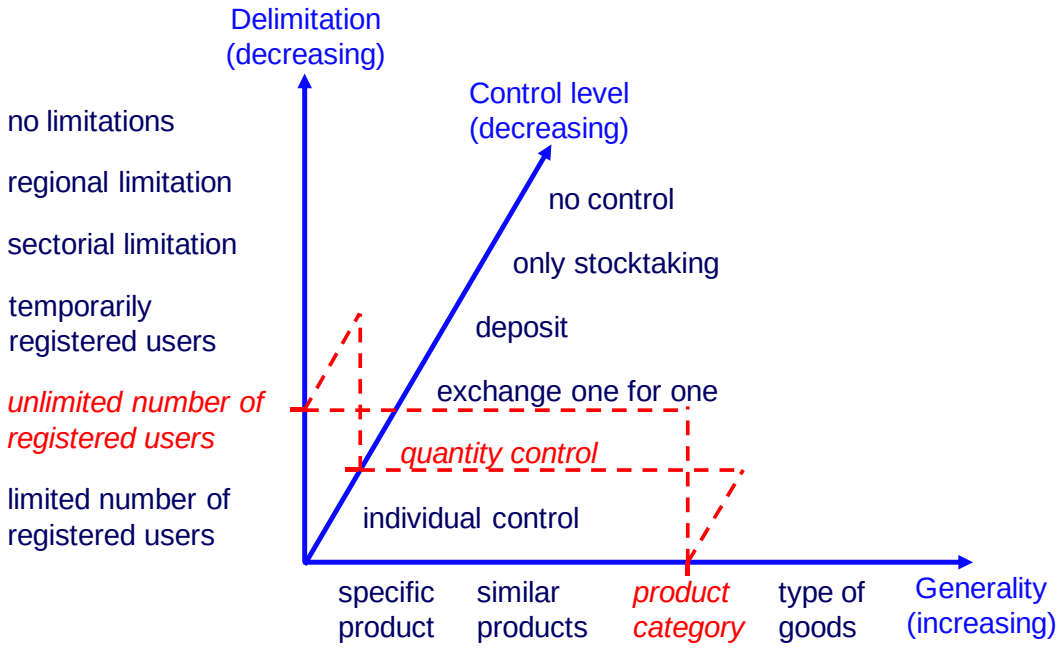



***Figure 4**. Features of pooling systems within the automotive industry.*

Based in Sweden, there are currently only ***two major packaging pools*** in the automotive industry, owned by Volvo Group and Scania CV AB respectively. Volvo's system is also used by Volvo Car Corporation and its suppliers. In addition, several of the larger Swedish suppliers have return systems of their own with more or less general packaging. Also remnants of Saab Automobile's system are still used by Saab Parts.

## *Present Situation*

Structure

In return systems in general, we talk about fillers and releasers of the packaging. In the automotive industry the assembly plant usually is a releaser and the supplier is filler, but the assembly plant can also be filler (to CKD plants and aftermarket) and a primary supplier may also be a releaser (in flows from its secondary suppliers).

In a return system special packaging usually is easier to handle both administratively and physically, as it moves in closed loops. (See Figure 5 below). However, the return transports are for the same reason often long and the packaging utilization low. In addition, special packaging is of technical reasons usually not collapsible and therefore bulky to transport even empty.

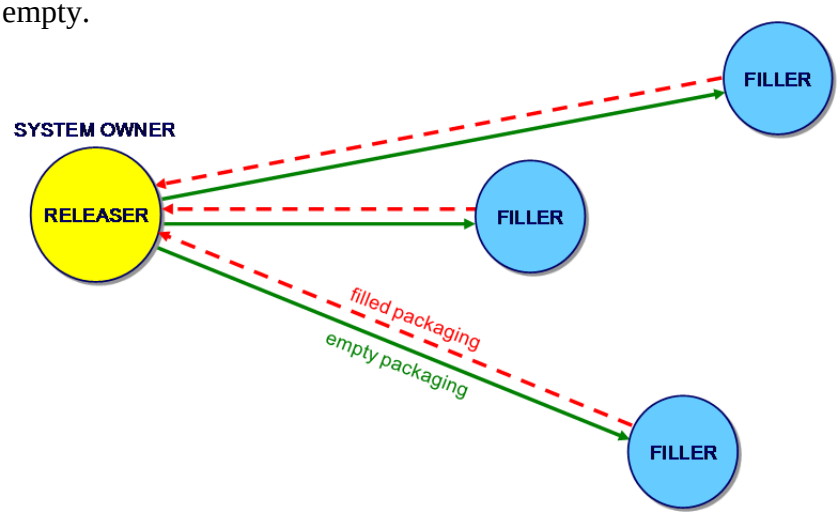



***Figure 5**. Return system for special packaging.*

In a pooling system (return system with a packaging pool) the types of packaging are more general and can therefore be utilized more efficiently through distribution to any filler who has the need at the very moment. With strategically located depots can also transport distances be reduced by distribution from a nearby depot. The depots are of course primarily located to the larger releasers. In other cases, the collection from releaser to depot usually can be performed with rational setups and in large shipments. (See Figure 6 below).

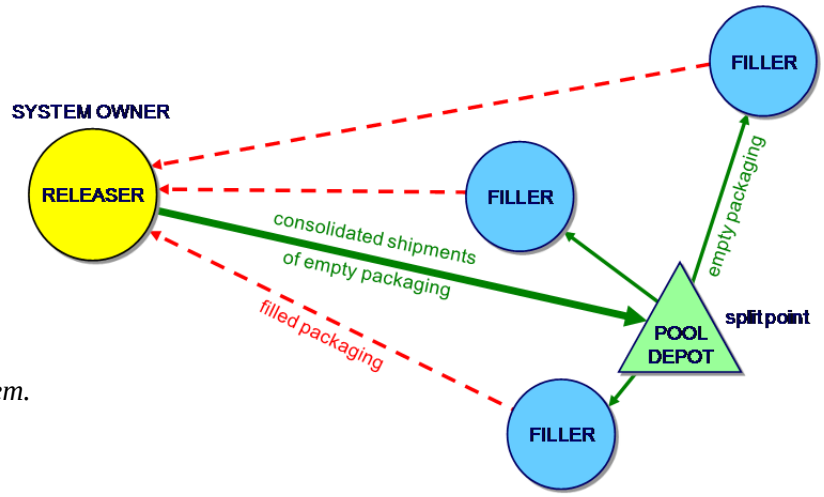



***Figure 6**. Pooling system.*

In addition to the packaging stock itself the ***main components of a pooling system*** are largely as follows:

- IT systems for management and control of the packaging circulation
- Human resources for the operational management of the pool, the control tower
- Transport setups for the allocation and distribution of empty packaging
- Depots and terminals for buffering of empty packaging
- Resources in the depots for sorting, inspection, cleaning, repair, folding and packing of empty packaging
- Resources for the tactical and strategic management of the pool: planning of packaging needs, development and acquisition of packaging, optimization of the depot structure and allocation of packaging, business development, etc.
- Business model for the pool services

As an example, Volvo's system includes in Europe about 15 depots connected with releasers, Scania's system about 5. Volvo's system has also 5 detached depots which receive empty packaging from more than one Volvo plant. In most cases, the depots are run by external contractors.

Volkswagen Group has a great number of releasers spread both within and outside Germany. Each releaser is responsible for the distribution of empty packaging to the fillers within his region. This means relatively short transport distances. This is also one of the reasons why it is not considered so important to use collapsible packaging types, neither in the VW system nor in most of the other systems of German carmakers.

Multiplicity

With a few exceptions, the packaging types in the Swedish automotive industry pools are not technically compatible with each other, even if one disregards color and company logotype. However, not only the packaging but also the other main components listed above are pool-specific, and in many cases they differ between the pools even in principle.

Most Swedish engineering companies who are primary or secondary suppliers in the automotive industry use more than one return system at each of their plants. A survey has been done regarding 30 plants belonging to companies of the type mentioned, members of Odette Sweden and regarded as a representative sample. The survey shows that 87% of the plants have to deal with two or more systems, in some cases including their own. (See Figure 7 below). Both Volvo's and Scania's pools are used at 67% of the plants.

For example in Germany the situation is even more complex. Volkswagen Group, BMW and Daimler are all working in separate pools, while Ford and Opel are using the pool provider Chep (see below under "Other Pooling Systems and Other Sectors"). Also many of the major suppliers have their own systems. The reason is that the vehicle manufacturers normally do not accept that their pool is used by secondary suppliers. Thus the major suppliers in the German automotive industry, such as SKF and Bosch, have to work with 15-20 different pooling systems, including their own. Certainly standard KLT boxes (see below under "Packaging") are widely used, but these are still pool-specific by different color and company logotype. For KLT boxes there are also a couple of independent pool providers plus an open exchange system. Since the latter lacks a responsible operator it apparently does not work so well qualitatively.

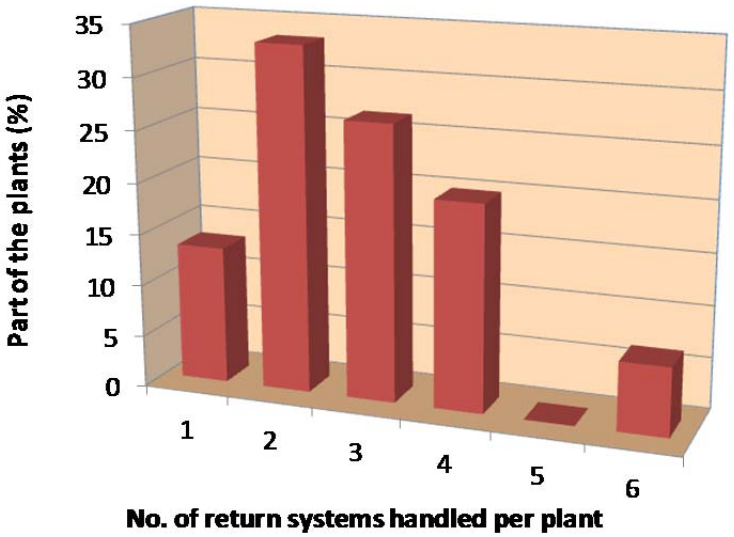



***Figure 7**. Number of pooling systems used by suppliers in the Swedish automotive industry.*

However, the German carmakers' pooling systems are ***significantly larger*** than the Swedish ones, with larger flow volumes and denser structures. This enables them to operate more efficiently with lower return transportation costs and better utilization of the packaging stocks.

Packaging

The Volvo and Scania pools contain 80-90 different types of packaging each. The largest group, both regarding the number of types and the capital tied up, is the ***wooden packaging***: pallets, pallet collars, lids and spacers in half pallet size (about 600x800 mm footprint), full pallet size (ca. 800x1200 mm) and a few larger sizes. (See Figure 8 below). Volvo's wooden packaging originates from the footprint 820x1225 mm, whereas Scania is based on the more general dimensions 800x1200 mm.


***Figure 8**. Examples of packaging types in the Volvo pool.*

The second largest group consists of smaller plastic boxes of different heights and with footprints in half pallet size or smaller. (See Figure 8 above). As for the design both Volvo's and Scania's pools contain a couple of different ranges that are not mutually compatible.

An idea of the size of these pools is given by the following example from Volvo's pool:

- Number of ***pallets*** in the pool approximately 3.5 million
- Number of ***plastic boxes*** in the pool approximately 2.5 million
- Replacement value merely of ***wooden packaging*** in the pool supposed to be at least 140 million €

In Volkswagen's pool, as in most German pools, there is no wooden packaging. The mostly used carrier is instead a steel or plastic pallet with the size of 1000x1200 mm. To some extent both foldable and non-foldable containers with this footprint are used, but mainly KLT boxes (KleinLadungsTräger) by the German VDA standard, i.e. plastic boxes of a couple of different generations and in a number of sizes. (See Figure 9 below). These are not foldable or even nestable. Also Scania's pool contains KLT boxes of a dozen different dimensions.

***Figure 9***. *Examples of KLT-boxes of two generations.*

Management

Often special packaging is managed in the same return system as the pool. One of the advantages of this is that the handling and distribution of the special packaging can be co-ordinated with the pool-packaging.

Volvo's pooling system including the pool packaging is owned and managed by a unit within Volvo Group, Volvo Group Logistics Services (VLS). In Scania's system the pool packaging is owned by Scania CV AB, while the operational management is handled by an external contractor. In both systems, however, the special packaging is in most cases owned by the unit within the company who is the user of the packaging, or in some cases by the supplier who is the filler.

The depots, especially those that are separate from the releasers' plants, are mostly operated by external contractors.

Several of the major primary suppliers, such as Autoliv and Thule, have their own pools, owned and managed by themselves. Lots Logistiksystem AB is the contractor of the web-based administrative system Viatracking, used by both the mentioned companies.

In Volkswagen's system the pool packaging is owned by Volkswagen AG while special packaging is owned by the respective vehicle manufacturer within the group and managed in separate systems.

All users of a pool, fillers as well as releasers, are registered in the pooling system with the types of packaging approved for each user. In the vehicle manufacturers' pools are secondary suppliers usually not accepted as users if they are not contracted directly by the vehicle manufacturer.

The IT systems for management of the pools are usually web-based. Fillers order empty packaging via a web portal. For example, in Volvo's pool the filler has to provide a confirmed requirement forecast monthly and per packaging type. The packaging is then ordered each week and delivered with weekly precision after about two weeks lead time, provided that the order quantity is within the scope of the forecast. In Scania's pooling system only a reasonability assessment of the order size is made. Also in the Volkswagen system the delivery lead time is about 2 weeks.

Delivery quantities of empty packaging can also be limited by the current availability of the ordered type of packaging. Back orders for missing quantities are not registered in Volvo's system. Fillers using both pools are experiencing a higher service level in Scania's system.

Packaging transactions are reported to the IT system at dispatch of filled packaging from the filler and at arrival filled to the releaser. The packaging used for a delivery of products is reported by the filler also on notification and waybill. The releaser reports released packaging as available in the pool. Depots are reporting both incoming and outgoing transactions. Each packaging type inventory is balanced at each user and at the depots. This theoretical balance is reconciled through regular physical stocktaking. In Volvo's system the users do this four times a year. In Scania's system stocktaking has been done only once per year, but an increased frequency is considered. The depots are taking stock every day, at Audi three times a day (every shift).

Business Model

In Scania's return system no fees are charged for the use of pool packaging. The same applies e.g. to Autoliv's system.

In Volvo's system a rental fee is charged per unit of pool packaging for each day at the user, but the first 21 days are free. In addition to the rent a transaction fee is charged for each packaging unit (including special packaging) when dispatched filled from the filler. The fee is paid by the receiving releaser and the rate is dependent upon the latter's distance from the filler. The fee is intended to cover the costs of VLS mainly for the distribution of empty packaging to the filler, particularly the transportation cost.

In Volkswagen's pooling system no transaction fees are charged but, however, a rental fee per day. Only the first two days at the user are free.

### *Trends*

Packaging Size

- Increasing use of half size pallets (600x800 mm) instead of full size pallets (800x1200 mm)
- Changeover to plastic boxes instead of wooden pallet collars
- Increasing number of variants of plastic boxes, especially smaller sizes

The reasons are partly ergonomic, partly an increased tempo in the material flows with more frequent deliveries and smaller buffer sizes.

An increasing number of variants of the final products is resulting in an increasing number of parts at each assembly station and thus less space for each part.

The increasing number of size-variants of packaging stems from an ambition to adapt the packaging size to the needed product quantity in order to utilize the transport volume as efficiently as possible.

Packaging Material

- Increasing questioning of wood as a material in returnable packaging, the automotive industry in the rest of Europe uses plastic or steel instead
- Increasing use of disposable packaging as a substitute for pool packaging

The reasons for questioning wood are mainly ergonomic and environmental. A plastic pallet can be made lighter than a wooden pallet and has an invariable weight (does not absorb moisture). It is certainly more expensive but is expected to have a longer useful life. It can also be recycled more effectively and has a significant residual value.

Increasing demand for cleanliness in the plants is another reason to deviate from wood. Such demands are also reducing the possibilities of using wooden packaging internationally.

The use of disposable packaging increases for reasons of transportation economy when transport distances for empty packaging are long, e.g. to other continents. Difficulties making reporting and recirculation work in certain regions might also have an impact .

Packaging Type

- Increasing number of types of special packaging, not least in the form of product-specific fixtures in general pool packaging

The reasons are partly the ongoing change of the production structure towards larger and more complex components in the flows to the assembly plants, partly an increasing need for sequence packing even of smaller components. In addition, special packaging is sometimes chosen for reasons of transport economy, even if it were technically feasible to use pool packaging.

Transport

- Increasing demands for collapsibility
- Increasing demands for adaptation of packaging dimensions to current means of transport with respect to footprint and height
- Increasing demands for stackability both filled and empty as well as for higher bearing strength also of dynamic loads

The requirements apply to special packaging as well and are based on the growing portion of corporate logistic cost that is due to transportation, not least through the increased transport distances owing to globalization.

### *Other Pooling Systems and Other Industries*

Electrolux – Smart-Carriers Services

The Electrolux Group is one of the world's largest manufacturers of white goods with additional trademarks as Elektro-Helios, Zanussi and AEG. The flow structure between suppliers and assembly plants in the white goods industry is very similar to that in the automotive industry. Electrolux uses a company-specific pool system with

- 26 different types of packaging
- 150 fillers (constantly growing number)
- 16 releasers (assembly plants).

The packaging types are principally

- pallet and lid made of plastic (800x1200 mm)
- FLC (foldable large containers, e.g. 800x1200 and 600x800)
- FSC (foldable small containers, e.g., 400x600)
- Euro Containers (small plastic boxes). (See Figure 10 below).

***Figure 10**. Examples of packaging types in the Electrolux pool.*

The pool is operated as an overall undertaking by an independent pool provider, namely the Amsterdam-based Smart-Carriers Services BV (SCS). This company also owns the packaging and charges Electrolux a rent per year and per unit of the packaging stock. Furthermore a transaction fee is charged at the delivery of empty packaging to a filler.

SCS control tower is planning and ordering the transports of empty packaging to the filler from an optimal source (releaser or depot). Shipments are presently paid by Electrolux but could instead be paid by SCS and covered through the transaction fee.

SCS describes parts of their administrative processes as follows:

> *A user at a filler location places a request for empty packaging via the SCS Portal or an EDI with their ERP system. This request is relayed instantly to the SCS Control Tower were planners have real-time information on stock levels and planned orders.*
>
> *SCS Planners will identify the most cost-optimal sourcing location (depot) based on transport costs and historic availability patterns. Once a location is selected the request is assigned a unique transport order number. The details of this order are sent via EDI*

*to the transport service provider responsible for that lane. Confirmed collection dates/time-slots and truck references are then sent back to the SCS Portal.*

*The sourcing location will receive a "Picking Request" related to the approved transport order. The request will also indicate the date (and slot-time) the transport service provider has confirmed. Once the order is collected the transport order status will change to "In Shipment"; updating local stock levels accordingly.*

*Once the empty packaging is delivered, the receiver will indicate receipt via the SCS Portal; local stock levels will be updated accordingly. It is then up to the filling location to create an order for the delivery of components. This is done in the SCS Portal (or through a DSDSV) where packaging type, quantity, and delivery location are selected (DSDSV-communicated). Once the order is shipped out, local stock levels will be updated.*

*Packaging emptied during production is transferred to an "empty packaging compound" or other storage. Stock levels for available (empty) packaging can be updated via the SCS Portal stock module.*

*The SCS Control Tower uses the following data to plan a transport:*

- *Route Distance*
- *Agreed Lanes*
- *Transport Cost*
- *Current Stock Availability*
- *Forecasted Availability*
- *Other (plant closures, etc.)*

*SCS records data to generate the following reports:*

- *Internal Cycle Time*
- *Quantity Shipped (per x period)*
- *Average Stock*
- *Damage Rate*
- *Loss Rate*

SCS can also manage user-owned packaging in a pool, and they are prepared to meet requests for different and differentiated business models and other administrative functions and packaging types.

Retail sector for food – Svenska Retursystem

Svenska Retursystem AB (SRS) was established in 1997and is owned by the Food Suppliers' Association and Swedish Retailers' Association with 50 % each. SRS has developed into a major player with about 1 000 retail suppliers as customers in 14 countries in Europe. The main focus is on the retail sector for food and other everyday commodities.

The turnover of 53 million € (2012) is to 13 % outside Sweden. Their pooling system used by producers, wholesalers and retailers in most of the industry's flows to and within Sweden.

SRS has about 125 employees, headquarter in Stockholm, storage depots and four cleaning plants of their own. The packaging in the pool is owned by SRS and consists of full and half size plastic pallets and six types of plastic boxes with different footprint and height. (See Figure 11 below).

***Figure 11***. *Examples of packaging types in the SRS pool.*

The packaging is mostly circulating from depot to filler (producer) and from there via wholesaler to releaser (retailer). The released packaging is taken back by the wholesaler, from which SRS collects it for quality control and cleaning.

For boxes and half pallets a deposit system is used, where the pledge is invoiced further in the circulation to wholesaler and releaser and then credited on the way back. A transaction fee is charged for delivery of empty packaging to filler.

For the full size pallet a so-called balance system is used with transaction fee and daily rental fee. This business model will probably be applied to the other packaging types as well in the future. Transaction fee is paid upon ordering empty pallets and upon receipt of pallets loaded with goods from a user of the system. Rental fee is paid per pallet per day by each user. Inventory has to be taken at the request STS. Missing quantity is to be compensated with the replacement value. In this system over 5 million pallet transactions are made annually.

Ordering and reporting of transactions are made via the SRS web portal. The lead time for delivery and collection of empty packaging is 1-2 business days. The service level of the pool is 99.8 %.

SRS is not unfamiliar with undertaking a role as pool provider also within the automotive industry, managing other business models and packaging types.

Chep

Chep was founded in 1945 in Australia. It is a global pool operator with over 7 000 employees in more than 50 countries and a turnover of USD 4.8 billion. They also have automotive industry customers (in Germany e.g. Ford and Opel). Pallets of various kinds, constituting by far the largest part of their packaging stock, number 238 million in all.

Chep runs a general open pool. The packaging range is quite wide, including both wooden and plastic pallets in the formats 800x1200 and 1000x1200 mm, foldable containers and foldable smaller plastic boxes in various sizes. (See Figure 12 below). The packaging range is determined by Chep and cannot be customized by users. Nor any user-owned packaging types can be managed in the system.


***Figure 12***. *Examples of packaging types in the Chep pool.*

Sea Containers

As regards the general ISO standard sea containers (shipping containers, freight containers) there is no general pooling system, only a number of local and global leasing companies. The larger ones (e.g. CTX, Triton) have a network of depots and can offer various forms of leasing (e.g. long-term, one-way trip) of both new and used containers. The mostly used practice is, however, that a shipping company owns the container and lets the shipper have it at his disposal rental free for e.g. 10 days at each end of the sea transport.

Each sea container has a unique identity, marked with RFID technology. Regardless of ownership system, a container can be tracked via a number of different tracking portals. Lately, also the possibility to locate and track the container via satellite has become more widespread.

## *Development Areas*

Integration

Volvo Group, Volvo Car Corporation and Scania CV AB have together several plants (releasers) spread over the country and the rest of Europe, not to mention a large number of ***joint suppliers***, both in Sweden and abroad. As stated above, 67% of the suppliers in the Swedish automotive industry use both Volvo's and Scania's pooling systems. Many of them also use one of the Swedish primary suppliers' systems. These factors together suggest that significant benefits could be gained by integrating the existing pool systems in the Swedish automotive industry. (See Figure 13 below).

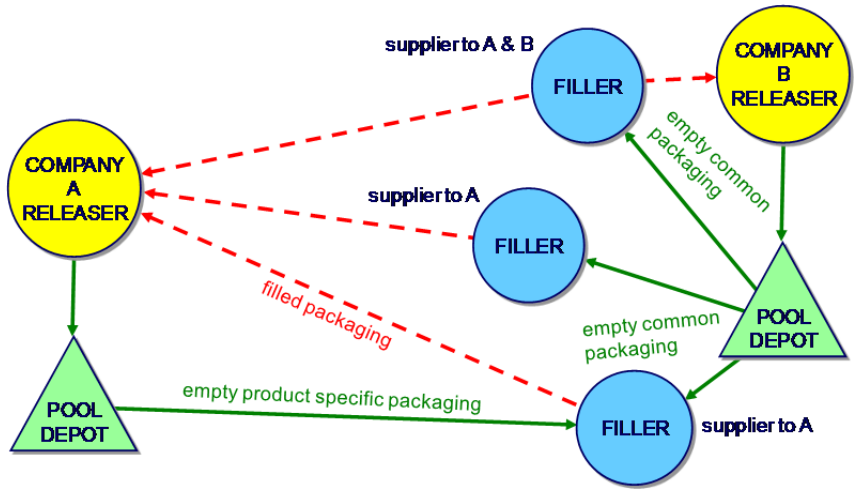



***Figure 13**. The principle of an integrated pool.*

Such an integration can be done ***gradually*** in several steps. If only the ***depots*** and the ***administrative system*** becomes common, and the transports by that can be coordinated for distribution of all types of packaging, the following advantages will be obtained:

- Denser depot structure generally entails shorter transport distances when distributing empty packaging from the depots and when allocating empty packaging from releasers to depots
- Larger transport volumes by co-ordinating distribution to joint fillers can be used to get lower freight cost and/or more frequent deliveries
- Joint distribution transports to several fillers in a region also enable the organization of so-called milk rounds, thereby further reducing transport costs
- More efficient depot operations by utilizing joint resources, e.g. for cleaning and repair
- For all the fillers that were previously using more than one of the return systems now integrated, their administrative work will be simplified thanks to a uniform interface to the pool administrator, at best even with uniform rules for planning, inspection, inventory etc.

With an increasing share of ***common packaging types*** in the integrated pool, the aforementioned advantages will be further ***strengthened*** and the following will be ***added***:

- More efficient use of packaging by more frequent deliveries and smaller buffers of empty packaging, resulting in faster circulation and thus reduced capital cost

- More efficient handling and storage of empty packaging plus reduced risk of mistakes at the fillers and at the depots owing to fewer packaging types

The administration of such a joint pooling system could usefully be transferred to an external pool provider, e.g. Smart-Carriers Services or Svenska Retursystem. Also the ownership of the common packaging types could be taken over by such a contractor.

Business Models Generally

In addition to ownership aspects, the most important parts of the business model in a return system are the principles of ***cost distribution*** among the system's principals, packaging owners, users and operators. The means in this matter consist of rental fees and other fees of various kinds. Two or more of the variants of each type of charge, as well as various rules and amounts, can be applied in a single return system ***differentiated*** with respect to user. The same applies to the different options for handling the costs.

***Transaction fees*** may occur, for example, in the following variants:

- No fee is charged (e.g. VW, Scania, Autoliv)
- Fee per unit is charged the filler on delivery of empty packaging (e.g. SCS-Electrolux, SRS)
- Fee per unit is charged the receiver on reception of filled packaging (e.g. Volvo, SRS), in Volvo's system the amount is distance dependent, in the SRS system quantity dependent
- Fee per unit is charged the releaser per unit when the packaging is released, or when it is collected by the pool operator

***Rental fees*** may occur, for example, in the following variants:

- No rent is charged (e.g. Scania, Autoliv)
- Rent per unit and per day is charged the filler after a certain number of rent-free days, unless the filler is the owner of the packaging (e.g. Volvo with 21 rent-free days, VW with 2, SRS with 0)
- Rent is charged the releaser similarly, unless the releaser is the owner of the packaging (e.g. Volvo, VW)
- Rent per unit and per year for the average total packaging quantity in the pool is charged the principal of the pool, unless the principal is the owner of the packaging (e.g. SCS-Electrolux)

***Transport costs*** for distribution and collection of empty containers can be handled according to the following options:

- All freight is paid for by the principal and possibly further allocated to users through transaction fees or otherwise (e.g. SCS-Electrolux)
- All freight is paid for by the pool provider for further allocation to users through transaction fees (e.g. Volvo, SRS)
- Freight at distribution is paid for by the ordering filler
- Freight at collection is paid for by ordering releaser

***Depot costs*** can be handled according to the following options:

- The cost of a connected depot is defrayed by the releaser through own premises and operations

- The depot is operated by an external contractor at the expense of the pool provider or the principal, who may further allocate the cost to users through transaction fees

Business Model in an Integrated System

An integrated return system may have the following characteristics:

- The principals are Volvo Group, Volvo Car Corporation, Scania CV AB and one or more primary suppliers
- Pool operator is an independent pool provider, such as SCS or SRS
- Owners of company-specific pool packaging are the respective principals, for example Volvo's pool packaging is owned by VLS as today
- The owner of the common stock of pool packaging is the pool provider

In such an integrated pooling system the business model can be differentiated with respect to the ownership of the packaging. This is the state of things already today regarding the special packaging in both Volvo's and Scania's return systems.

In an integrated pool also the ***principles of rental and other fees can be differentiated*** for different categories of users, such as below:

- ***Transportation*** of empty packaging in distribution and collection is booked and paid for by the pool provider
- The pool provider is responsible for and pays for the operation of the ***depots***
- The pool provider charges the respective packaging owners a transaction fee per unit at the delivery of ***company-specific*** pool packaging to a filler
- At the delivery of ***common*** pool packaging to a filler, the principal in question is charged transaction fees in proportion to the number of filled units delivered over a certain period from the current filler to one of the principal's releasers
- The pool provider charges analogically each principal a daily rental fee per utilized unit of the ***common*** pool packaging in proportion to the principal's flow volume of filled packaging
- Each principal can decide if and, if so, in what ways he will ***charge*** his users the corresponding rental and transaction fees

Structure

An extended pool also increases the need for qualified ***strategic*** decision models for the assessment of

- optimal number of depots
- optimal location of depots
- dimensioning of premises and other resources at the depots.

On the ***tactical*** process level methods and tools for dimensioning buffer sizes per packaging type in each depot are required.

On an ***operational*** level a rapid decision tool is needed for selecting the optimal sourcing depot and shipment size for distribution of empty packaging to a certain filler at a given time. (See Figure 14 below).

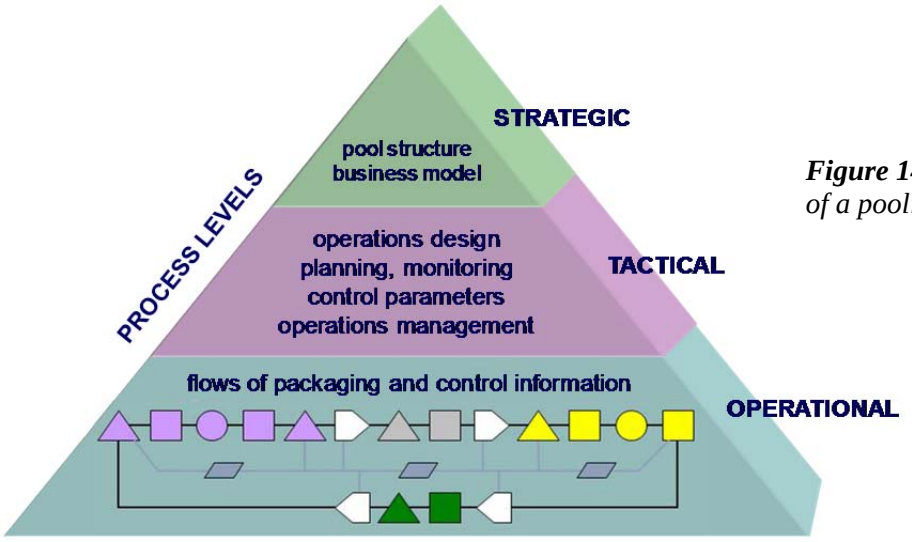



***Figure 14**. Process levels of a pooling system*

Administration at Fillers

Regardless of the number of return systems that a filler has to work with, there is need for improvement in the ***existing*** administrative systems. The needs may concern everything from more effective functionality and better accuracy to a more uniform and user friendly interface. The recommended requirements are described in a NAF report from 2010 named "Improved Packaging Management in the Automotive Industry". This report will also provide guidelines for the ***requirement specification*** of the engaged pool provider's administrative system.

Packaging

Regardless of the degree of integration in the return systems the aim should be to reduce the number of types and variants of packaging. This applies both to product-specific special packaging and to general pool packaging.

In cases where it is not possible to use the pool packaging, there are methods to ***rationalize*** the design of ***special packaging***, e.g. through modularization. At MAN Truck & Bus AG is for example a module system developed for construction and adaptation of special packaging. (See Figure 15 below).

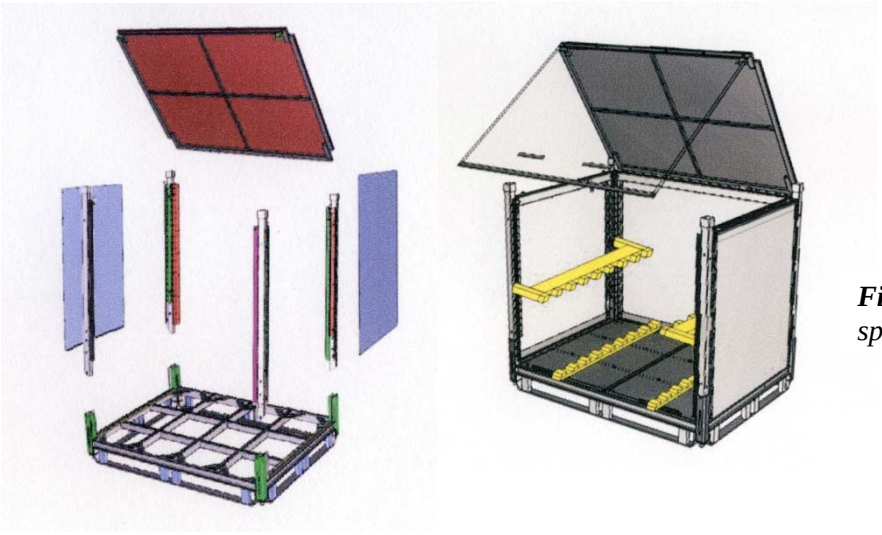


***Figure 15**. Module system for special packaging at MAN.*

One area that requires even greater attention is the establishment of decision models regarding the use of ***disposable packaging*** instead of returnable. Especially when the transport distances for empty packaging are long, disposable packaging may be the optimal alternative. Such a model has for example been developed by Henrik Pålsson and others at the Department of Design Sciences at Lund University. This model takes into account both the economic and environmental factors regarding packaging manufacturing, filling, emptying, volume utilization, transport filled and empty, handling, storage, management in the packaging system and disposal.

An argument frequently expressed against disposable packaging is that it must be repacked on arrival at the releaser to fit into the subsequent internal handling and storage. In most cases this should not be necessary. At Audi in Ingolstadt, for example, incoming products in disposable packaging are repacked only in exceptional cases. Bosch uses a disposable packaging in corrugated cardboard that is adapted to the German VDA standard for KLT boxes. Even the base of it is designed as on a KLT-box, notched to lock when stacked. (See Figure 16 below).

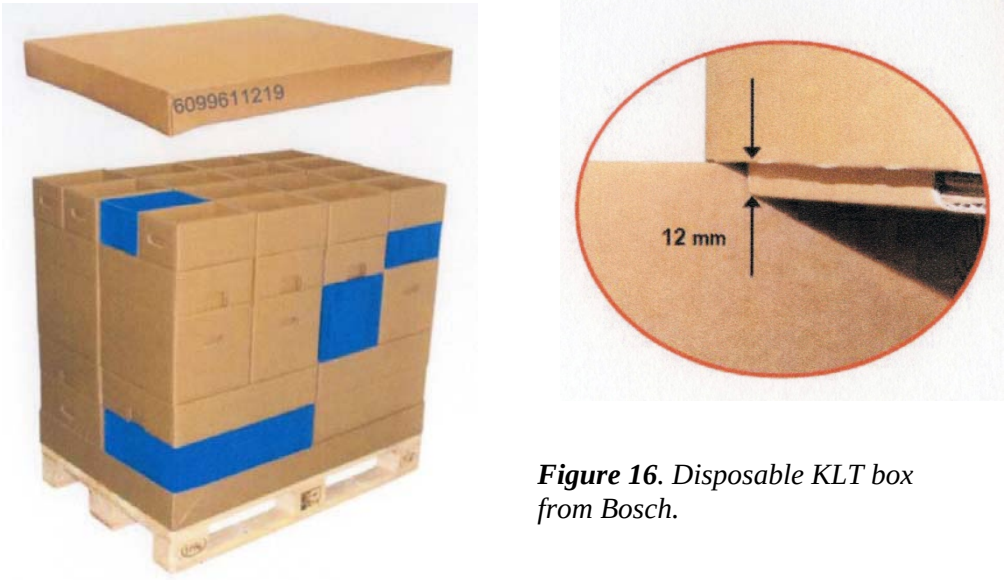



***Figure 16***. *Disposable KLT box from Bosch.*

Considering a future integration of the return systems the aim should be a ***gradual changeover of the pool packaging to types that can serve as common*** in such a pool. When it comes to plastic boxes the German VDA standard for KLT boxes can possibly serve as a ***common denominator***. KLT boxes are now also available as collapsible. (See Figure 17 below).

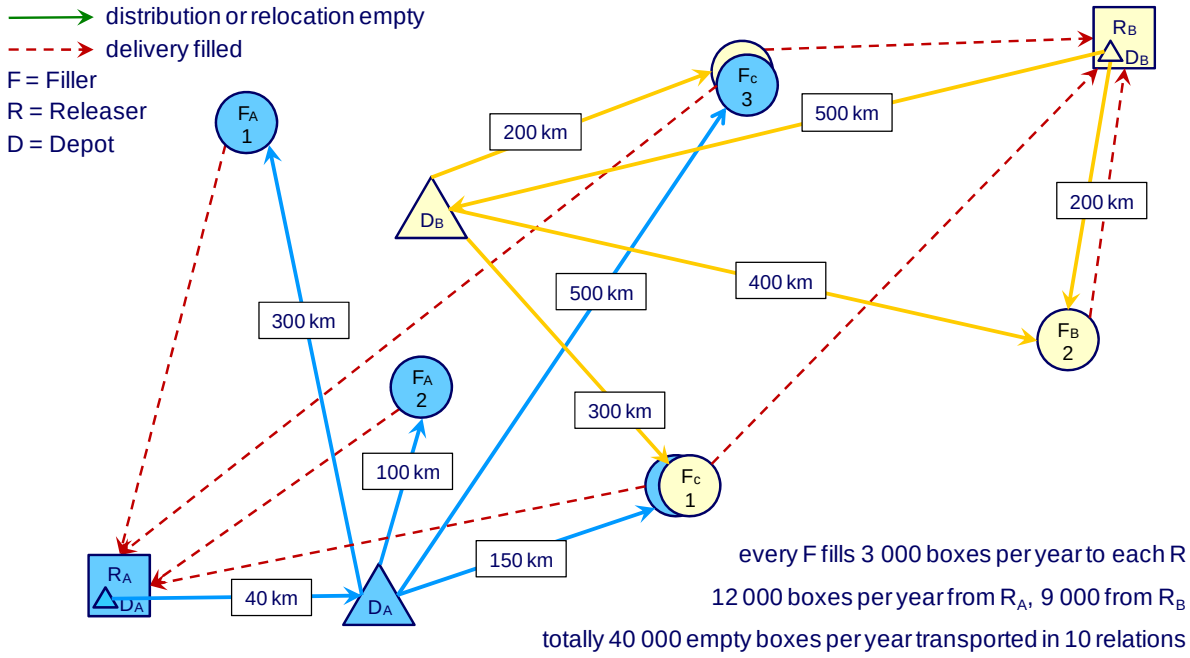
***Figure 17***. *Example of a foldable KLT box.*

## *Cost-cutting Potential in Pool Integration*

Effects on Return Transports

To get an idea of the potential savings in the transport of empty packaging from an integration of two pool systems, two scenarios have been simulated. The scenarios represent realistic parts of a pool system in the Swedish automotive industry.

- Scenario 1: Structure with two separate systems (blue and yellow), each with one releaser, 2 depots and 4 and 3 fillers respectively. Two of the fillers are common to both the releasers. (See Figure 18 below).

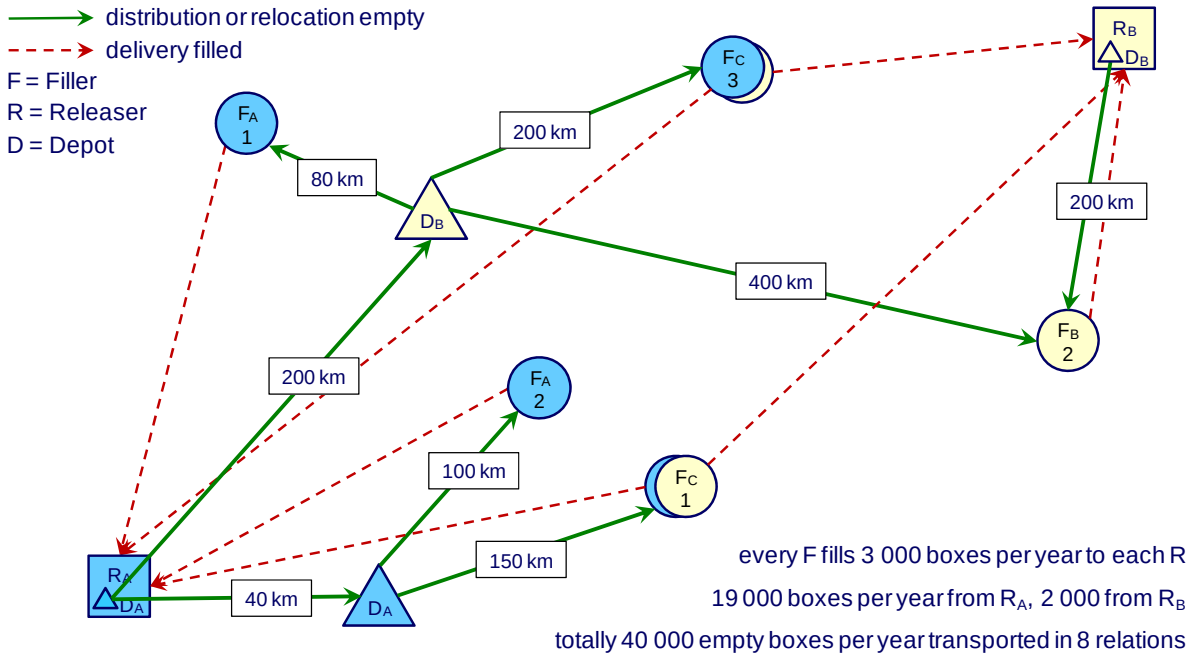



Number of empty boxes per year (blue or yellow packaging system)

| from \ to | $D_A$ | $F_A$ 1 | $F_A$ 2 | $F_C$ 3 | $D_B$ | $F_C$ 1 | $F_B$ 2 | Total |
|---|---|---|---|---|---|---|---|---|
| $R_A$ / $D_A$ | 12 000 | | | | | | | **12 000** |
| $D_A$ | | 3 000 | 3 000 | 3 000 | | 3 000 | | **12 000** |
| $R_B$ / $D_B$ | | | | | 7 000 | | 2 000 | **9 000** |
| $D_B$ | | | | 3 000 | | 3 000 | 1 000 | **7 000** |
| **Total** | **12 000** | **3 000** | **3 000** | **6 000** | **7 000** | **6 000** | **3 000** | **40 000** |

***Figure 18**. Scenario 1 with two separate pooling systems.*

- Scenario 2: The same structure but with one common system, common packaging and jointly used depots. The flow volumes to the fillers and the distances are unchanged from Scenario 1. Empty packaging is distributed from the nearest depot. (See Figure 19 below).




Number of empty boxes per year (green packaging system)

| from \ to | $D_A$ | $F_A$ 1 | $F_A$ 2 | $F_C$ 3 | $D_B$ | $F_C$ 1 | $F_B$ 2 | Total |
|---|---|---|---|---|---|---|---|---|
| $R_A$ / $D_A$ | 9 000 | | | | 10 000 | | | **19 000** |
| $D_A$ | | | 3 000 | | | 6 000 | | **9 000** |
| $R_B$ / $D_B$ | | | | | | | 2 000 | **2 000** |
| $D_B$ | | 3 000 | | 6 000 | | | 1 000 | **10 000** |
| **Total** | **9 000** | **3 000** | **3 000** | **6 000** | **10 000** | **6 000** | **3 000** | **40 000** |

***Figure 19**. Scenario 2 with one joint pooling system.*

In the calculations the following parameter values are used:

- As an example has been chosen Volvo's plastic box 400x300x200 mm with a lid
- Number of empty boxes in the unit load for return shipment: 80 (strapped on a pallet with a lid)

- Unit load volume: 2.4 $m^3$
- Unit load weight: 160 kg
- Unit load value: 8 000 SEK
- Useful life of packaging: 20 cycles
- Capital cost factor: 10 % per year
- Minimum tax weight per $m^3$ for freight calculation: 280 kg (normal value in Sweden)
- Resulting tax weight per unit load: 672 kg
- Number of unit loads on full truck with trailer (FTL): 48
- Realistic freight tariff for shipper with large flows

The calculations have been carried out both for FTL shipments on all relations and for optimized shipment sizes, where the freight cost has been weighed against the capital cost of the packaging during the build-up of the shipment.

Integration of the two pooling systems is in this case resulting in the following:

- Freight costs are reduced by 20 % with optimized shipment sizes and by 21% with FTL shipments
- The transport work in ton kilometers decreases by 38 %

If the simulation is carried out with 10 times larger flow volumes, the result is as follows:

- ***Freight costs are reduced by 21%*** with both optimized shipment sizes and FTL shipments
- The transport work in ton kilometers decreases by 38%
- Accordingly also the ***environmental impact***, such as $CO_2$ emissions, ***decreases by 38%***

Corresponding simulations have also been made for

- structures with consistently longer transport distances (simulating flows to/from the rest of Europe)
- structures without joint fillers
- minimum tax weight 333 kg/$m^3$ (normal value in the rest of Europe)
- packaging with triple the volume weight (equivalent to wooden packing)
- packaging with 25 % less volume value (equivalent to wooden packaging).

In all cases, the result has remained about the same as above.

Effects on Packaging Utilization

If two company-specific pools are integrated into one with common packing, the number of packaging types will be about halved. According to an established logistical axiom, the total buffer of empty packaging could then be reduced by a factor 1 divided by $\oplus 2$ . This would reduce the packaging stock by over 29 %. In practice, also an increased delivery frequency, shorter transport distances and more efficient depot handling would contribute to this.

As a quantified example the following rough estimate can be made:

- If the replacement value of packaging in the Volvo and Scania pools together is assumed to be 225 million €, more effective utilization through an integration will free approximately 29 % or ***65 million €*** of the capital tied up. This represents an increase in circulation rate only by less than 1 cycle per year. With a capital cost factor of 10 % per year and with 6 years useful life of packaging, the reduction of invested capital will result in a cost saving of ***over 17 million € per year***.

Effects on Internal Costs at Fillers

A changeover from two or more different return systems into a single one with a dominant share of common types of packaging will undoubtedly cause saving opportunities internally at the fillers, primarily through

- reduced operator time (simpler routines, only one interface for ordering and reporting)
- lower risk of mistakes in administration and handling (simpler routines, fewer opportunities to mix-up packaging types)
- reduced need for space in storage of empty packaging (fewer packaging types).

The size of this cost-cutting potential needs to be further investigated, which has been beyond the scope of this study.

Effects on Packaging

With an increase of the number of common packing types in an integrated pool, also the resources will augment for technical development of various types of packaging, as well as for development of methods and tools for handling, cleaning and repair of the packaging. The larger volumes may also provide some benefits in connection with purchase of packaging.