THE EFFICIENT UNIT LOADS REPORT

ECR Europe
Efficient Consumer Response

A.T. KEARNEY
An EDS Company

ACKNOWLEDGEMENTS

The Efficient Unit Loads project began late in 1995. Its objective was to promote harmonisation and integration of transport and storage items, regarded as a key contributor to the overall efficiency of the consumer driven supply process. On behalf of the ECR Europe Board, we would like to thank all those listed below. They gave freely of their time and their expertise has helped make this project a success.

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We would also like to give special thanks to Katrin Recke from AIM who provided valuable support and assistance at any time.

Ray Allcock TESCO
Robert Verhulst PROCTER & GAMBLE
Co-Chairmen of the ECR Europe Efficient Unit Loads project.

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EXECUTIVE SUMMARY

Efficient Unit Loads are absolutely key in improving transport, storage and handling efficiency across the total supply chain.

Unit loads play a key role across the supply chain, grouping primary and transport products to facilitate transport and handling.

Used by manufacturers, retailers and service providers, unit loads are key cost drivers. They impact on transport, storage, handling and packaging, which together, represent 12-15% of retail sales price. Developing more Efficient Unit Loads is critical to the success of ECR and is estimated to save 1.2% of retail sales price.

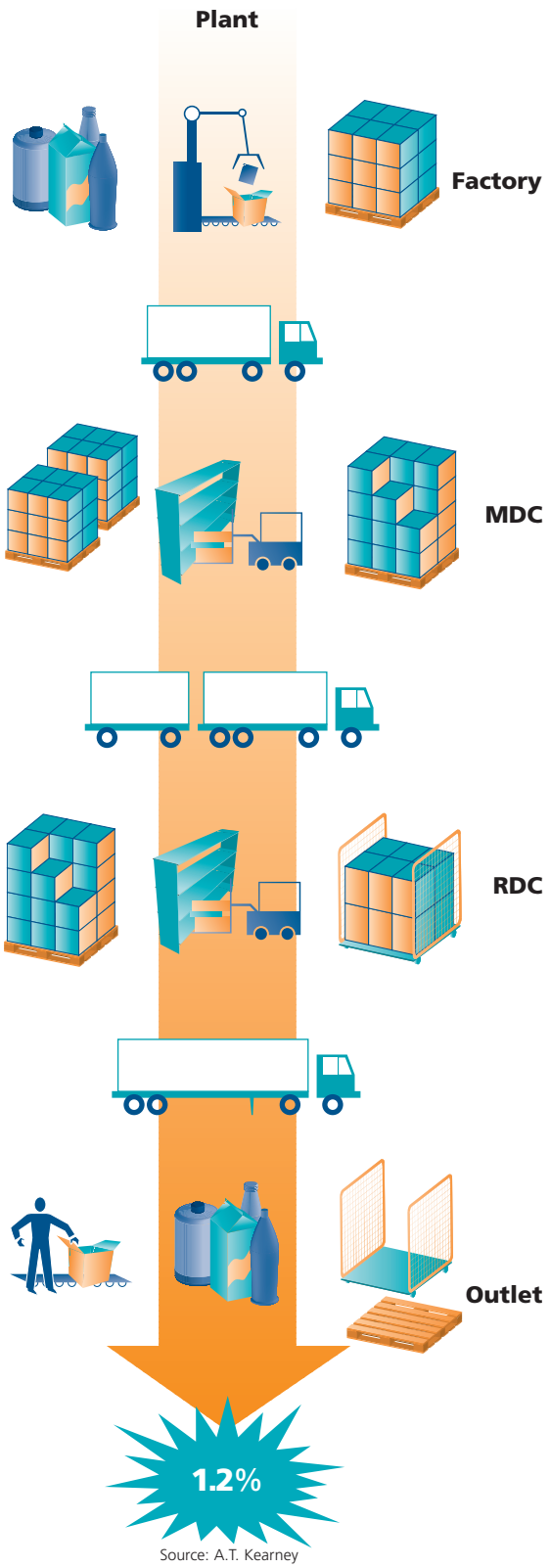
- Efficient Unit Loads impact 12-15% of retail sales price. Savings opportunities represent 1.2% of retail sales price.

The Efficient Unit Loads (EUL) project is one of three ECR Europe supply side projects, whose ultimate objective is supply chain integration. This can only be achieved by harmonising physical aspects of the supply chain.

- EUL Mission: To improve the efficiency and effectiveness of current and future supply chains by promoting harmonisation and integration of transport and storage items.

The traditional approach to supply chain management has been for each player to optimise his part, often to the detriment of 'total' chain efficiency. Thus, manufacturers have typically used pallets to optimise space utilisation and retailers have improved handling productivity by using roll cages. This disjointed approach has resulted in unnecessary, non-value added handling, where loads are often reassembled more than 10 times, at different stages in the supply chain.

- "The challenge is to break the half chain view, where each participant focuses on his part rather than on a total optimum."
  H. L. Henner Klein, A.T. Kearney, Geneva 1996



Source: A.T. Kearney

Strictly modular dimensions

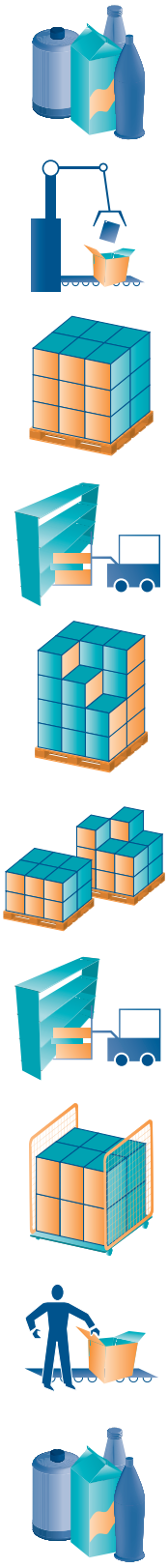
1200 x 800
800 x 600
600 x 400
400 x 300
300 x 200
+
Additional "shelf" fitting dimensions

400 x 200
300 x 100

Euro pallet family

1200 x 800
800 x 600
600 x 400
+
Industry pallet

1200 x1000



Source: A.T. Kearney

The problem is compounded by a wide variety of unit load dimensions across Europe. There are too many standards and they differ from country to country. Established international standards are not always used and a widely applied, consistent set of European standards is required to achieve EUL harmonisation. This should be based on the modularity principle as this dramatically improves space utilisation. Within the European grocery industry the **600x400** mm master module is widely accepted and is recommended in this Report as the basis for unit load dimensions. To achieve breakthrough results, all variable constraints must be challenged, although fixed or genuine constraints are recognised.

- Unit load harmonisation is key to supply chain integration and breakthrough results.

A wide range of secondary unit load dimensions are currently in use, driven by primary product size. This proliferation adds complexity and should be rationalised. Since space utilisation is key to EUL, available spaces across the supply chain should be based on seven modules: five based on strict modularity with the **600x400** and two additional modules, representing shelf replenishment needs.

Secondary reusable transport items (RTI), such as boxes and crates, offer significant potential savings for selected category flows. In order to limit burgeoning proliferation and complexity, the EUL team recommends establishing a RTI council to develop European standards.

Tertiary items are critical to the success of ECR.

More than 30 different pallet sizes and types are in use across Europe. These should be rationalised to four recommended plan dimensions.

Current pallet heights make poor use of vehicle inner heights, often based on previous design. As a result, 15% additional grocery trucks are required. As vehicle technology develops and extra inner truck height is made available, pallet height standards need to be increased. High cube and double stacking technologies should also be monitored and pallet heights adapted to reflect developments.

- Pallet height should be derived from inner truck height.

The current situation, in which manufacturers typically use pallets and retailers favour roll cages, is a barrier to Efficient Replenishment. As cross-docked volume increases, the need for an integrated tertiary item – used across the total supply chain – becomes critical.

Suppliers of tertiary items need to develop a tertiary item which combines the advantages of pallets with those of role cages to enable effective cross-docking. The Dolly is one such item but it is only suitable for those applications using RTI.

- Technical developments are required to integrate pallets and roll cages.

EUL projected savings of 1.2% of retail sales price are not evenly spread among manufacturers and retailers. Retailers expect to gain three quarters of the savings, mainly through more efficient assortment creation and shelf replenishment. However, retailers' operational gains are likely to be manufacturers' investment needs. For example, switching to RTI to achieve more efficient retail shelf operations will require manufacturers to invest in the production line.

- EUL opportunities are not equally spread between manufacturers and retailers.

Future pricing must incorporate a suitable compensation mechanism to ensure that such investment takes place.

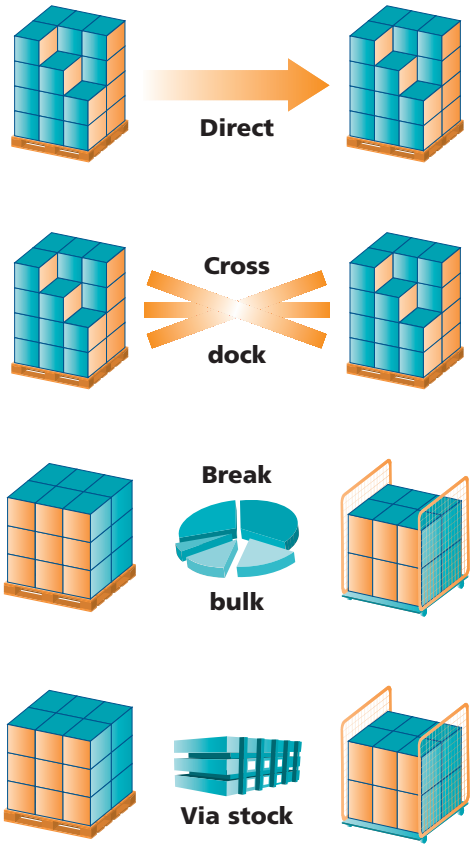
A clear vision, leadership and a long-term perspective are required to ensure that projected ECR savings become a reality.

- Efficient Unit Load developments require a process- and category-oriented approach.

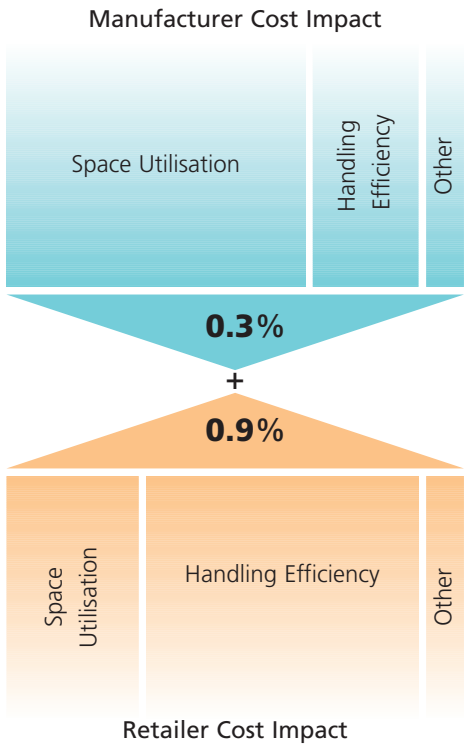
In order to make best use of spaces available in the supply chain and to minimise the overall handling along the chain, the unit loads design must be very process-oriented, together with the principal replenishment flow modules, allowing category-specific increases in cross docking and break bulk operations

- EUL make optimal use of spaces available in the supply chain and minimise handling.

This Report provides guidelines rather than standards. It should be used by standards bodies, and by manufacturers, retailers and service providers, working together to design and operate Efficient Unit Loads supply chains. This will "fulfil consumer wishes better, faster and at less cost."



Source: A.T. Kearney



Source: A.T. Kearney Survey, Efficient Unit Loads project

1 INTRODUCTION

The harmonisation of transport and storage items is a main driver to supply chain integration.

ECR Europe

The Efficient Consumer Response (ECR) Europe initiative was created to provide European grocery consumers with the best value, service and variety of products through consumer driven collaborative action.

Manufacturers and retailers, working together, can achieve significant improvements to be shared mutually, and also with consumers. The initial Value Chain Analysis estimated potential savings to be US$ 33 bn (ECU 25 bn) per annum, if manufacturer-retailer partnerships address:

- Efficient Replenishment
- Efficient Promotion
- Efficient Assortment
- Efficient Product Introduction.

These potential savings represent a reduction in retail sales price of 5.7 percent, comprising 4.8 percent from operating cost reduction and 0.9 percent by reducing inventory costs.

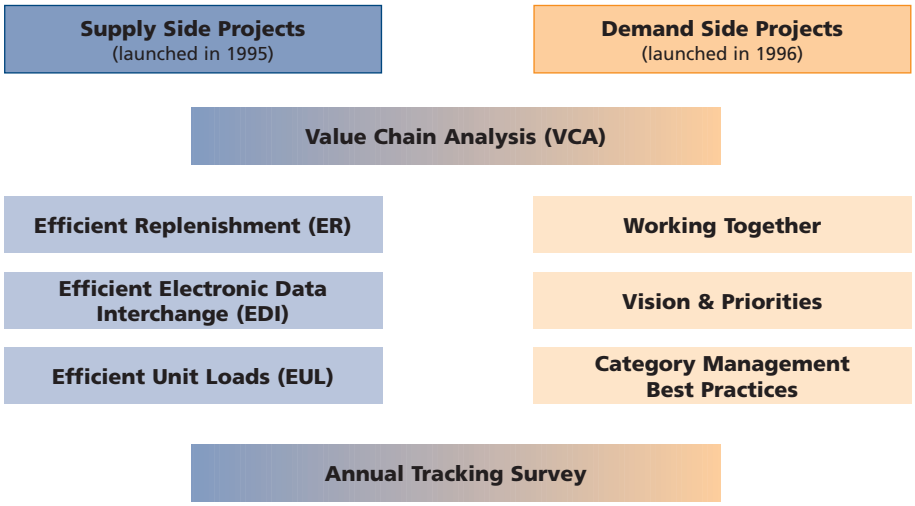
The ECR Europe initiative, in conjunction with numerous national projects, is establishing ECR as a significant and valuable approach to improve the grocery industry in Europe. Considerable momentum is being achieved as manufacturers and retailers co-operate, working together to fulfil consumer wishes better, faster and at less cost.

■ Mission of ECR Europe: Working together to fulfil consumer wishes better, faster and at less cost.

To explore the improvement opportunities in more detail and to provide practical supply chain guidelines for manufacturers, retailers and service providers, six functional sub-projects have been initiated by the ECR Board of Europe.

An Annual Tracking Survey will monitor progress, document achievements and reveal any gaps which need to be addressed.

Figure 1: ECR Europe projects



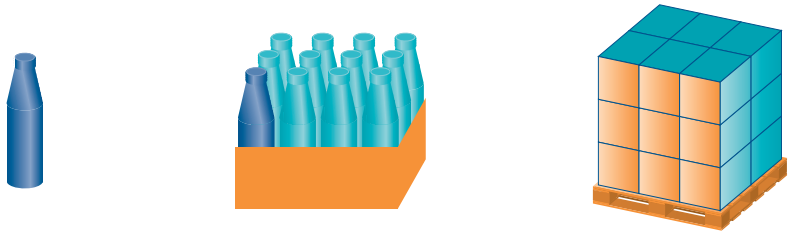
Source: ECR Europe

Efficient Unit Loads

This Report summarises the findings and recommendations of the Efficient Unit Loads (EUL) project team and provides a way forward to achieve breakthrough results. Guidelines and recommendations will be given, but no standards will be defined. The Efficient Unit Loads team of ECR Europe was not mandated to be a standards committee.

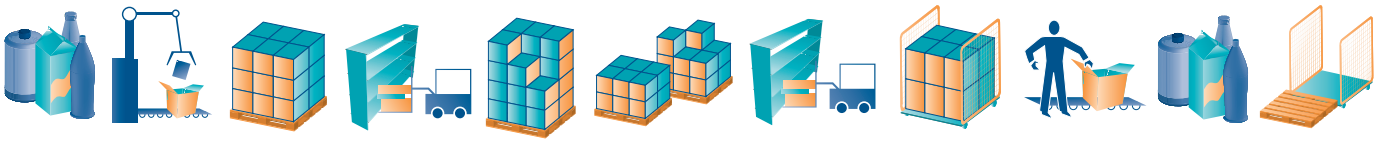
Chapters 3 and 4 examine the current unit loads situation and identify the key driving principles which need to be addressed to develop EUL. Chapters 5-7 review the different types of unit loads, Chapter 5 – one-way secondary unit loads, Chapter 6 – reusable secondary unit loads, known as Reusable Transport Items (RTI) and, Chapter 7 – tertiary items. This includes a review of current practices, advantages and disadvantages of different types of unit loads, and constraints and possible trade-offs, before developing conclusions and recommendations or guidelines. The potential benefits of Efficient Unit Loads – both quantifiable and non-quantifiable – are presented in Chapter 8, and Chapter 9 deals with achieving tangible progress. Unit load terms and additional data and information are listed in Appendix 10. A list of contact names and addresses concludes this Report on Efficient Unit Loads. Throughout the remainder of this Report, dimensions will be given in millimetres (mm).

Figure 2: Mission of Efficient Unit Loads project



Primary product **Secondary unit load** **Tertiary unit load**

To improve efficiency and effectiveness in current and future supply chains by promoting harmonisation and integration of transport and storage items; and to consider how to establish a European framework to develop and manage reusable transport and storage items.



Source: A.T. Kearney

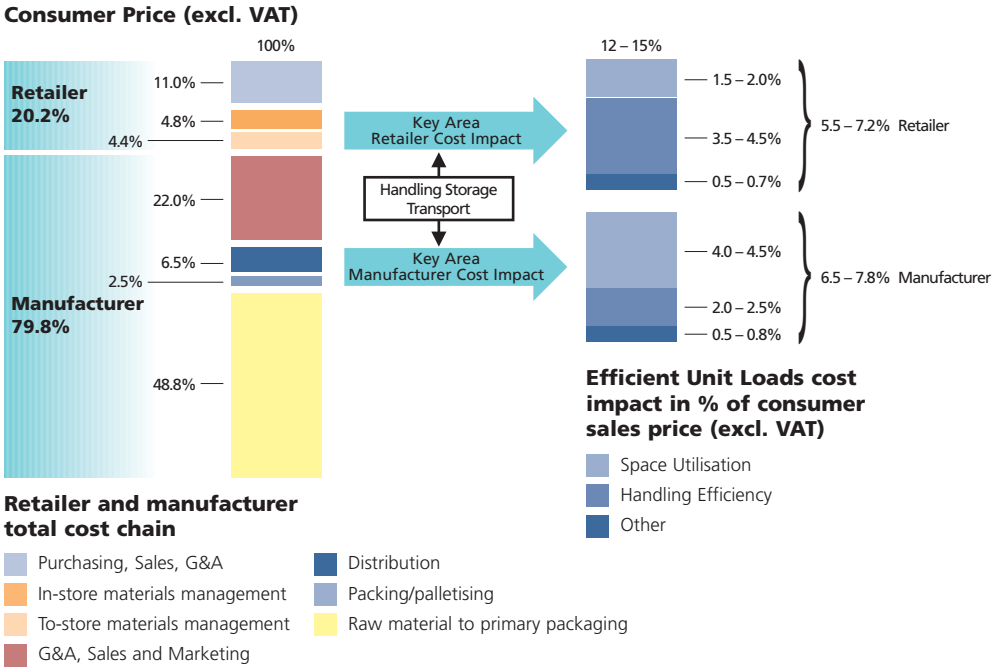
2 BACKGROUND

Unit loads impact almost one seventh of total supply chain cost and they are gaining greater significance as Europe becomes increasingly integrated.

Efficient Unit Loads

A unit load consists of a group of products put together to facilitate transport and handling. This includes secondary items such as cardboard boxes and plastic trays, which group or package primary products and tertiary items such as pallets and roll cages, which, in turn, group secondary items. Primary products are not considered in this report, except in the way they impact on secondary and tertiary item design. Definitions for secondary, tertiary and primary packaging levels are given in Appendix 1. Unit loads represent a key cost driver since they impact on transport, storage, handling and packaging, estimated to account for 12–15% of retail sales price.

Figure 3: Efficient Unit Loads cost impact



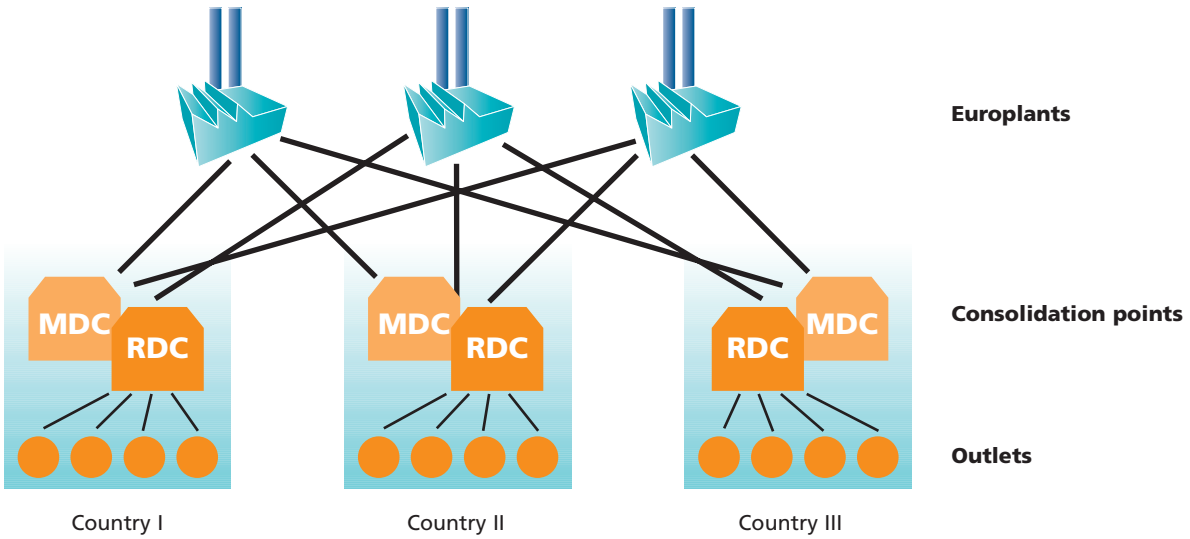
Source: A.T. Kearney Survey, Efficient Unit Loads project

Efficient Unit Loads generate transport and storage savings.

Unit loads are involved in every step of the supply chain, moving product from the production line through to the retail shelf and sometimes beyond into the consumer's home. Developments such as roll cages, and more recently, dollies, have improved retail handling efficiency, and automation has improved handling efficiency in the factory. However, these developments highlight the traditional unilateral approach to supply chain management, where every player has optimised handling and storage in his part of the supply chain. Although roll cages reduce retail handling, particularly at the store, they are unsuitable for manufacturing operations. Similarly, pallets used by manufacturers are only appropriate for a few high volume products within the retail part of the supply chain. As a result, additional, non-value adding steps are required, in particular at the manufacturer/ retailer interface where unit loads are reassembled as products move towards the consumer.

Figure 4: Pan-European factories supplying different markets

With emerging 'European' supply chains, unit loads proliferation is a major issue, also gaining further importance as the trade goes international.



Source: A.T. Kearney

The fragmented approach to unit loads is exacerbated by the proliferation of items in use and the increasingly pan-European nature of the grocery industry is currently compounding this variety. The 280 million European pallet population consists of more than 30 different sizes and types. Penetration of the Euro pallet, the most popular, varies by almost 90% across the different European countries. This can result in identical products being delivered in different unit loads, stacked differently according to country and customer. Apart from the operating inefficiencies, this results in stock levels which are higher than necessary.

Pan-European, single source production and warehousing are other key drivers since longer transport distances and environmental pressures make optimum truck utilisation even more critical. Customers demand two different pallet systems: the Euro and the Industry pallet, which currently forces pan-European manufacturers to stock both in the same factory and MDC, a cumbersome operation that results in storage inefficiencies.

Environmental pressure, and the cost of waste disposal are just a few factors which are driving a growing trend to use RTI as a substitute for one-way secondary unit loads.

The previous approach to optimise a part of the supply chain has led to inefficiencies, as manufacturers have sought to optimise space utilisation – particularly in transport – and retailers have concentrated on handling productivity. The impact of this disjointed approach could worsen as product proliferation increases and as Efficient Replenishment principles result in smaller, more frequent deliveries. By working together, in the true spirit of ECR, manufacturers and retailers can develop an integrated approach to overcome many existing problems.

- To become more efficient, today's supply chains require further integration which will be driven by harmonising unit loads.

Efficient Unit Loads are an important element in ECR and are essential to the successful application of Efficient Replenishment (ER) guidelines.

3 THE CURRENT SITUATION

Today's unit loads perform poorly due to the half chain view taken by both manufacturers and retailers.

To assess today's unit load situation, a survey was conducted by A.T. Kearney among 25 leading European companies, representing a grocery turnover of more than ECU 85 bn. Twelve European countries were covered.

The survey focused on the following key areas:

- Use of different transport and storage items
- Reasons for using specific transport and storage items
- Performance of all unit loads currently in use
- Principles for managing reusable transport items
- Use of existing standards
- Bottlenecks blocking the introduction of EUL
- Potential drivers for change
- Extent of agreement and disagreement between manufacturers and retailers.

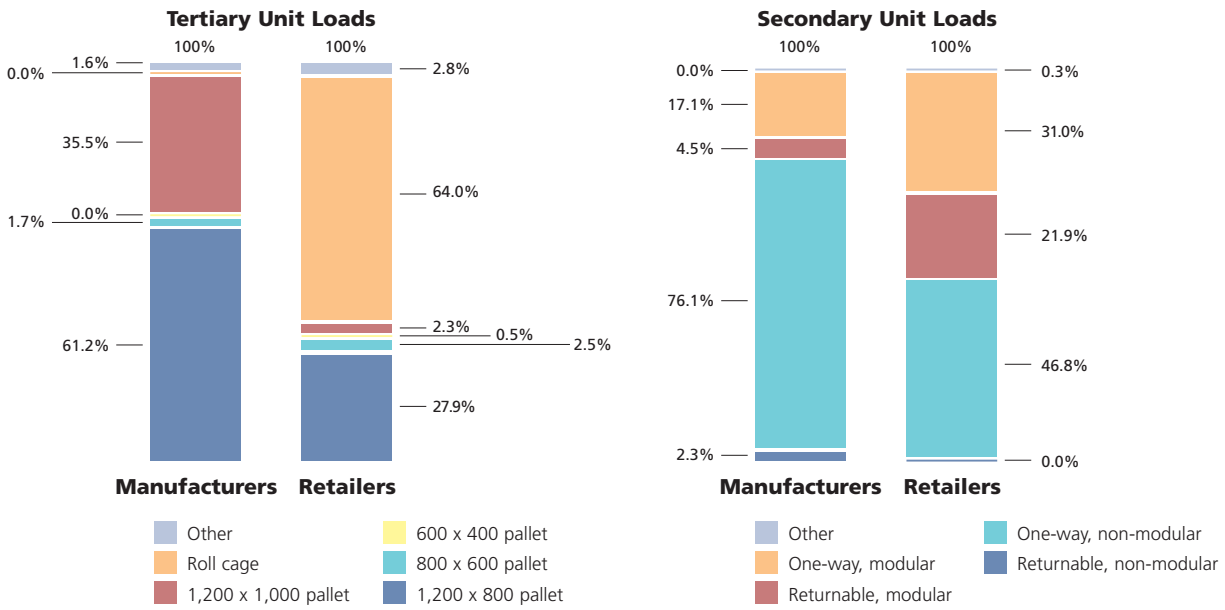
Out of 25 responses, 14 were given by manufacturers, representing some ECU 39 bn in turnover, and eleven were given by retailers, with turnover amounting to ECU 46 bn.

■ Today's unit loads are not the optimum solution.

Current supply chains are disjointed where the two half chains meet

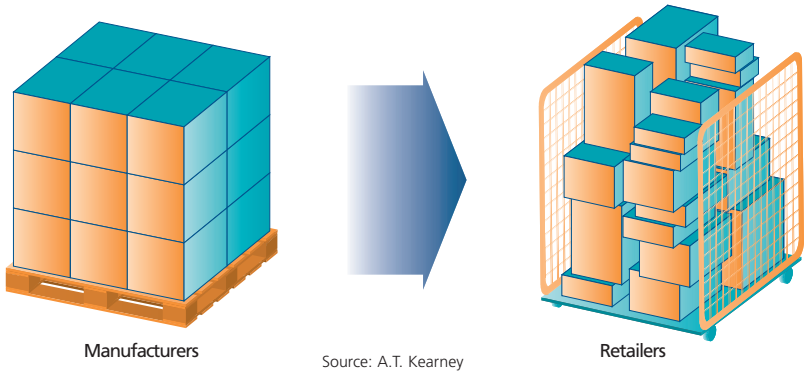
The assortment creation point in the supply chain, usually the retail distribution centre (RDC), is the main point of disruption. Figure 5 shows that more than two thirds of all products are repacked at the tertiary packaging level, mostly involving a change from pallets to roll cages (from 0 % outbound MDC to 64 % outbound RDC).

Figure 5: Disjointed supply chains
Distribution of product volume shipped according to unit load type



Source: A.T. Kearney Survey, Efficient Unit Loads project

Figure 6: Pallet and roll cage



Source: A.T. Kearney

There is also considerable inefficiency at the secondary packaging level. More than three quarters of the goods leaving the manufacturer are in secondary unit loads which do not make optimal use of secondary spaces. Although retailers claim to prefer modular secondary unit loads, nearly half the products leaving the RDC remain in non-modular secondary unit loads. Many well-stacked manufacturer unit loads (on pallets) end up in problem retailer unit loads (on roll cages).

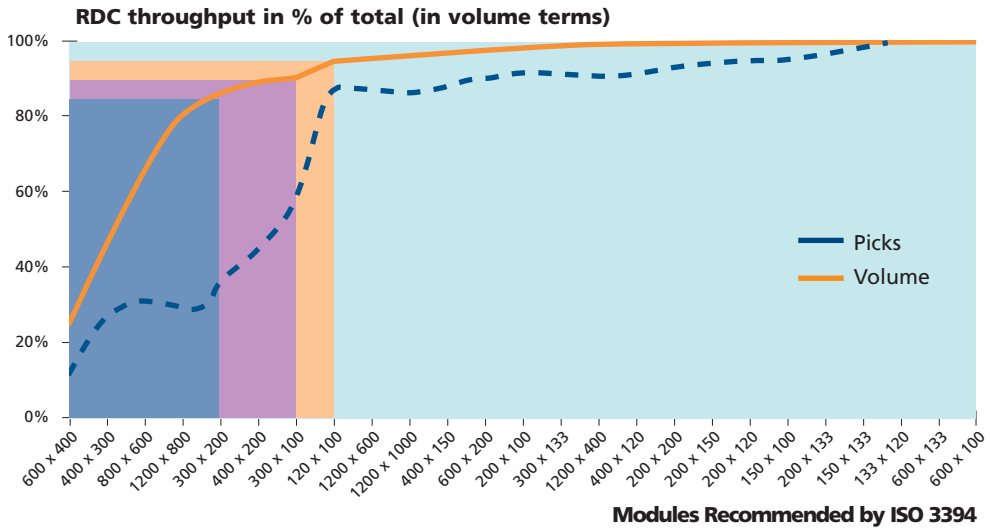
As well as this physical disruption, there is a significant difference in the respective parties' understanding of their supply chains. The "half chain view" still dominates most participants' mind-sets.

- The half chain view still dominates the discussion and this is reflected by the disjointed nature of current physical supply chains.

International standards are preferable to local standards

Although there is an international standard ISO 3394 for the plan dimension or footprint of secondary unit loads (see Appendix 10), it has been revealed that the majority of secondary unit loads do not comply with this standard, as the average utilisation of the available plan dimensions is only about 70%. Indeed, as 7 out of 25 defined modules already account for more than 90 % of the volume throughput, this is a priority for action (See Figure 7).

Figure 7: Cumulative module usage



1st priority: Major volume and handling impact

2nd priority: Minor volume impact but major handling impact on shelf replenishment

No priority: No major volume impact but handling impact at RDC; these small secondary unit loads are usually picked into larger ones for distribution

No priority: No major volume and handling impact

Source: A.T. Kearney Survey, Efficient Unit Loads project

The international standard ISO 3676 is widely used for pallet plan dimensions for tertiary unit loads. However, there is a need to build a Euro pallet family including a Half and Quarter pallet format. This topic is addressed in Chapter 7. With regard to pallet height (pallet plus load), there is a proliferation of standards throughout Europe, differing by country, region and even company. Overall, too many different standards exist and international standards are not used sufficiently.

Recent trends suggest the following European scenario over the next two years:

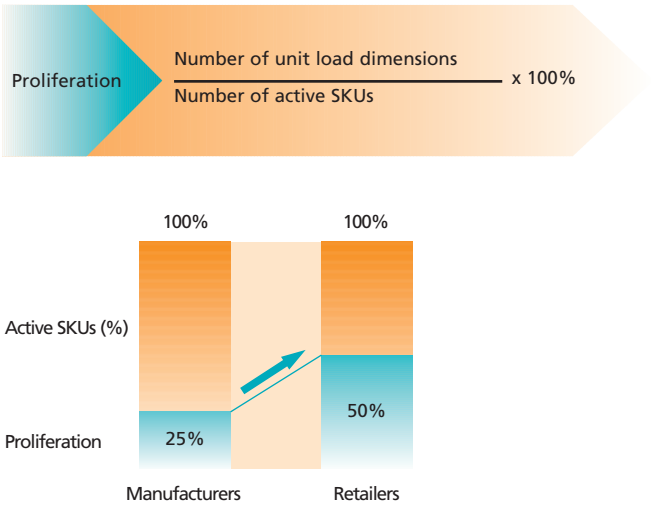
- The population of Industry and Euro pallets will remain fairly stable
- Use of Half and Quarter Euro pallets, both plan dimensions are recommended in ISO 3394, will double, although they will only account for six percent of product volume.
- Roll cages will be used less
- Secondary unit loads will become more modular
- Retailer use of reusable modular secondary unit loads (RTI) will increase.

■ Existing international standards should be used more rigorously before establishing new standards.

There is a wide variety of unit load dimensions

On average, for every two SKUs, a separate secondary unit load dimension passes through the retail system. Manufacturers start with an average proliferation of four SKUs for each secondary unit load dimension. At the RDC or consolidation point, the proliferation has doubled to 50 percent, with resulting inefficiencies (see figure 8). Such proliferation is also a barrier to automation. Appendix. 10.2 shows that this varies significantly by category.

Figure 8: Proliferation of secondary unit load dimensions



Source: A.T. Kearney Survey, Efficient Unit Loads project

Today's unit loads perform poorly

The survey revealed that unit loads currently perform poorly in a number of key areas, which are addressed later in this Report in more detail. These are:

- Pallets, favoured by manufacturers, perform poorly in terms of product protection, theft prevention and weight of the pallet itself. Half and Quarter Euro pallets are inefficient as they first need to be put on Euro pallets before going into racking
- Roll cages, used in retail operations, are perceived as expensive, heavy and inefficient for storage. They are involved in more than 30 percent of staff injuries.
- One-way secondary unit loads are considered to be insufficiently durable and are rarely modular. They are often incompatible with other unit loads.
- Returnable secondary unit loads, or secondary RTI are seen as compatible, durable and stable; however, identification is a disadvantage.

Poorly performing unit loads are widely accepted

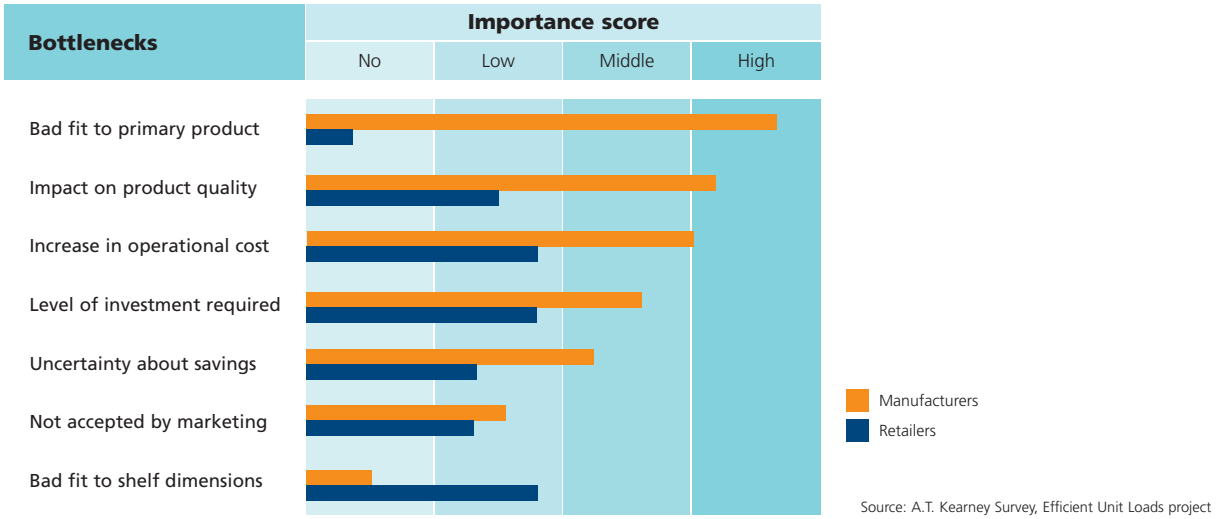
Even though manufacturers and retailers are aware of the poor performance of unit loads, they use them widely:

- Pallets are chosen because they fit existing infrastructure. They are a widely accepted, proven solution, requested by all trading partners
- Despite their disadvantages, roll cages are widely accepted and are the favoured means of shipping most assortments within the retailers' half of the supply chain
- One-way secondary unit loads are chosen by manufacturers to fit existing packing equipment. They also are a widely accepted, proven solution
- RTI are perceived to offer many advantages, and are being used increasingly, particularly by retailers. However, identification remains a problem.

Different areas of focus hinder change

When asked about bottlenecks or barriers preventing EUL, manufacturers and retailers focused on different issues. Manufacturers regard primary product fit as the key issue since secondary unit loads are designed to protect the integrity of primary product characteristics, and retailers view shelf space utilisation as the most critical issue. As will be explained later, product focus and shelf focus impose different constraints on unit loads. Both manufacturers and retailers regard investment and operational costs as key bottlenecks, particularly if a suitable compensation mechanism has not been developed.

Figure 9: Bottlenecks preventing Efficient Unit Loads

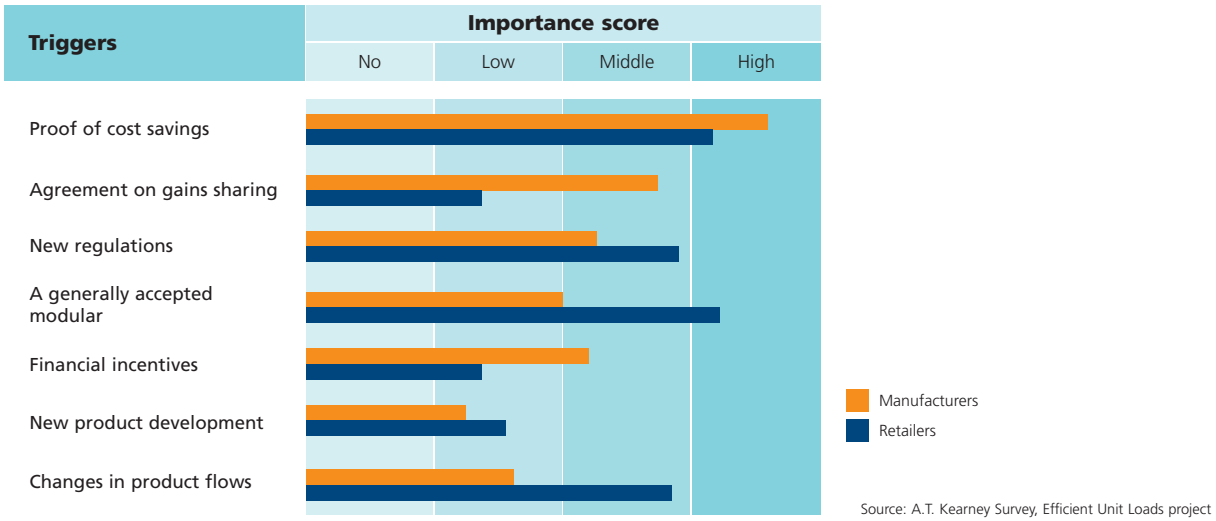


Source: A.T. Kearney Survey, Efficient Unit Loads project

Proof of cost savings will drive change

Both manufacturers and retailers regard proof of cost savings as the most important driver for change in designing EUL. Manufacturers are particularly sensitive to pay-back issues such as sharing of gains and other financial incentives. Retailers see additional triggers in the shape of new (environmental) regulations, and new replenishment techniques, which will lead to changes in product flows. Retailers – handling assortments – expect to gain more from the use of Efficient Unit Loads than manufacturers, but manufacturers are more likely to have to invest. This topic is covered in Chapter 8.

Figure 10: Drivers for change



Source: A.T. Kearney Survey, Efficient Unit Loads project

Ways forward are based on agreement

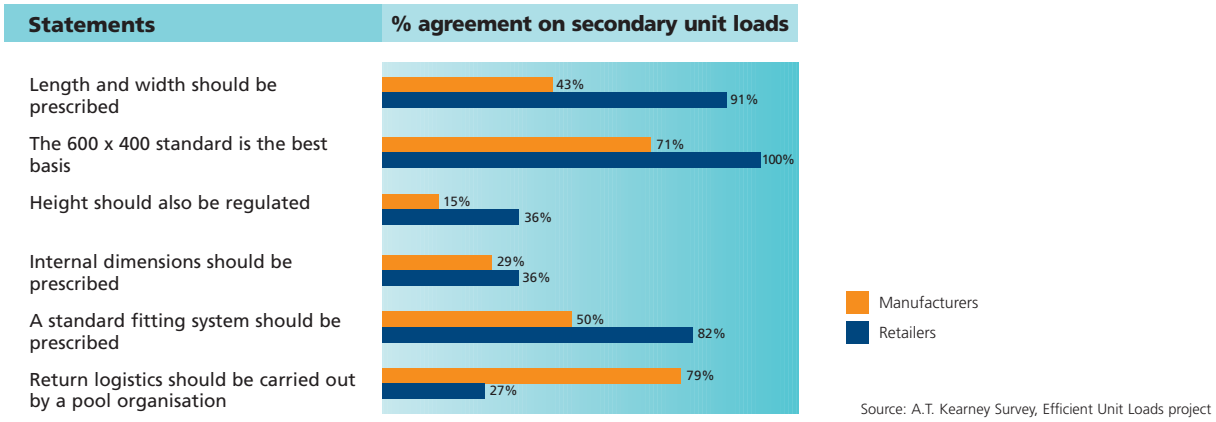
Agreement exists between manufacturers and retailers regarding the key dimensions of secondary and tertiary unit loads, although major investments will, nonetheless, be required.

Secondary unit loads

While retailers see a clear need for prescribed length and width, manufacturers do not. Agreement exists on a basis for such a prescription: use of the 600x400 master module. Both players are not interested in height and internal dimension regulations.

With regard to RTI loads, there are differing opinions on return logistics. Manufacturers do not regard this operation as a critical success factor. Retailers, who often operate their own systems, tend to view return logistics as a means of competitive advantage and are reluctant to relinquish control to a pool operator. Exceptions are manufacturers operating their own return logistics systems, particularly those in the beverage industry, who use both reusable primary packaging (bottles) and reusable secondary unit loads.

Figure 11: Agreements on secondary unit load issues



Source: A.T. Kearney Survey, Efficient Unit Loads project

Tertiary unit loads

Prescribed length and width is seen as a must by manufacturers and retailers, with the **600x400** master module accepted as the basis.

The majority do not support stacking height regulations. Manufacturers, who reject a fixed height for pallets, disagree with retailers, who would like to see such a limit imposed. This highlights the importance of this issue, which is addressed in Chapter 7.

Attention is drawn to the question of whether or not return logistics should be carried out by a pool organisation. Manufacturers who responded to this particular question referred it to their predominant tertiary transport and storage item – i.e. the pallet. Retailers answered the question with roll cages in mind. The different responses reflect different practices, with pallets predominantly in open pools or exchange systems and roll cages in in-house, mainly captive systems.

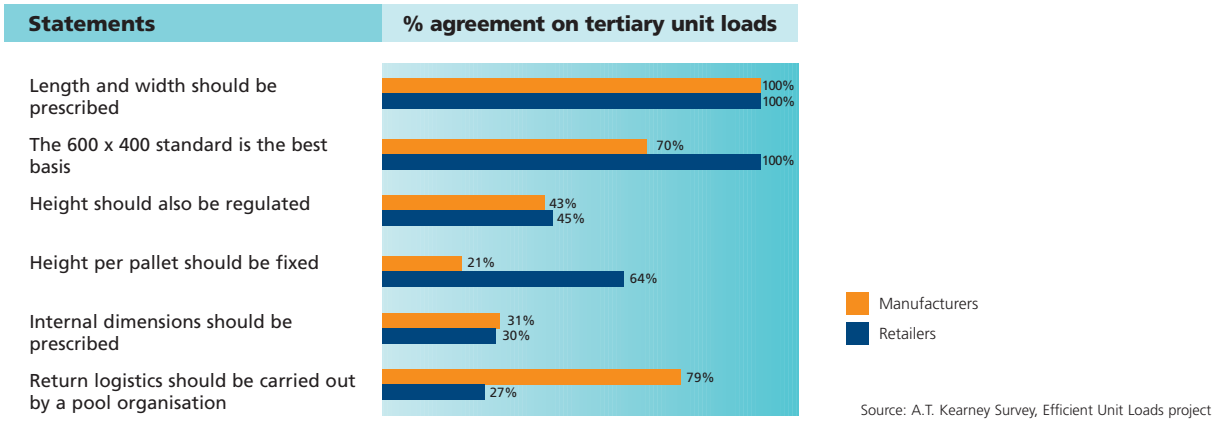
General

Changing the current unsatisfactory situation requires significant investment. Since investing in one part of the supply chain yields savings in other parts, effective compensation mechanisms will have to be put in place to ensure a true 'win-win' situation. If supply chain members fail to achieve win-win, change will not materialise and the total supply chain will remain inefficient and costly.

- Effective compensation mechanisms have to be put in place to make EUL a win for each supply chain member.

The survey provides evidence that manufacturers and retailers agree on the strategic importance of EUL and the potential for developing a total or integrated supply chain solution. The level of agreement has increased as participating manufacturers and retailers worked together to develop the last chapters of this Report. Previously, it was vitally important to define a set of fundamental principles or key success drivers underlying EUL. This was essential to ensure that both manufacturers and retailers appreciated the 'total' supply chain, and not just each respective half chain view.

Figure 12: Agreements on tertiary unit load issues



Source: A.T. Kearney Survey, Efficient Unit Loads project

4 DRIVING PRINCIPLES

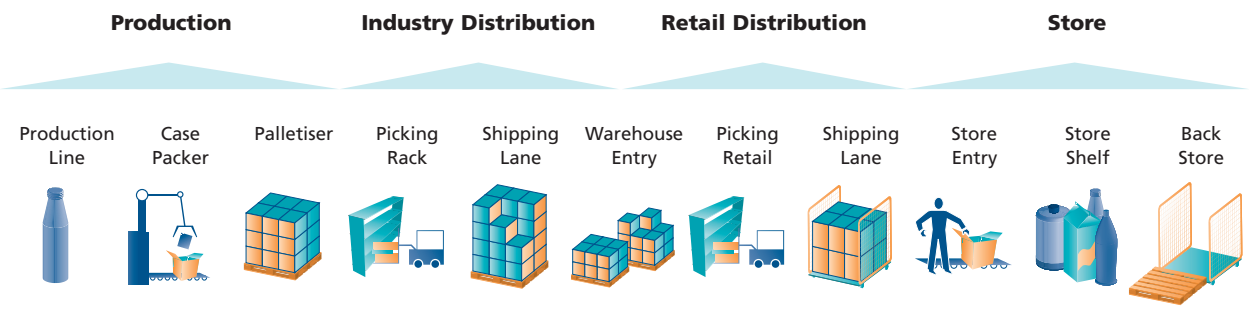
Manufacturers and retailers need to commit themselves to a set of driving principles.

To make ECR a reality, barriers such as the current 'half chain view' need to be removed. In order to achieve this, both manufacturers and retailers need to commit themselves to a set of driving principles.

Unit loads should remain intact as far as possible along the supply chain

From the end of the production line to the retail shelf, the product is often handled more than ten times. Once a higher order unit load has been built, it should remain intact as far down the chain as possible, since every regrouping means additional handling, which costs money. An important step where regrouping takes place is at the RDC. There, the two half supply chains meet and product assortments are created. In highly integrated supply chains, the products are handled only a few times – ideally, the product is shipped from plant to shelf, at the highest load aggregation.

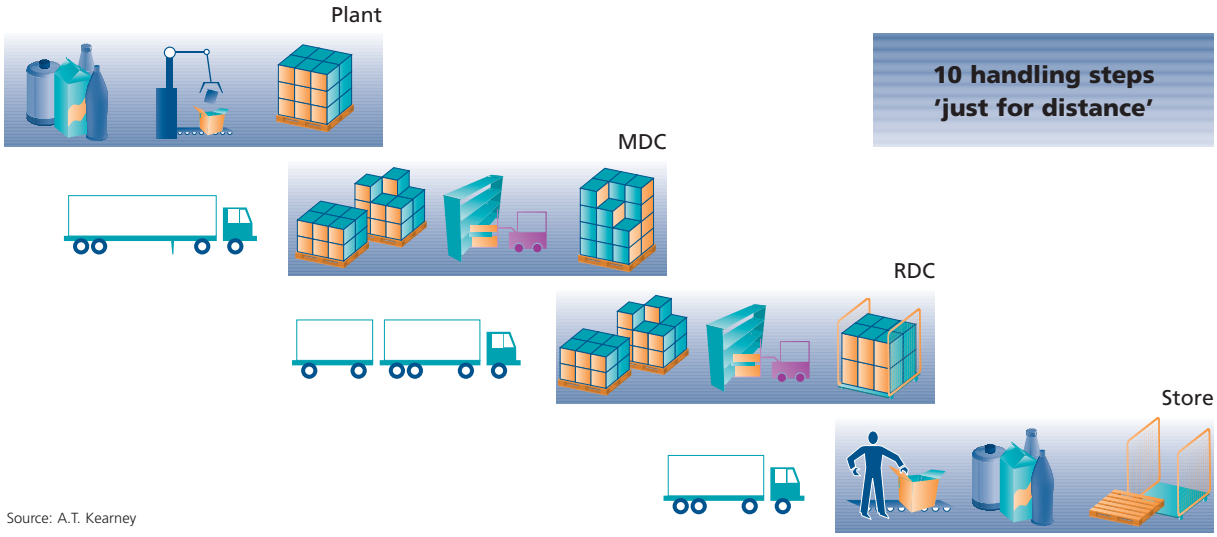
Figure 13: Typical handling chain



SKU	One	One	One	One	Multiple	One	One	Multiple	One	One	Multiple
Unit Load Level	Primary	Secondary	Tertiary	Secondary	Tertiary	Tertiary	Secondary	Tertiary	Secondary	Primary	Tertiary

Source: A.T. Kearney

Figure 14: Typical total supply chain



Source: A.T. Kearney

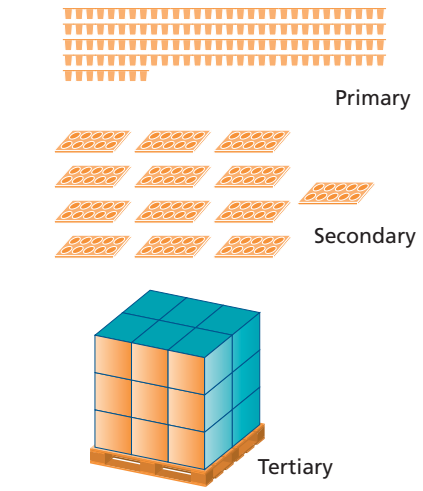
EUL should optimise available spaces

Grouping on every level – secondary and tertiary – involves filling space efficiently. This also applies to filling racks and trucks. Transport is a key cost, particularly for manufacturers. The increasing cost of road transport and the resulting environmental damage make it critical to achieve the best possible fill of the transport cube or space. Storage costs, although important, are typically less than transport costs, and therefore, the impact of poorly utilised storage space is less critical.

The ultimate objective in developing Efficient Unit Load supply chains is therefore to minimise handling and maximise transport space utilisation. However, these two goals can conflict. A key concern of manufacturers is to avoid moving empty spaces in their product-dedicated distribution networks, whereas a key concern of retailers is to obtain the lowest cost handling of their assortments through to shop shelves. Applying ER principles and techniques – with less stocks, smaller and more frequent flows, cross-docking, and roll cage sequencing – will worsen this conflict.

- EUL make optimal use of spaces available in the supply chain and minimise handling.

Figure 15: Grouping of yoghurts on secondary and tertiary levels (example)



Packaging level	Number of items	One time handling cost per item	Total handling cost
Primary	1,280	0.03 ECU	38.4 ECU
Secondary	128	0.05 ECU	6.40 ECU
Tertiary	1	1.00 ECU	1.00 ECU

Source: A.T. Kearney, Efficient Unit Loads project

Modular co-ordination drives supply chain efficiency

Since optimal space utilisation is necessary for EUL, a co-ordinated approach is required by all players across the supply chain. A modular, co-ordinated infrastructure makes it easier to:

- Define available spaces
- Combine two loads to form a new modular load
- Group smaller items to fill larger spaces efficiently – putting primary packs into secondary unit loads, secondary unit loads on a pallet or in a roll cage, or placing tertiary unit loads in a vehicle
- Measure actual space utilisation
- Make optimal use of capacities (see below).

■ Supply chains with modular co-ordinated spaces make product movement more efficient.

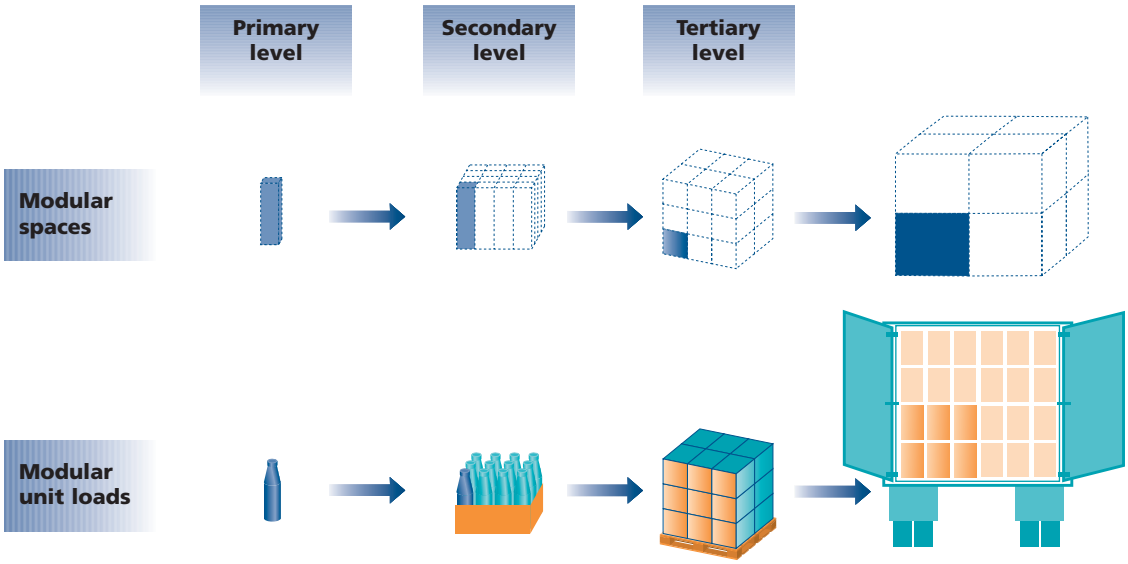
The basic plan module – **600x400** creates multiples and sub-modules which are compatible with truck dimensions, common pallet configurations, racks, dollies, shelves, and existing standards (ISO 3394, ISO 3676). Too many sub-modules are currently used – fewer will improve efficiency.

The modular principle should also apply to space height occupied by primary packs and tertiary unit loads, since trucks, racks and shelves impose height constraints. For secondary unit loads this is currently only important if the secondary unit load is placed on a shelf, although developments such as automated assortment creation will make secondary height increasingly critical.

■ Efficient Unit Loads are about modular space utilisation and not about modular packaging

A distinction must be made between *dimensions of modular spaces* made available for unit loads and *dimensions of unit loads*. The spaces made available must have exact, modular dimensions. Unit loads have to optimally use the modular spaces available. The goal is close co-ordination of the two, across the supply chain.

Figure 16: Modular spaces and modular unit loads



Source: A.T. Kearney

Fixed constraints include:

- Transport infrastructure such as streets, bridges and tunnels
- Outer truck length, width and height, closely linked to traffic infrastructure and also regulated by the European Directive (96/53/EC)
- Inner truck width, closely linked to outer truck width
- Consumer household constraints such as cupboards, fridges, and plates
- Consumer requirements such as the size of a food portion
- Consumer and employee ergonomics, defining what an average person can lift, reach, hold and move without strain or risk of injury

Currently regarded as variable constraints, within a long-term fixed limit:

- Inner truck height. Technical developments will permit more efficient use of truck height to improve inner height. Fixed outer truck height imposes a long-term limit
- Inner truck length, set by the fixed outer length. Technical improvements are still possible
- Pallet and roll cage plan dimensions, linked to inner truck width.

Variable, largely company-specific or local constraints are:

- Production facilities, including factory layouts, production and packing lines
- Warehouse layouts
- Warehouse racking slots
- Retail store layouts
- Shop shelf dimensions
- Primary product dimensions
- Operating methods.

Accept fixed and challenge variable constraints

Unit loads are restricted by many factors. A whole set of constraints results from supply chain infrastructure, such as trucks, racks, doors and handling equipment, which mostly affect tertiary unit loads. Constraints imposed on primary products also have an influence on unit loads. These include production lines, shop shelves, cupboards, refrigerators and even plate size. Other constraints on unit loads are derived from market requirements, consumer and employee ergonomics, operational methods and legislation.

There is a distinction between fixed and variable constraints. Only long-term fixed constraints that cannot be bypassed are to be viewed as ultimately restrictive. All other constraints must be challenged.

- Only long-term fixed constraints should limit the Efficient Unit Loads design. The validity of constraints must be challenged.

- Efficient Unit Loads seek the optimum 'total supply chain' solution within all genuine constraints.

Supply chain capacity has a space and time dimension

Capacity at any point in the supply chain can be defined by the modular spaces available. For activities involving the handling and moving of products, availability has a time dimension. Efficient use of available capacity requires optimal scheduling. ECR Europe has addressed this issue in the Efficient Replenishment project. This EUL Report only addresses physical elements and not time elements of capacity.

- EUL supply chains can be realised if structures, capacities, activities and unit loads are designed in close co-operation.

Total supply chain mapping will create transparency

There is no universal EUL solution since unit loads should be designed to fit different types of supply chains. A Unit Loads Efficiency Matrix has been developed which uses five key structural elements to assess unit load performance along a total supply chain. The five elements are:

Figure 17: Chain elements and key parameters of the Unit Loads Efficiency Matrix

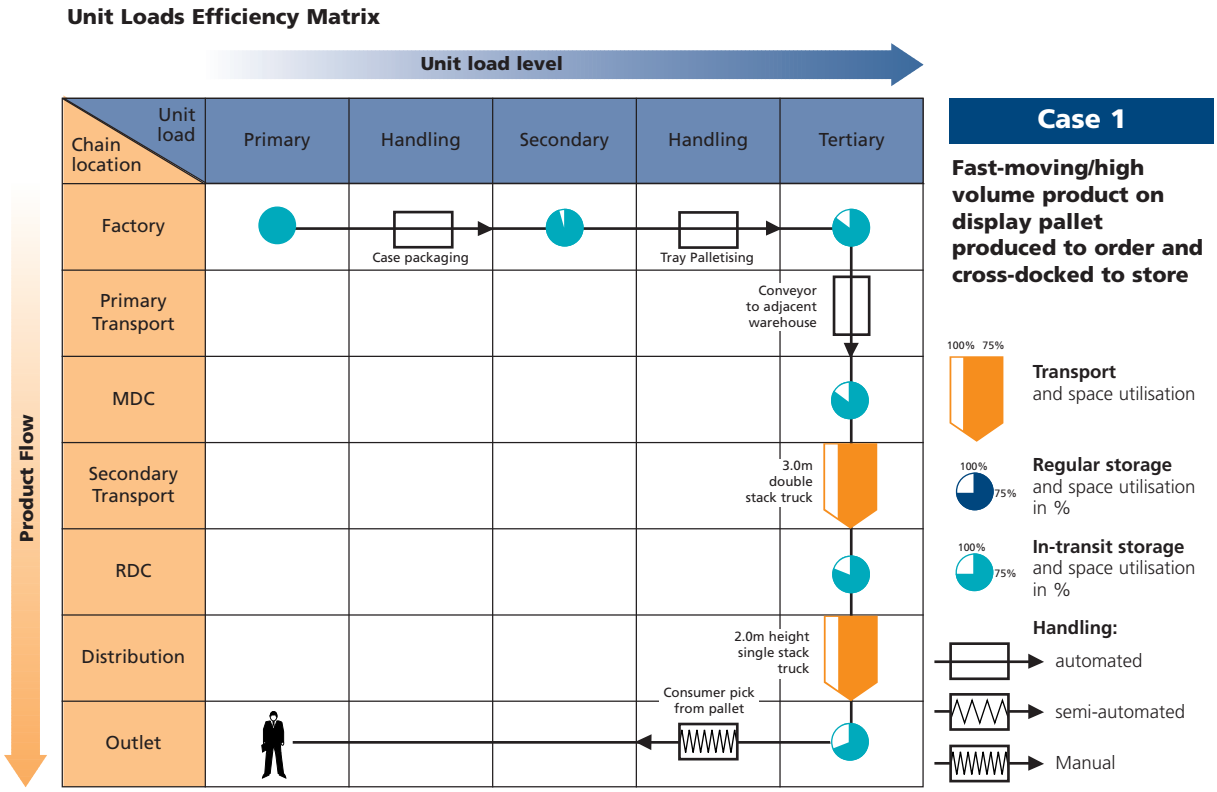
Structural Chain elements	Key parameters
Location in chain	Factory, MDC, RDC, store
Packaging/unit load level	Primary, secondary, tertiary
Handling, de-/consolidation	Number of steps and automation level
Storage, in-transit storage	Space utilisation of storage unit
Transport	Space utilisation of transport unit

The Unit Loads Efficiency Matrix is used to demonstrate two product-specific examples.

Case 1
High volume/fast-moving product: Display pallets produced to order and cross-docked at RDC

The primary product is put directly on a display pallet after being packed in a tray at the factory. The pallet is conveyed to the adjacent MDC. The production "to order" of full truck size quantities allows direct shipment without MDC storage to a retail RDC, where the pallets are cross-docked and shipped to stores.

Figure 18: Application example of the Unit Loads Efficiency Matrix



Source: A.T. Kearney

This chain is highly efficient from an Efficient Replenishment and EUL aspect:

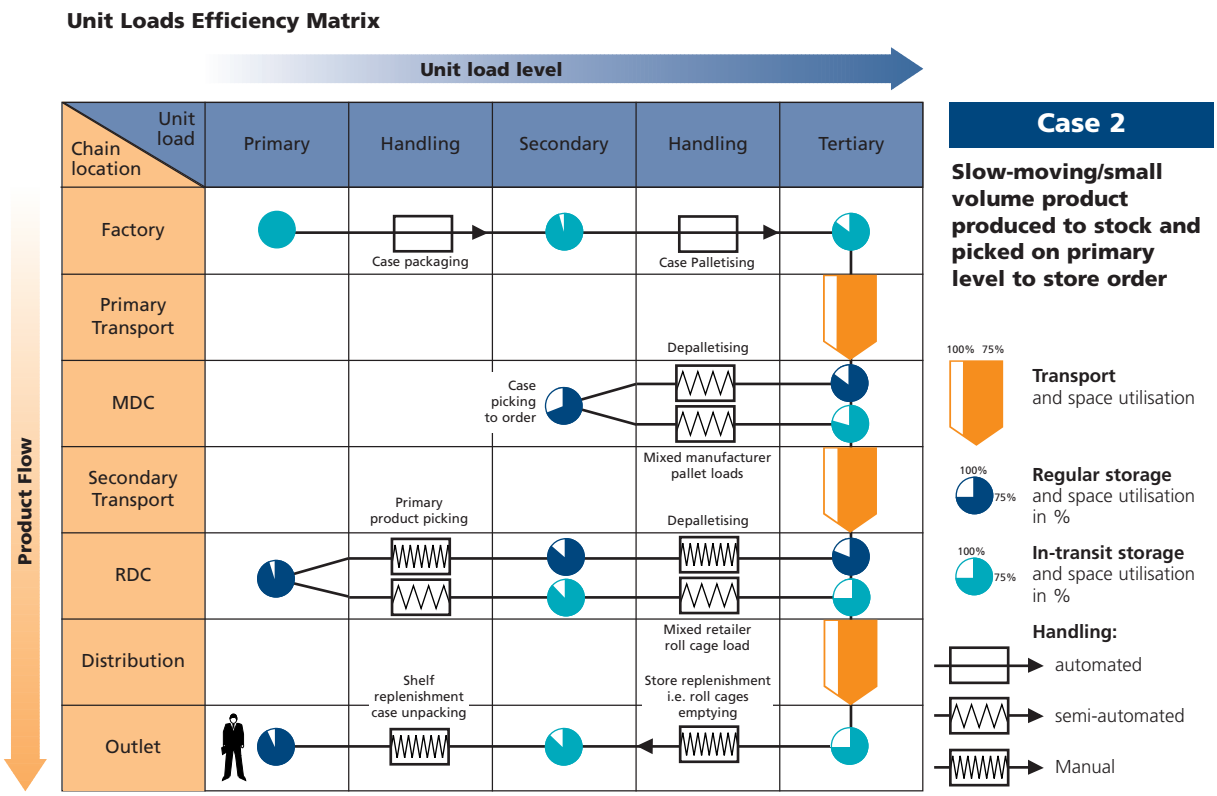
- Production to order in manufacturer's full truckload
- No storage, except temporarily in transit during transport and cross-docking
- No reassembly of unit loads. After automatic packing and palletising, the "original" pallet goes directly to the point-of-sale.

Potential improvement is possible in terms of truck space utilisation. In this case, different truck dimensions and different tertiary unit load dimensions may be used for transport from the RDC to store, resulting in sub-optimal space utilisation. However, relative to total chain performance, this is a minor issue.

Case 2
Small volume/slow-moving product: Produced to stock and picked on primary level to store order

The primary product is packed into secondary unit loads and palletised for transportation and storage at the remote MDC. The secondary unit loads are picked to order for RDC replenishment on mixed pallets. At the RDC, the primary products are picked from original cases to outlet replenishment order, and new secondary unit loads are formed using secondary RTI trays. Outlets are replenished with roll cages and within the outlet, single sales units are displayed on shelves.

Figure 19: Application example of the Unit Loads Efficiency Matrix



Source: A.T. Kearney

There are a number of major inefficiencies in this supply chain:

- The high number of handling steps, with a low level of automation
- Multiple storage locations, with a minimum of two at both MDC and RDC, represent a doubling in stock
- Mixed tertiary unit loads providing poor tertiary space utilisation for both the manufacturer (using pallets) and the retailer (using roll cages)
- Intensive handling of primary product, as secondary unit loads are deconsolidated at RDC, and shelf replenishment at the outlet.

Unit load integration along the supply chain would support the improvement of these highly disconnected supply chains. Key levers are:

- Reduction in the number of handling steps
- Reduction of case picking (either at MDC or RDC)
- Reduction in the number of storage locations (either at MDC or RDC)
- Better space utilisation, in particular, in transport, through an integrated tertiary unit load, fulfilling both the mission of pallets and roll cages.

The Unit Loads Efficiency Matrix easily highlights the inefficiencies within this chain.

5 SECONDARY UNIT LOADS

Secondary dimensional proliferation adds complexity without increasing efficiency.

5.1. What are Secondary Unit Loads?

Secondary unit loads comprise all "Packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units, whether the latter is sold as such to the final user or consumer, or whether it serves only as a means to replenish the shelves at the point-of-sale; it can be removed from the product without affecting its characteristics" (94/62/EC). Other terms used in this context include "transport" or "distribution" packaging.

Typical secondary unit loads are boxes, crates and trays, made of various materials such as (corrugated) cardboard, paper, plastic, foil, composite materials, or even combinations of those materials.

Secondary unit loads are designed for single (one-way) use or reuse. If made for reuse, secondary unit loads are likely to consist of synthetic material due to durability, hygiene and cost. Since multiple usage involves different aspects and drivers, reusable secondary unit loads (one type of RTI) are discussed in Chapter 6. In this current chapter the focus is on one-way secondary unit loads.

Following secondary unit loads along the supply chain, they are used in five main activities:

- Packing
- Palletising
- Assortment creation
- Shelf filling
- Recycling/disposal.

These give rise to five key requirements of secondary unit loads:

- Effective or modular space utilisation
- Handling efficiency
- Primary product protection
- Efficient packaging material utilisation
- Recyclability/disposal.

5.2. Space Utilisation

Today, primary packs are often assembled in standard collations, derived from shelf replenishment quantities, which are "wrapped" in corrugated cardboard to form a secondary unit load. The secondary unit load dimensions therefore depend on the primary product dimensions, the case count requested and the thickness of the packaging material. Consequently, secondary, tertiary and other spaces may be poorly utilised. To assess the extent of this problem, A.T. Kearney conducted a study among retailers in the EUL team, reviewing space utilisation by secondary and tertiary unit loads at the most critical point in the supply chain – the assortment creation point or RDC. A description of the analysis and results are given in Appendix 10.3. These results, together with those previously depicted reveal that:

- Two thirds of volume passing through RDCs is picked at secondary unit load level
- Average utilisation of spaces by secondary unit loads is poor
- Many different secondary unit load dimensions are used
- The top seven modules – in volume terms used as a modular system, reach a space utilisation of 69%. With an additional 18 modules – ISO modular – space utilisation is only improved by 2%
- Over 90 percent of total volume throughput uses only seven modular dimensions, which are derived from the **600x400** mm master module; see Appendix 8.3.
- Shelf facing has a comparatively small impact on secondary unit load dimensions.

■ Secondary dimensional proliferation adds complexity without improving space utilisation.

Figure 20: Cumulative module usage and recommendation

ISO modular system		% volume impact	Average surface utilisation
7	top 7 ISO	90%	71.1%
18	remaining	10%	64.4%
25	**total (all dimensions)**	**100%**	**71%**
7	**recommended modules**	**100%**	**69%**

Source: A.T. Kearney, Efficient Unit Loads project

The following recommendations clearly differentiate between spaces made available in the supply chain for secondary unit loads and secondary unit loads which make optimal use of these spaces. Hereby, space refers to the plan dimension or surface area and not to the cubic capacity or volume (see Appendix 10.3).

Recommendations

- Spaces made available should be based on the **600x400** master module. This adds up to a total of five modular dimensions: 1200x800, 800x600, 600x400, 400x300 and 300x200 mm
- The height of secondary unit loads is left up to the discretion of the user but should be derived in a modular form from the maximum stacking heights of tertiary unit loads.

Additional Guidelines

- If secondary unit loads cannot be designed in accordance with the above plan dimensions, they should fit the modular tertiary space
- The plan dimensions 1200x1000, 400x200 and 300x100 mm are also recognised. The first is further covered in Chapter 7 – Tertiary Items.
- Primary products should be adapted to reflect modularity, subject to market requirements
- No plus tolerance is allowed. Fully loaded secondary unit loads, including bulging, as a result of other loads stacked on them, may not exceed the designated modular space.

Such an approach is contrary to the current practice, in which packaging is designed primarily to protect primary products. In order to follow these recommendations, it will be necessary to adapt primary product dimensions to best utilise modular secondary and/or tertiary space available, and to review order quantities.

- To optimally use modular secondary spaces, primary product dimensions have to be reviewed and replenishment quantities and case count reconsidered.

- A manufacturer in the EUL team: "From our analysis, we have discovered that we can improve pallet utilisation by seven to ten percent, by introducing only minor (less than 1 cm) changes to our primary pack sizes – and we have already started doing it!"

5.3. Handling Efficiency

The main difference between handling at the factory (packing and palletising) and in the store (unpacking and shelf replenishment) lies in the degree of automation. Handling at the plant is often highly automated, dealing with a limited range of secondary unit loads, at a low handling cost per unit. In contrast, shelf replenishment is a manual operation, handling a wide variety of secondary unit load types, which are costly per unit. Although both operations will benefit from improved harmonisation of secondary unit loads, the shelf replenishment process is of special interest. According to estimates provided by the EUL team, shelf replenishment on average amounts to 1.7 percent of the retail sales price.

Currently there is often a duplication in handling as primary packs are placed into secondary packaging by the manufacturer, then taken out again by the retailer before going on the shelf. The cost of packaging must be considered in addition to the handling cost. Eliminating one of these two handling steps should be a priority within EUL.

There is considerable potential in placing the secondary unit load on the shelf as a display item since this eliminates most primary handling. Secondary unit loads serving as display items should have an attractive appearance and allow easy consumer access.

■ Shelf replenishment costs amount to 1.7 percent of retail sales price.

To limit handling costs, several retailers have developed detailed individual guidelines. This could potentially add complexity and general retail guidelines would be useful.

Since key secondary handling elements are palletising and assortment creation, secondary items must be designed for both manual and automatic handling.

The following aspects should be considered when handling secondary unit loads:

- Safety: use of knives to open firmly glued, secondary unit loads is intrinsically unsafe. Accidents result from handling the knife and from the sharp edges produced by cutting corrugated board. The primary pack can be damaged
- Ergonomics: size, together with weight, determine whether it is ergonomically sound to handle a secondary unit load manually. Guidelines and legislation on the maximum weight allowed for a secondary unit load exist, but they differ by country. Harmonisation is desirable with a recommended maximum weight of about 15kg. The European Council Directive 89/391/EEC should be a reference (see also ergonomics impact on pallet height in Chapter 7).
- Stacking: pack sizes closer to modular dimensions improve stacking of any mix of secondary unit loads, particularly assortments. Interlinked stackability within the module, a feature in many RTI systems, is often ideal, together with interlinked stackability within the tertiary load – key when using pallets.

Shelf replenishment cost

Example of a major European retailer:

A comparison of activity costs for different secondary unit loads was carried out, including: opening and emptying the secondary unit load, putting the product on the shelf, and recovering the waste material. Relative costs, using the first as a reference were:

Cardboard box without lid	**100%**
Cardboard tray plus foil:	**110 %**
Paper wrapper:	**125 %**
Cardboard box with lid:	**140 %**
Foil wrapper:	**150 %**
Cardboard wrapper:	**150 %**

Source: A.T. Kearney, Efficient Unit Loads project

- Identification: efficient identification of secondary unit loads improves the productivity of many activities along the supply chain, such as checking and order picking.

5.4. Material Management

Cost and environmental considerations dictate that minimal new material should enter the cycle. Material requirements of secondary unit loads vary significantly and need to be evaluated by product and application, however, the following guidelines can be applied:

- As little material as possible should be used
- As few different materials as possible should be used
- If two or more different materials are used, they should be easy to separate
- No composite materials should be used
- Materials must be readily recyclable and should be marked to facilitate separation for recycling
- Additional elements such as glue, adhesive tape and printing colours should be environmentally sound and must not impede recycling.

5.5. Conclusions

The proliferation of secondary unit loads adds complexity and leads to poor space utilisation, throughout the supply chain. Traditional methods must be challenged and manufacturers and retailers need to work together, using the seven recommended module dimensions, to develop efficient secondary loads. Compromises can be achieved, although they will involve trade-off analysis, such as:

- Case count versus modularity
- Shelf dimensions versus modularity
- Shelf replenishment versus modularity
- Shelf facings versus modularity
- Secondary height versus pallet loading height
- Stability versus material usage.

Secondary loads, far more than tertiary loads, require a multi-functional approach, because of their key interface with the primary product. A key to success is challenging the current constraints imposed by the design of primary products, redesigning them to fit modular spaces and designing secondary loads to fit shelves and tertiary spaces.

6 REUSABLE TRANSPORT ITEMS (RTI)

Secondary Reuseable Transport Items, especially promoted by retailers, can offer significant savings potential for specific product categories.

6.1. What are Reusable Transport Items?

Reusable Transport Items (RTI) include all secondary and tertiary unit loads designed for widespread use and to be returned by the receiver for reuse (for the definition of "reuse" see Appendix 10.1.). Secondary RTI are sometimes called Reusable Transport Packaging (RTP). Excluded are reusable primary packaging such as bottles and combinations of reusable primary and secondary packaging, such as beer bottles in cases. Also not considered are reusable unit loads used in close circuit or captive systems, such as display items.

All design features concerning tertiary RTI are covered in Chapter 7. Most requirements of secondary unit loads, depicted in the previous chapter, are also valid for secondary RTI, but with some important additional requirements. Also, as the secondary RTI market is growing rapidly, this chapter focuses on secondary RTI.

6.2. Secondary RTI Applications

Secondary RTI are only suitable for certain applications. To obtain maximum benefit they should be applied over a total supply chain. Secondary RTI have potential for significant quantifiable cost savings, mostly within the assortment handling, or retail part of the supply chain. It has been noted that corresponding improvements in retail operations represent one percent of retail sales price, while exact savings are dependent on the particular application.

- Secondary RTI have potential for significant savings that can be as much as 1 percent of retail sales price.

Potential sources of supply chain savings:

- Lower packaging costs for those applications where RTI are cheaper
- Integrated supply chain solutions such as trays with dollies – described in Chapter 7 together with new replenishment techniques – pick-to-store in manufacturing, followed by cross-docking in the RDC; pick-by-line
- Improved transport utilisation to stores, using trays and dollies instead of roll cages and due to the fact that RTI fit modular spaces
- Easier checking through consistent positioning of labels / bar-codes
- Handling productivity gains in assortment creation, including automation
- Handling productivity gains in shelf replenishment
- Less product wastage through reduced product handling and improved product protection
- Reduced cost of disposal or recycling of waste packaging.

Non-quantifiable potential benefits:

- Competitive advantage, if supply chain members prefer RTI
- RTI as one solution to increasingly stringent environmental legislation
- Improved handling safety
- Some increased flexibility in designing primary packaging, as stability requirements are less stringent
- Increased sales through better product condition, and improved display using appropriate RTI and shelf design
- Public perception as "green"
- Less hassle for the consumer due to more efficient shelf replenishment during store opening hours

RTI risks:

- Potential need to re-invest in packing line systems
- Sub-optimal primary product fit especially for rigid primary packs
- Proliferation of unit loads resulting in SKU proliferation, due to some supply chain players requesting RTI and others one-way
- Proliferation of incompatible RTI types and administration systems
- Increased storage and primary transport costs of lower density loads. The lower density results from the RTI internal space not being fully used and the thickness of RTI walls
- Failure in the supply of RTI, leading to production delays
- Unacceptable hygiene or flavour-transfer risks
- Failure in achieving high turn rates
- Lack of effective management systems
- Losses and security costs
- Automation problems caused by inappropriate RTI and incompatible RTI types
- Insufficient storage space for empty RTI
- Loss of control of RTI costs.

■ Secondary RTI are one key to supply chain integration.

In a competitive environment these savings will ultimately result in lower prices for the consumer.

To achieve RTI benefits, all supply chain players – manufacturers, service providers, retailers – have to work together. Working together is also essential to detect and minimise the potential risks associated with RTI applications.

To determine whether the whole chain does benefit from RTI, a dialogue between players based on real costs and benefits is needed, as is a compensation mechanism between trade partners. TRANSBOX is one example of a successful system.

TRANSBOX

In 1991, Kesko, Finland's largest retailer, introduced RTI in order to reduce logistics costs, including the cost of waste packaging disposal. They chose a 600x400 master module, stackable and nestable, strong and easy to handle both manually and by automation, which provided improved product protection.

Retail competitors followed suit, but instead of developing their own solutions, they agreed to create a joint pool with Kesko. This was also supported by seven key food suppliers. Jointly, the pool members account for 95 percent of retail turnover, and 50 percent of food turnover. The pool – TRANSBOX – operates at cost, with the founder companies as shareholders.

TRANSBOX now administers a pool of approximately 2.32m boxes, of three height and colour variants. This includes forecasting demand and buying more RTI if necessary; transporting stocks to where they are needed in advance, usually using empty legs of shareholders' vehicles; ensuring high utilisation and controlling losses. TRANSBOX only charges a user fee to cover administration and any excess transport. It is considering the option of introducing a deposit to reduce the loss rate.

TRANSBOX has proved highly successful, with a per trip fee significantly less than the cost of most one-way packaging.

6.3. Key Success Factors for RTI Efficiency

For secondary and tertiary RTI to be successful, cost advantages must be generated over one-way. As with every other unit load, there are two costs associated with the use of RTI: the per usage fee and the "supply chain cost" including all costs from the actual use of the unit load. RTI are most cost effective if they:

- Comply with a set of common European standards that provide the framework
- Have the right RTI design
- Are used for the right application
- Are managed efficiently.

6.4. A Set of Common European Standards

Currently, a proliferation of secondary RTI designs are causing significant inefficiencies wherever incompatible versions mix in the supply chain. This results from a lack of standards at a European level, together with a large number of various degrees of freedom, which include: outer dimensions, inner dimensions, material, stacking system, volume reduction system, and specific application needs. Secondary RTI should comply with a pan-European set of standards in order to achieve compatibility across the overall supply chain. These standards must address:

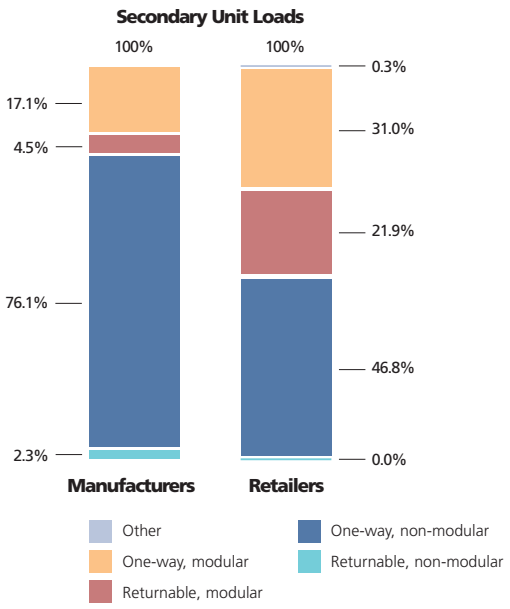
- Maximum external dimensions, based on the space to be occupied. The length and width aspect of this standardisation are uncontroversial, as the plan dimension of **600x400** is the Europe-wide standard
- Stacking system characteristics, so that items of different types or derivative sizes, e.g. half crates, will interstack easily (speedily and with a low cost impact) and securely
- Minimum internal dimensions, so that primary packs may be designed to make best use of internal space and be easy to withdraw, to avoid changes of primary pack dimensions or wasted spaces when migrating from one RTI system to another
- Filling system characteristics, so packing machinery may be adapted to suit.

At a European level only the external dimensions of length and width are standardised. Current secondary RTI systems usually comply with the ISO standard 3394 as can be seen in Figure 21.

To limit proliferation, two plan dimensions are needed: **600x400** and 400x300 mm for most applications. No standardisation exists for the third external dimension in height. In this case, the approach outlined in the recommendations on secondary unit loads should also be applied.

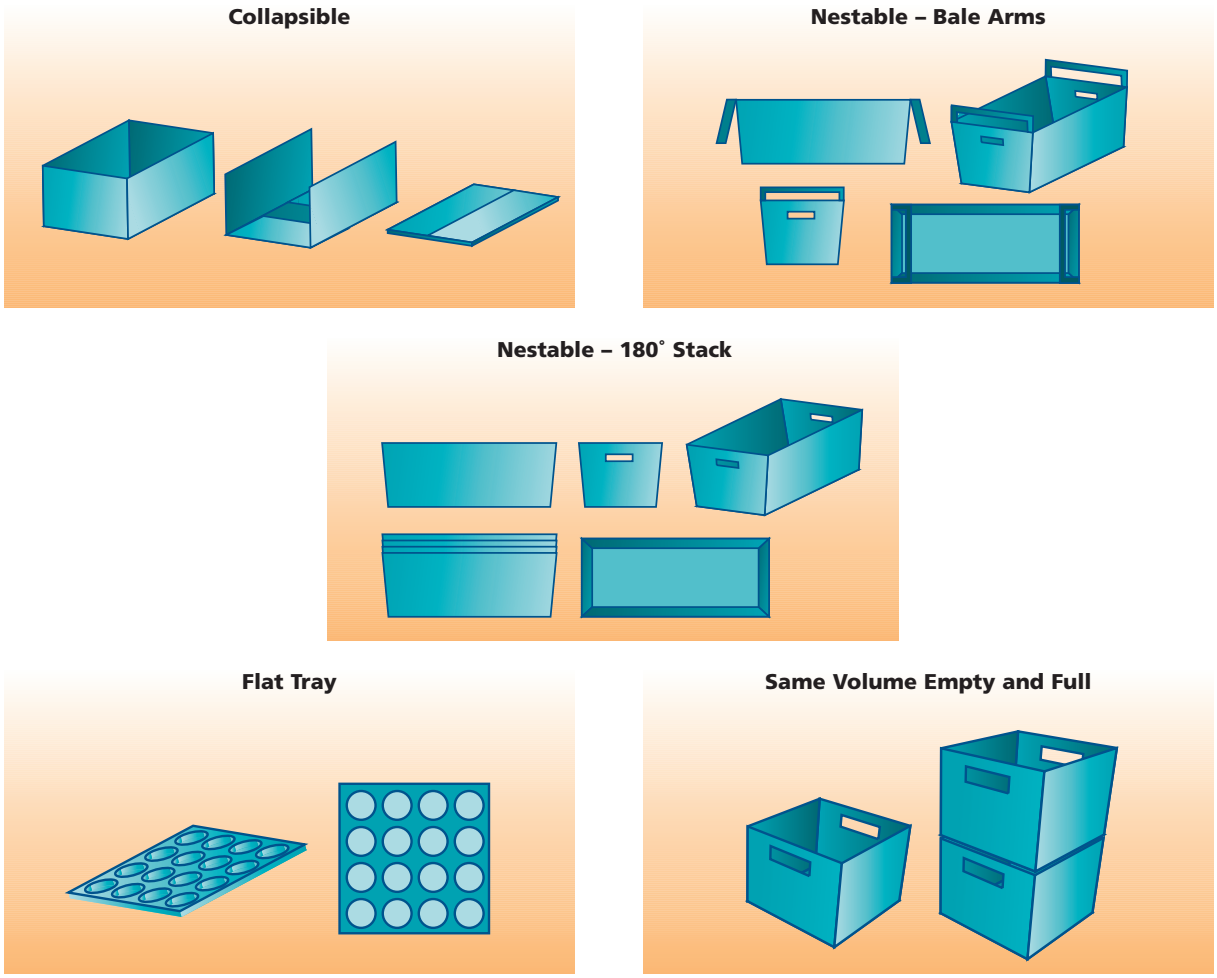
Figure 21: Product volume by unit load type

Distribution of product volume shipped by unit load type



Source: A.T. Kearney Survey, Efficient Unit Loads project

Figure 22: Some RTI design alternatives



Source: A.T. Kearney, Efficient Unit Loads project

6.5. The Right Secondary RTI Design

Although specific applications require specific features, typical design criteria are:

- Suitable for both automated and manual handling, e.g. with handholds
- Limited in proliferation, whilst not constraining development
- Ease of identification, automatically and manually, in terms of the item itself, the owner and the RTI contents
- Be durable

RTI is appropriate in two different environments. The first is in dedicated retail operations, where it allows efficient shelf filling, eliminating the cost and handling associated with secondary packaging. In this type of dedicated system, the higher the turn rate of such RTI, the more the retail investment is justified. Retail-owned RTI used for fresh fruit and vegetables, for example, can generate a turn rate of 20 upwards.

6.6. The Right RTI Management

An appropriate management system for secondary and tertiary RTI has to ensure that RTI stocks are in the right place, quantity and condition, i.e. clean, at the right time. The management system covers forecasting, stock balancing, control, communication channels, hand-over, servicing and charging. Much of the inter-company communication required for (forecasting data, orders of empties, invoices, payment) should be electronic. Guidelines on the efficient use of Electronic Data Interchange (EDI) have been published by ECR Europe in the ER and EDI Report.

Depending on the particular application, management systems vary significantly. The main differences occur in the ownership of RTI and their penetration, leading to individual, bilateral and pool RTI systems. Management systems should focus on three aspects:

- Harmonisation
- Turn rate
- Forecasting

- On a day-to-day basis, a large Dutch retailer handles some 50 different, mostly incompatible, secondary RTI. These are managed by a variety of different systems and therefore, harmonisation would simplify operations.

The management control system should focus on improving the turn rate first rather than on controlling current losses. Used in conjunction with accurate forecasting, this will ensure that RTI are in the right place at the right time.

Other aspects of an effective control system are:

- Choice of system supplier, so that competitive pressure leads to high standards and low prices
- Some obligatory rules, but maximum flexibility within these rules, so that systems can be tailored to particular applications
- Defined construction standards – some of these will also pertain to legislation, e.g. for RTI in contact with primary food products. All RTI joining a pool should meet these standards.
- Effective procedures for ensuring that items are undamaged and meet set hygiene standards
- Simple, low cost, inter-pool compatible administrative procedures
- RTI logistics service providers with an obligation to collect and sort items from all pool operators
- Security arrangements to avoid the development of "grey markets" in RTI or misuse.

- The Efficient Unit Loads team recommends establishing a RTI council under the umbrella of EAN International, supported by the CCG and other national initiatives dealing with RTI. Its purpose is to establish standards and promote best practice in developing and managing RTI.

6.7. Choosing the Right Secondary RTI Solution

In deciding whether or not RTI is suitable for a particular application, many factors should be considered. To facilitate such a decision a number of useful criteria are depicted in Appendix 10.4. Based on a model provided by Konferenz Industrie-Handel, these criteria, for example, include seasonality, product, protection and supply chain structure. Additional criteria can be incorporated to reflect particular business needs. Fruit, vegetables and fresh meat, often shipped in RTI, are examples of products which meet such criteria, however, other products may also be suitable.

If RTI appears to offer potential advantages, the next steps should comprise the following five points:

".. SET UP AN APPROPRIATE TEAM"

Within most organisations, RTI impact many functions: product development, packaging design, marketing, production planning, production, sales, buying, transport, warehousing, and retail operations. If RTI is only perceived, e.g. as a packaging issue, it is unlikely that a whole supply chain view can be taken, and thus, decisions to adopt, reject or vary RTI systems will be based on incomplete data.

- Intelligent use of RTI is a multi-functional issue.

"...GO FOR THE EASY WINNERS FIRST"

It is beneficial to introduce RTI systems from the start but to avoid some of the problems inherent in a mix of RTI and non-RTI systems an overall introduction for a complete category is recommended. A good approach is to introduce RTI systems initially for those applications that are likely to produce immediate, obvious benefits across the whole supply chain, obtain these benefits quickly, and use that initial experience as an incentive to adapt more categories progressively to RTI.

"...CHOOSE YOUR PARTNER"

Supply chain partners need to form partnerships to obtain a whole supply chain view. While one or the other partner may be the initiator or be dominant initially, the best result will be obtained from willing, co-operative organisations able to take balanced views, and with salesman/buyer or other functional relationships that take account of more than just item unit price.

"...DIFFERENT BUT COMPATIBLE"

There is always a temptation for partners to regard each supply chain as unique, requiring a unique RTI solution. This may be the case, but wherever possible, operating and design principles should ensure that the preferred system is compatible with other systems.

"...TWO PLUS TWO MAKES FIVE"

Traditionally, supply chain costs have been commercially sensitive. Can partners trust each other enough to believe each set of figures? The financial and the soft benefits and costs must be calculated. If a competitor adopts RTI there could be a penalty. If the net benefit is sufficient to justify change, then:

- Negotiate sharing of benefits and costs between the partners
- Adapt the organisation, methods and systems to reflect use of RTI and to optimise benefits (if there was a net benefit using RTI with the existing organisation, methods and system, there will be a greater benefit after adoption)
- On-going, find ways to improve the number of turns achieved per year. Poor RTI utilisation costs money.

Organisations that can provide assistance include:

- Associations such as EuroCommerce or AIM, who are aware of RTI progress in their sectors, and can recommend European and national associations
- ECR national boards, now operating in most Western European countries
- CCG – especially on rules for ensuring compatibility of RTI designs, and on operating systems for pools of RTI
- Management Consultants – who can bring previous experience, objectivity and partner identification to an RTI project
- Standardisation bodies – such as EAN, CEN or its national standards institutes, who develop the standards
- Manufacturers of RTI – generally plastics manufacturers, who often have a useful overview, and will be up-to-date on the latest design techniques
- Commercial Partners – such as manufacturers or retailers, who may already be using RTI with other partners; or RTI pool operators and service providers expanding their businesses.

7 TERTIARY UNIT LOADS

Tertiary Unit Loads can have a significant economic impact and reduce total grocery truck movements by 15%.

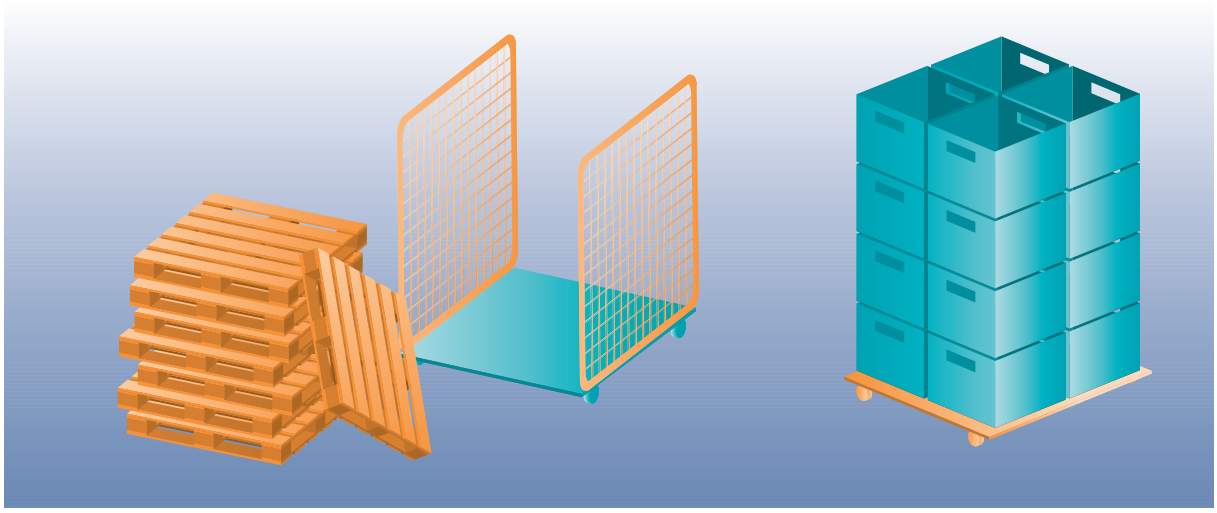
7.1. What are Tertiary Items?

Tertiary packaging is "Packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packaging in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers" (94/62/EC), but does include pallets, roll cages, dollies, slip sheets, box pallets and display pallets.

Tertiary items consolidate quantities of secondary or primary items to facilitate handling activities such as receiving, storage, loading, transport and shipping, using equipment such as forklift trucks, racking, roller/chain conveyors and trucks. They also provide protection and stability to primary and secondary goods in transit. However, the tertiary items themselves take up valuable space and load weight, reducing the number of secondary items which can be carried or stored. They can have other uses, e.g. to display product in retail outlets.

- Tertiary items facilitate storage and transport by improving handling productivity. They are also used for product display and to provide protection and stability.

Figure 23: Pallets, roll cage, dolly and trays



Source: A.T. Kearney, Efficient Unit Loads project

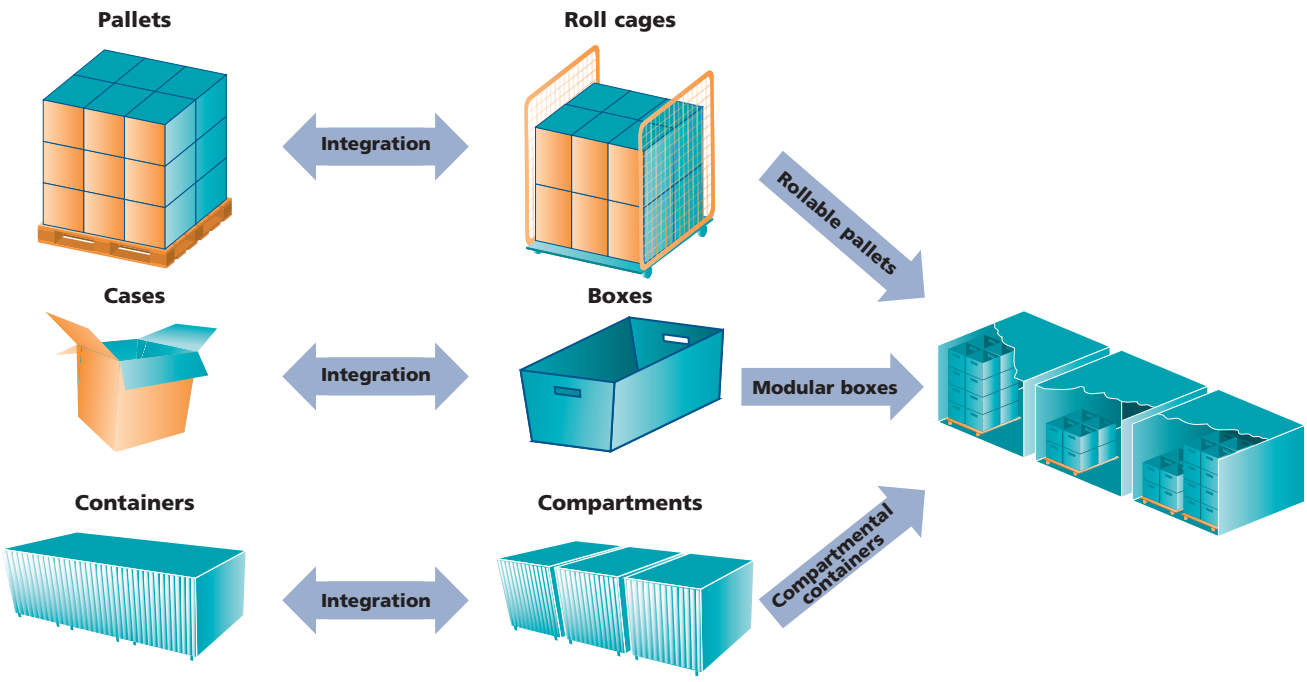
In their various roles, tertiary items offer significant potential for total supply chain savings and are key to integrated supply chain solutions.

The pallet is the predominant tertiary item used in the factory, with dollies sometimes used to carry stacks of RTIs. The roll cage is the predominant tertiary item used in the retail part of the supply chain. However, developments such as Efficient Replenishment will require new tertiary solutions which can be used right across the whole supply chain.

In Europe, a proliferation of unit load dimensions exists – footprints and heights – resulting from piecemeal development within single nations and different supply chains. The rationalisation of manufacturers' logistics networks – with one or few European plants and/or central warehouses supplying many countries – and the growing internationalisation of retailers have resulted in the increasing interchange of tertiary items. With trends towards faster throughputs, mechanised handling, and environmental concern there is a need to standardise and rationalise fragmented tertiary items.

- Supply chain developments increase tertiary mixing and interchange and drive the need for state-of-the-art developments.

Figure 24: Integration of unit loads



Source: A.T. Kearney, Efficient Unit Loads project

7.2. Pallets

The pallet is the dominant tertiary item. Today, in Europe, there are around 280 million pallets in circulation (Chep, 1993). These comprise more than 30 different pallet sizes and types. The following guidelines cover: pallet plan dimensions, pallet overhang, pallet height (load plus item), load weight, and item height.

- In Europe there are more than 280 million pallets in use, comprising more than 30 different sizes and types.

Pallet plan dimensions

The currently diverse European pallet population should be rationalised.

In the EUL project survey, Chapter 3, retailers and manufacturers agreed that the **600x400** master module should be the basis for the recommended pallet footprint. The pallet footprints of the Euro-family are compatible with this module.

The Half Euro pallet, **800x600** mm and the Quarter Euro pallet 600x400 mm are used mainly for display purposes, although both pallets can play a useful role in cross-docking operations to minimise order picking. The Quarter pallet's current design means that a second and bigger pallet is needed for racking. Development is therefore required to allow easier handling and stacking.

The Industry pallet – 1200x1000 mm – is also recommended in particular product sectors, e.g.

- the beverage industry, where it is often used in factory-to-outlet 'captive' systems,

and in particular countries, e.g.

- UK
- The Netherlands
- Finland.

Advantages of the industry pallet include larger unit loads, handling efficiency and stacking stability by allowing interlinked stacking of 300x400 units. Although it is recognised that using the half industry pallet within an infrastructure designed for using the full industry pallet has efficiency advantages, the half industry pallet is not a recommended dimension. This is mainly because the half industry pallet is incompatible with the 400x600 module. In addition, the advantages already mentioned for the full industry pallet do not apply to the half industry.

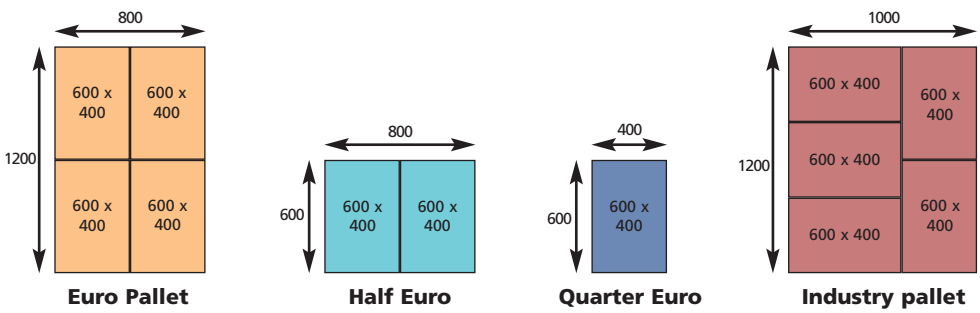
- 4 pallet plan dimensions are recommended: 1200x800, 800x600, 600x400 and 1200x1000mm.

When grocery manufacturing was largely country based, companies used Industry and Euro pallets in discrete operations. An increase in pan-European manufacturing has forced companies to operate with two separate pallet systems, often in the same plant or DC. Another disadvantage of using both Industry and Euro pallets concerns racking, where bay width has to find a compromise that is sub-optimal for both. There are therefore disadvantages when the Euro and Industry pallet are used together.

There are two solutions:

- Rationalise to one pallet for those countries and companies using both Euro and Industry pallets. Some companies have already changed to Euro pallets, notably some beverage companies which distribute from one pan-European factory across Europe. However, it will take time to implement such a change.
- Increase the volume of cross-docked products. A single tertiary item will then move through the supply chain from manufacturer to retailer, eliminating many of the current non-value adding handling steps and disadvantages associated with two different pallet formats.

- Long-term only one pallet family is favourable for Europe.



Pallet Overhang

Pallet overhang is a key cause of product damage. Loads which overhang pallet edges are damaged by handling equipment and can create problems for automated handling operations and vehicle loading. Zero pallet overhang is therefore recommended.

- Zero pallet overhang is recommended.

Pallet Height

The height of a pallet – load plus item – as it moves through the supply chain is a key cost driver. A variety of factors and constraints determine pallet height, and an analysis has been carried out to identify their relative importance within the total supply chain. This addressed the impact of transportation, order picking, storage racks, packaging costs and store operations.

- Transport
  Transport is the key cost driver and due to the significant environmental damage caused by road transport, optimisation of truck volume is of paramount importance.

- Pallet height should be derived from inner truck height dimensions and should maximise height utilisation.

Current pallet heights are often based on previous lower vehicle heights. The calculation below demonstrates that there are 15% extra grocery trucks on European roads as a result of failure to optimise available height, which is currently 2400 mm for standard trucks and 2800 to 3050 mm for 'high cube' vehicles. New internal truck heights which are typically 2700 mm, and technical developments, such as double stacking, should be monitored and pallet heights increased accordingly.

Since many loads are not weight limited full inner truck height, e.g. up to 3050 mm, should be utilised for light loads.

Once a load has been formed it should be maintained as far along the supply chain as possible, therefore restrictions on height, such as door dimensions should be removed by investing accordingly..

- Improved truck volume utilisation could result in major environmental improvements.

Extra grocery trucks on the road (example calculation)

- **Assumptions:**
  - pallets item height of 150mm
  - truck internal height of 2400mm (net of handling room)
  - weight limited: volume limited trucks = 50:50
- **Efficiency:**
  - truck height available for product = 2400 - 150 = 2250mm
  - product height on a pallet height of 1950mm (CCG2) = 1950 - 150 = 80%
  - truck cube utilisation (space available for product) = 1800/2250 = 80%
  - average across all current typical load heights = 70%
- **Extra grocery trucks:**
  - opportunity to fill the empty 30% only applies to volume limited trucks, i.e. approx. 50% of them
  - extra grocery trucks on the roads in Europe **15%**

- Order Picking
  The wide variety of picking heights used in different companies make it impossible to derive a common standard. Ergonomic considerations should not be a key determinant of pallet height, except for retail displays.

  Optimising transport height can result in warehouse inefficiencies, with sub-optimal warehouse layout and pickers using a variety of devices to reach difficult cases. Therefore, a trade-off needs to be made between:

- Providing pickers with safe, flexible and cost effective equipment, e.g. elevated picking devices which would allow them to operate at any time under safe and efficient conditions
- Incurring handling costs at the entry to the distribution centre, by lowering transported heights to safe picking heights.
- Storage racks
  Storage costs are usually considerably less than transport costs, therefore, optimisation of transport cube remains key. Although rack heights can be difficult to adjust due to in-rack sprinkler systems, and automation and welded cross beams can make racking inflexible, this should not be viewed as a key constraint and should be altered in the long term. It is recognised that investment in racking, for example, in automated warehousing, is crucial and such change could take time. The introduction of ER techniques such as cross-docking and reduction in inventories mean that the constraints imposed by storage racks will become less significant.
- Packaging cost
  As pallet height increases more packaging is needed to protect the product and load. The cost of such packaging needs to be considered.
- Store operations
  Store door heights can be constraints on pallet height. Display pallet heights are normally 1600/1700 mm and often lower to allow consumer access, with consequent loss of transport efficiency, unless pallets are transported, double stacked or delayered at the store.

Pallet load weight (pallet item excluded)

Pallet load weight is not a critical issue within ECR, except for manually handled pallets in cross-dock operations and retail stores. The following recommendations have already been established for maximum weights:

Maximum Pallet Load Weights (kgs)

Individual Euro pallets

- 1000 – weight not distributed
- 1500 – evenly distributed weight
- 2000 – compact load, fully spread on pallet

Source UIC-Codex 435-2 V 07/94

Stacked Euro pallets:

Individual Euro pallets

- 4000 – for bottom pallet, using full surface

Other pallets:

	Individual	Euro pallets
• Half Euro	500	2000
• Quarter Euro	250	750
• Industry	1250	6000

Source Chep

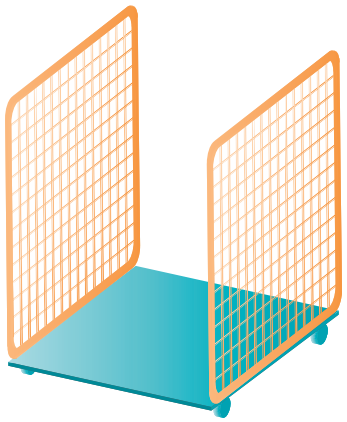
Pallet item height

Most pallet item heights vary between 145 and 162 mm. No guidelines for pallet item heights have been recommended, since this could potentially hinder the development of new materials for pallets, e.g. pallets made of recycled secondary material. The Industry pallet item is about 10 mm higher than the Euro pallet – a consideration when designing item plus load heights.

Part pallet heights

Since optimisation of transport cubes is key, this must be the main consideration when building part pallet loads. A number of options exist, such as slip sheets, to optimise the 'dead space' used by the pallets themselves but this will involve a trade-off with extra handling. Similarly, half height pallets can be designed to correspond to half truck height, rather than half pallet height (including the pallet itself).

Figure 25: Example of a roll cage



Source: A.T. Kearney, Efficient Unit Loads project

7.3. Roll Cages and Dollies

Roll cages are used extensively in many parts of Europe to carry assortments of secondary items from retailers' RDCs to stores.

The resulting benefits explain their extensive use. However, they also have major disadvantages.

Since fleets of roll cages are usually owned (or operated) by individual retailers, mostly in captive systems, there are no standard footprint or height dimensions and their designs differ radically. Also, an individual retailer may operate several different roll cage variants, sometimes compatible, and often intentionally incompatible, to help sorting and return to the correct re-use location. For this reason, no specific guidelines on roll cage dimensions have been provided.

Advantages of roll cages compared to pallets

- Sides contain the load, so it is less important that the assortment is incompatible for stacking
- They can be as high as vehicle, doorway, or ergonomic constraints allow, giving potential for better vehicle and warehouse space utilisation
- When wheeled, they permit faster loading and unloading of vehicles, and avoid the need for forklift trucks in stores
- Shrink-wrap or glue are not required to stabilise their load
- They can be designed to provide some product security
- Optimum loading method is through end doors from a dock, which is fully consistent with maintenance of temperature regimes, whilst pallets are best side-loaded for speed
- Roll cages are fully consistent with replenishment straight to store shelf, without handling in the back room, resulting in significant in-store productivity benefits.

Disadvantages of roll cages compared to pallets

- They are expensive, often ten times the cost of a pallet
- They can be damaged, are costly to repair, and inspection to identify repair needs is expensive and difficult
- They constitute a safety hazard to handling staff, and to customers if allowed on shop floors during trading
- They soon look unattractive in appearance, and are difficult to clean
- They occupy considerable space when empty (even when 'nested' or stacked)
- There is a productivity loss in nesting or stacking them, and in reassembling for re-use
- Their external dimensions are incompatible with the **600x400** master module, since their sides mean that they can only be loaded three across in a standard width European vehicle (the internal dimensions are generally compatible with the **600x400** master module only in that they are sized for modular secondary packaging plus handling space)
- They cannot be placed in standard pallet racking
- They are noisy when in use, for example during loading of empties at stores.

Advantages of dollies

- Significantly less expensive than cages (approx. one third the cost)
- Less damageable
- Can be designed so that damage is very obvious, thus reducing inspection difficulty and costs
- Need no assembly or disassembly
- Are fully compatible with the **600x400** module, so fit four across a vehicle, generating 25% improvement in loadability
- Are flexible in loading height as they have no fixed sides
- When empty, save approximately 80% of the space needed for empty roll cages
- Cause significantly fewer accidents
- Are acceptable in appearance and size on the sales floor during trading
- Are easy to clean.

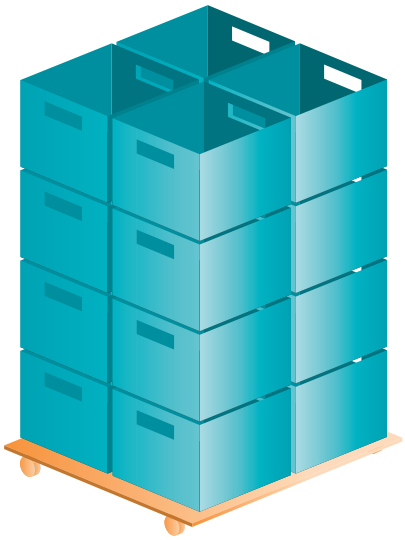
Dollies are also used extensively for retail deliveries from RDCs to stores.

Compared to roll cages, dollies have a number of advantages.

The key disadvantage of dollies compared to roll cages is that they can only be used for modular stacking secondary items, notably RTI or modular items secured with shrink wrap or bands, as on pallets.

- Suggested dimensions for dollies are compatible with the Euro pallet family 1200x800, 800x600 and **600x400** mm.

Figure 26: Example of dolly and trays



Source: A.T. Kearney, Efficient Unit Loads project

In the short-term, tertiary unit load design will involve a number of trade-offs, such as:

7.4. Trade-offs

- Maintaining a space efficient load, requiring minimum handling throughout the supply chain versus investment to remove capacity constraints
- Space utilisation versus handling costs around a constraint, e.g. around a height constraint at the entry to the distribution centre – until this point transport can maximise use of the cube at the constraint, handling costs are incurred to lower heights accordingly
- The efficient use of retail display space, with small, frequent deliveries, versus the penalty associated with poor vehicle fill
- Investment in new EUL and transport infrastructure versus investment in new scheduling systems to maximise the time dimension of capacity utilisation. Both should take place
- Maximum tertiary load height or fill versus secondary count
- Cost of own tertiary fleets, especially non-captive versus use of a tertiary pool
- Tertiary strength and design versus strength of primary and secondary contents
- Load heights versus cost of providing suitable equipment to ensure safe, ergonomic picking
- Tertiary item cost versus security and protection of contents
- Penalties of dealing with a mixture of tertiary item types versus the investment required to standardise on one type, e.g. pallets
- Creating one tertiary load for all supply chains and players, with low complexity, but some penalties, versus a variety of tertiary loads to optimise different supply chains and/or parts of supply chains, with cost of complexity, but lower penalties.

7.5. Other Guidelines

Load stability

Load stability is essential to prevent disintegration during handling, storage and shipment. This minimises product damage and avoids possible danger to personnel. Minimum material should be used for stabilisation and it should be as "ecological" as possible. The stabilisation material should also be easy to remove without damaging the product. Both columnar and interlocked stacking of secondary items are acceptable, although the Euro pallet only accommodates columnar stacking, whereas the Industry pallet allows interlocked stacking of 600x400 secondary items.

Effective administration systems and reverse logistics

It is essential to develop an effective administration system for tertiary items, similar to that described for RTI in Chapter 6. An efficient and effective return logistics system is also mandatory. Existing pallet pools, and recommendations on RTI return logistics in Chapter 6, both provide examples of best practice.

Exchange pallet systems can create problems, especially in automatic pallet handling systems, if the pallet exchanged is of a lower quality than the pallet issued. No pan-European standards exist covering pallets in use, but key criteria are damage levels, cleanliness, possible contamination from previous loads and moisture content (which affects pallet load protection and pallet item weight).

7.6. Conclusions

Developing efficient tertiary unit loads is vital to the success of ECR. The full benefit of ER can only be realised if the same tertiary item is used right across the 'total' chain. Other product flows, shown in Figure 30, would also be improved by using the common tertiary item.

- Current standards and practice poorly utilise vehicle volume.

A critical handling step in many supply chains is the assortment creation point, since this is where the two halves of the supply chain meet. Pallets are the main item in the manufacturers' part of the supply chain to optimise storage and handling. In the retailers' part of the supply chain, the more assortments created, the more pallets are replaced by roll cages and, more recently, dollies. This means that the typical retail RDC will receive one-of-kind products on pallets, and despatch assortments in roll cages or dollies. Since order picking of the assortment is required this change of unit load type has not normally entailed extra handling, but the increasing use of cross-docking will involve an extra handling step if the cross-docked load arrives at the RDC on a pallet and is transported to the store on a roll cage or dolly.

The dolly is currently the most versatile tertiary item, although it is affected by some of the limitations associated with pallets, explained in 7.2. Used in conjunction with RTI, the dolly can be used across the total chain. For other applications, technical developments are needed to overcome these limitations and to produce a tertiary item which will be suitable in both manufacturing and retail environments.

8 BENEFITS

Efficient Unit Loads can result in savings of 1.2% of retail sales price.

Working together to achieve more efficient unit loads across the total supply chain offers significant opportunities for improvement. These will result in both operational cost savings and more intangible, top-line benefits.

8.1. Cost Savings Opportunity

In May 1996, A.T. Kearney conducted a survey amongst members of the project team to estimate potential savings from the use of EUL. Each member considered all cost elements which EUL can influence, the reasons for the EUL impact and potential savings across his or her supply chain.

On average across Europe, EUL can save 1.2 percent of retail sales price. This amounts to some ECU 8.6 bn, based on 1994 turnover for European, fast-moving consumer goods. Since EUL aspects were not included in ECR Europe's Value Chain Analysis project, these EUL potential savings are largely additional to the 5.7 percent target, published in January 1996 by ECR Europe.

What are the sources of these potential savings opportunities? They are mainly derived from four areas:

- Better utilisation of transport cube
- Warehouse storage, handling and assortment creation
- In-store handling and shelf replenishment
- Packaging and materials management

A detailed breakdown is shown in Figure 27.

Although transport utilisation is important, EUL has the greatest impact on handling productivity along the chain – and, in particular, in creating major efficiency improvements at the point closest to the consumer – i.e. at store and shelf level.

In certain instances these savings could double if partners are willing to completely redesign their supply chains.

As with other ECR benefits, EUL savings opportunities will not be equally spread between manufacturers and retailers. Figure 27 shows how the 1.2 percent savings is split between retailers and manufacturers. Retail operations offer the biggest potential. Almost three quarters of the EUL savings potential – close to 0.9

Figure 27: Savings potential breakdown

Sources of savings potential[1]	Manufacturer %	Retailer %	Total %
Better utilisation of transport cube	0.08	0.17	0.25
Warehouse storage, handling and assortment creation	0.05	0.17	0.22
In-store handling and shelf replenishment	-	0.47	0.47
Packaging and materials management	0.17	-	0.17
Other[2]	0.03	0.06	0.09
Total EUL chain impact	**0.33**	**0.87**	**1.20**

[1] % of retail sales price, excl. VAT

[2] Loss & damages, cost of capital, administration, miscellaneous

Source: A.T. Kearney Survey, Efficient Unit Loads project

percent of retail sales price – can be realised in this part of the supply chain, where the main areas of potential improvement are assortment creation, transport and shelf replenishment. Manufacturers estimate EUL savings potential in their operations to amount to an excess of 0.3 percent of sales price, the main sources being packaging, transport and warehousing.

This estimate does not include any change-over costs or other investments which will be required to realise the potential savings. In many circumstances, the optimal solution can only be achieved after appropriate investments in new resources and technology. This should be a subject of further analysis. It could involve designing new packaging, altering storage facilities and installing automated handling equipment. The survey findings and team discussions indicate that manufacturer investments will usually be higher than that required from the retailer, therefore, commercial negotiations should be conducted to ensure that EUL are a win for all supply chain members involved.

■ Retailer's operational gains are manufacturer's investment needs.

Assessing the current situation showed clearly that complying with technical standards alone was not sufficient to create EUL. This would not prevent existing inefficiencies and would not stop the current practice of optimising just one part of the supply chain. This is exacerbated by:

- The upstream globalisation of many international manufacturers
- The downstream captive tailoring of many domestic retailers.

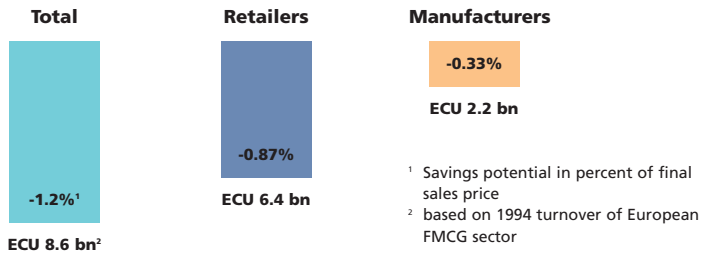
8.2. Intangibles

The EUL project has focused primarily on savings from cost reduction, to be distinguished from gains, such as additional sales revenues or improved margins. Although these are difficult to forecast, EUL can acquire very tangible benefits in this area. The following lists some of the intangibles:

- Reduced product damage
- Improved product accessibility
- Better product presentation
- Improved featuring
- Effective 'take-home' bundling
- Enhanced store appearance
- Environmental or 'green' image.

Last but not least, by reducing dimensional proliferation and simplifying operations, management and administrative resources can be channelled more productively – into reviewing the real performance drivers.

Figure 28: Efficient Unit Loads savings potential[1]



[1] Savings potential in percent of final sales price
[2] based on 1994 turnover of European FMCG sector

Source: 1) A.T. Kearney Survey, Efficient Unit Loads project
2) M & M Euro Data, 1994

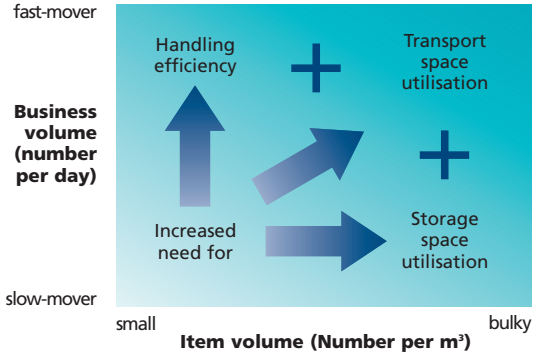
8.3. Choosing the Right Unit Loads System

As discussed earlier, there are two main drivers of Unit Loads Efficiency:

- Those which maximise utilisation of available space
- Those which minimise handling along the chain.

There is no universal solution as impact differs by category and type of product flow.

Figure 29: Efficiency drivers differ by category and product flow



Source: A.T. Kearney, Efficient Unit Loads project

Understanding key cost drivers can be helpful in identifying major deficiencies in current flow structures.

A real breakthrough requires a radical review and a greenfield redesign, considering the potential impact of ER. This could result in:

- More frequent deliveries
- Smaller delivery lot sizes
- Less volume volatility
- Reduced 'in-chain' stocking
- Increased cross-docking

Taking a total process view, EUL need to be tailored to suit a specific type of material flow.

8.4. EUL Design and Supply Chain Design

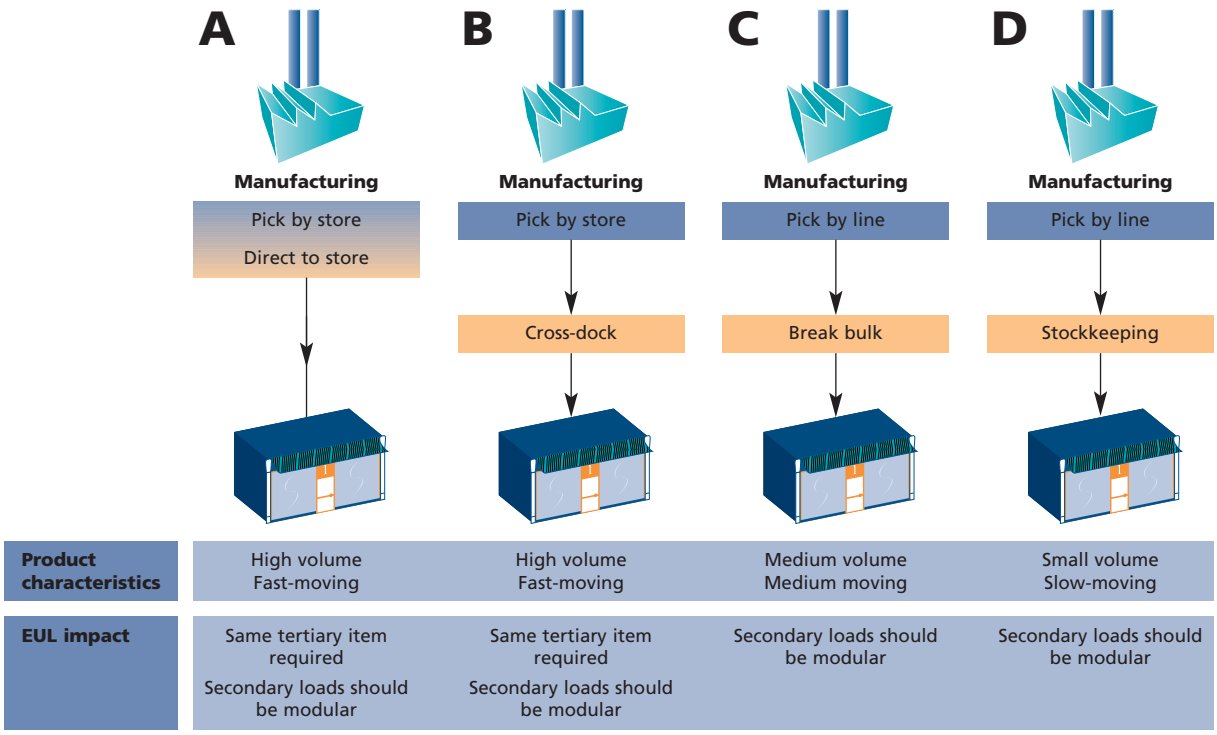
There are many different types of supply chains, driven by product category, volume, retail outlet type and product shelf life. There is no one optimum unit load to suit all types of supply chains. One key factor in determining EUL is the basic product flow. Figure 30 shows the four basic flow models with its three types of handling activities at the manufacturer MDC and at the RDC. These different activities impose very different requirements and constraints on EUL.

- Unit Loads design has to be closely co-ordinated with supply chain design.

Applying ER principles will result in more volume going through type B and C (stockless - consolidation) instead of the traditional supply methods A and D (either direct or via DC-stock).

This enables a set of guidelines and key success factors to be developed, which, if followed consistently, will make future unit loads significantly more efficient.

Figure 30: Basic flow from manufacturer to retailer



Source: A.T. Kearney, Efficient Unit Loads project

Figure 31: Success factors for the consistent flow of Efficient Unit Loads

A
- Easy-to-open and shelf-ready secondary loads or use of re-usable boxes from MDC or even point of manufacturer
- Manufacturer/retailer harmonised tertiary item (pallet, roll cage, or dollies) with continuous application up to point-of-sale

B
- Retailer/manufacturer consistent tertiary items (pallets, roll cages or dollies)
- Synchronised heights of tertiary unit loads
- Flexible order volume management to use capacity of tertiary items

C
- Harmonised secondary items/dimensions to facilitate automated bulk breakup
- Maximisation of pallet height (in-bound RDC/outbound MDC)
- Flexible order volume management to allow shipment of original 'one product' pallets (minimum picking at MDC)

D
- Harmonised storage equipment to allow tertiary unit loads to be hauled without adjustment and optimal use of transport capacity
- Introduction of reusable boxes for small volume SKUs which are demanded as single primary packages at store

Source: A.T. Kearney, Efficient Unit Loads project

There is no single optimum solution for all types of product flows and it is unlikely that there will be one universal solution for all supply chain participants. As technology advances, existing targets, standards, procedures and compromises must be reviewed and changed accordingly.

9 ACHIEVING TANGIBLE BENEFITS

Future changes will require a total supply chain perspective, a process-oriented approach and a strong emphasis on working together.

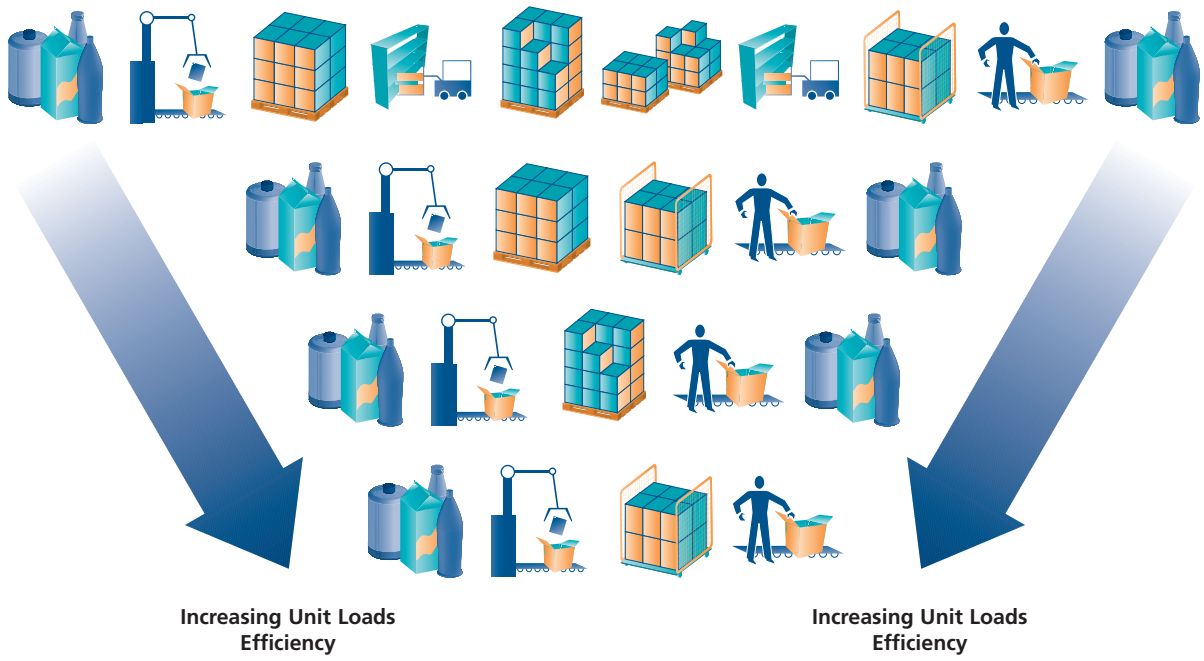
EUL are vital to the success of ECR. They play a special role in the development and implementation of ER but they have a potential impact far beyond this. A clear vision, leadership and a long-term perspective are needed to achieve the EUL savings discussed in this Report.

9.1. Management Focus

Key areas for management focus are:

- Eliminating unproductive, non-value adding assembly and disassembly operations. Currently loads are often built up more than ten times – the target should be considerably less than five (See Figure 32).

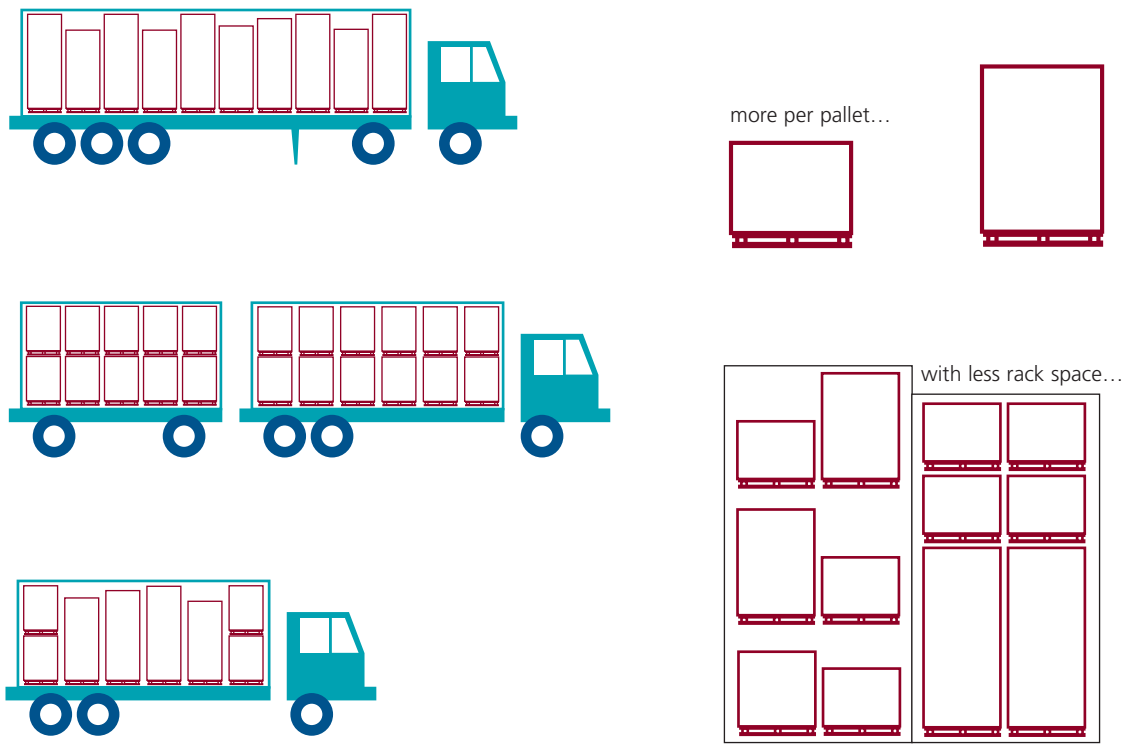
Figure 32: Reduction of handling steps



Source: A.T. Kearney, Efficient Unit Loads project

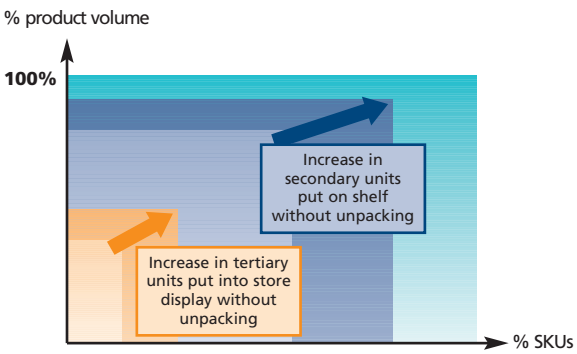
- Improving space utilisation, particularly within long distance transport (see Figure 33)
- Increasing handling productivity in shelf replenishment by developing more secondary and tertiary loads which can be put on shelves or moved more easily into position (see Figure 34)
- Increasing cross-docked volumes with synchronising replenishment and production sequences.

Figure 33: Space utilisation improvement



Source: A.T. Kearney, Efficient Unit Loads project

Figure 34: Shelf replenishment productivity increase



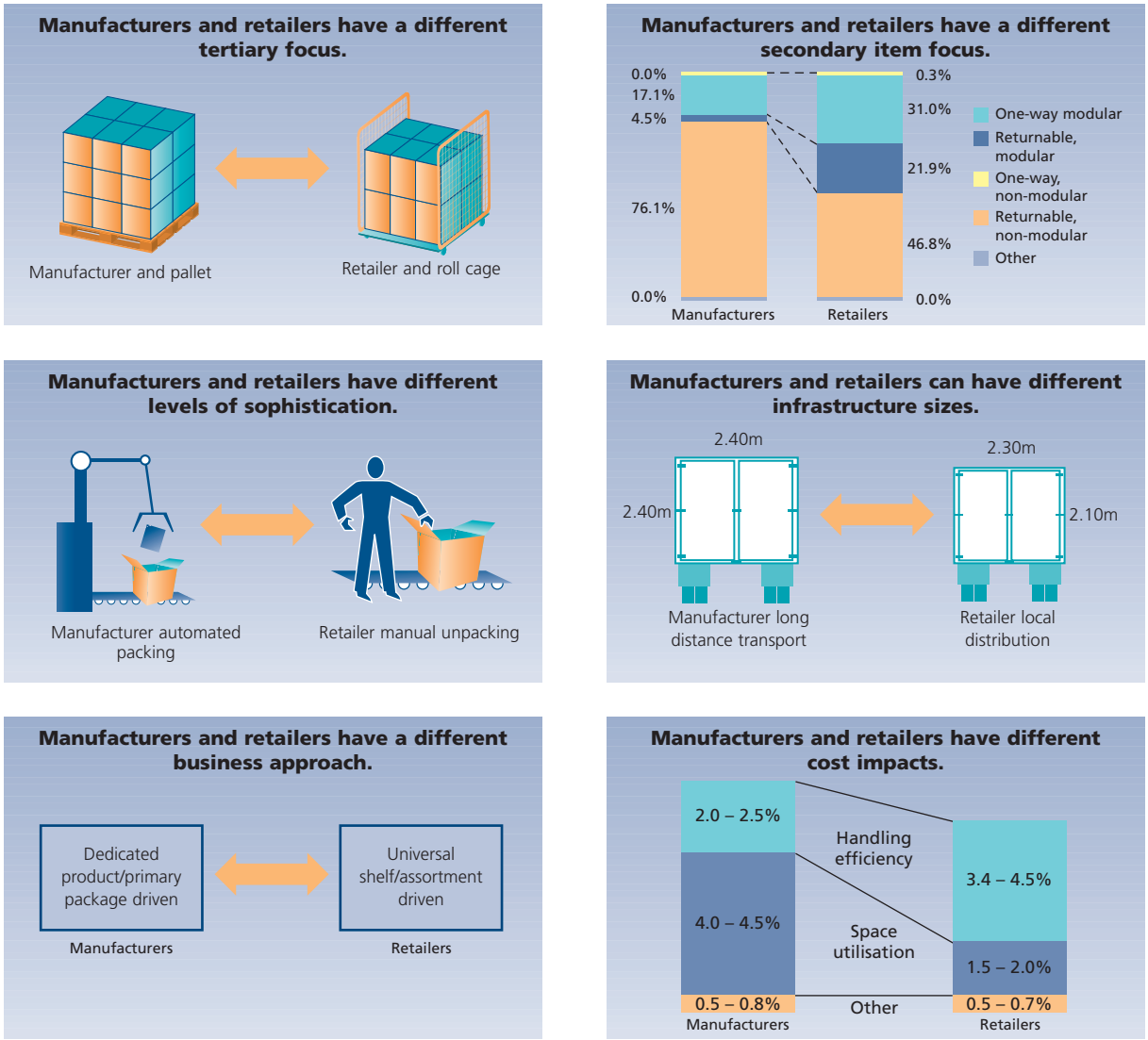
Source: A.T. Kearney, Efficient Unit Loads project

9.2. Key Success Factors

Before achieving these benefits, the following problem areas must be overcome:

- Thinking beyond the 'half chain' view and appreciating the optimum within a 'total' supply chain context. This will involve identifying where the two half chains are disjointed. Figure 35 illustrates the six main differences.

Figure 35: Key differences between manufacturers and retailers

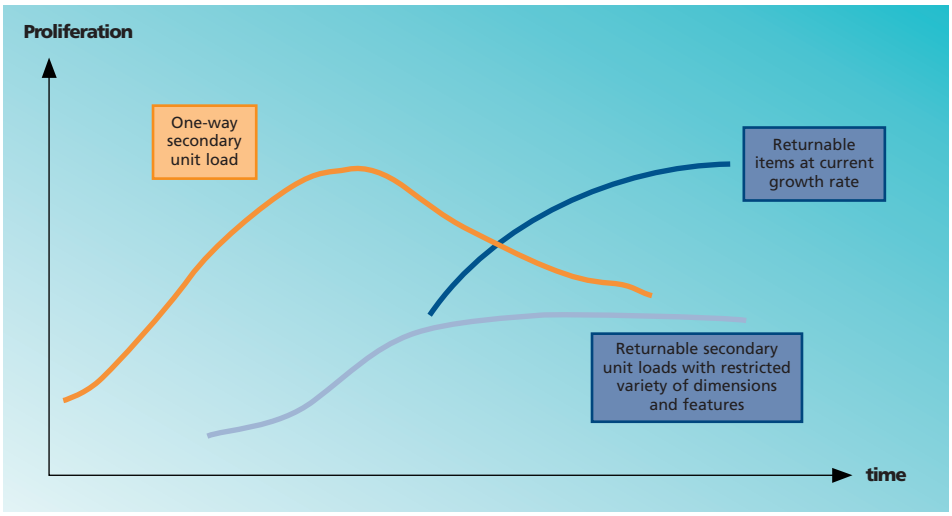


Source: A.T. Kearney

- Accepting only a limited number of fixed constraints and challenging the many variable ones. Adjusting existing standards to reflect technological developments
- Adopting a 'process' rather than a functional perspective and jointly designing unit loads to suit basic category requirements and supply flow models

- Reducing current dimensional proliferation in one-way secondary items and strictly limiting the burgeoning profusion of reusable secondary items or RTI (see Figure 36)
- Initiating research and development for a new generation of integrated tertiary items which will allow more products to be cross-docked.

Figure 36: Unit Loads development



Source: A.T. Kearney

9.3. Recommendations

The following recommendations have been developed jointly by A.T. Kearney and the EUL project team:

1 Manufacturers, retailers, service providers and suppliers of secondary and tertiary unit loads should work together to improve the total supply chain. This can be carried out through bilateral manufacturer – retailer initiatives or ones which also involve third parties. AIM, CIES, Euro Commerce and other organisations should actively support these initiatives.

2 A successful co-operation should start by assessing the current situation. Since many supply chains are not 'transparent', a useful diagnostic tool is the 'Unit Loads Efficiency Matrix' described in Chapter 4. This will provide an objective starting point on which to base discussions. It will identify major inefficiencies, benchmark operations and can be used to help in setting joint targets.

3 Both local, national and European associations should work together to limit the proliferation of unit load dimensions. European standards should be established; no new national standards should be accepted.

4 Existing standards should be updated accordingly to reflect technological or other developments.

5 A standardisation authority should be established at European level to promote best practice in the development and management of RTI. Preferably under the leadership and guidance of EAN International. This authority should be supported by CCG, CBL and other national initiatives dealing with RTI.

6 The ECR Board of Europe has set up several supply chain side related projects:

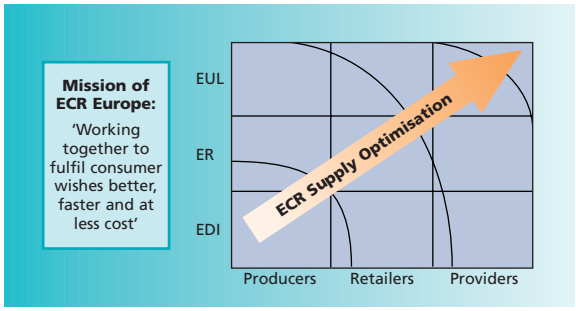
- EDI – Electronic Data Interchange
- ER – Efficient Replenishment
- EUL – Efficient Unit Loads

All three projects have focused on a functional

approach to drive ECR. A more process driven perspective is now required to achieve breakthrough results. As retailer benefits are likely to be manufacturer's investments, suitable ECR pricing models will need to be developed on a bilateral basis. This will be essential in moving current thinking from the 'half chain' view to one which considers the total supply chain – one where total supply chain achievements are rewarded.

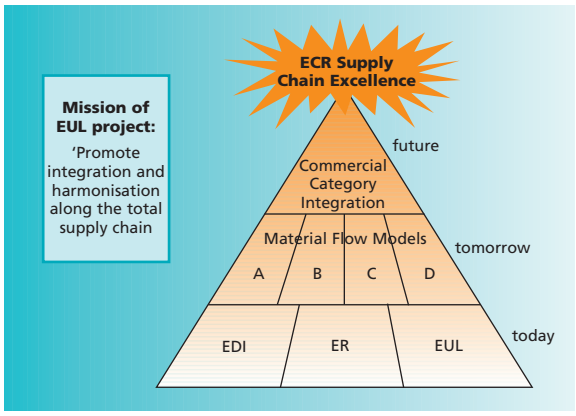
If all grocery players focus on the consumer, A.T. Kearney's vision of the extended enterprise and the seamless flow of information, goods and funds will become a reality as we move into the 21st century (see Figure 39).

Figure 37: Mission and evolution of ECR Europe



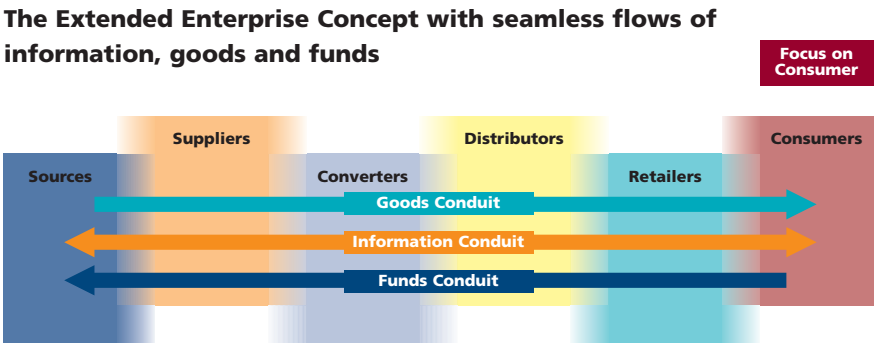
Source: A.T. Kearney, Efficient Unit Loads project

Figure 38: Mission and evolution of Efficient Unit Loads project



Source: A.T. Kearney, Efficient Unit Loads project

Figure 39: The Extended Enterprise Concept



Source: A.T. Kearney

10 APPENDIX

10.1. Definitions

Summarised here are all definitions relevant to this Report. For additional definitions refer to the Glossary of ECR Europe. The EUL team agreed to use European/international definitions wherever appropriate. Sources of definitions have been:

- The European Parliament and Council Directive on packaging and packaging waste 94/62/EC (20/12/1994) and
- The standard ISO 3676 – 1983: Packaging – Unit load sizes – Dimensions
- The standard ISO 3394 – 1984: Dimensions of rigid rectangular packages – Transport packages
- The Glossary of ECR Europe

For truck weights and dimensions please refer to the European Council Directive 96/53/EC. Regulations on the safety and health of workers are given in the European Council Directive 89/391/EEC.

Added Value
The additional value attributed to products, as the result of a particular physical process (e.g. production process, storage, transport).

Assortment Creation
Any operation consolidating product flows to produce a wide range of products. Assortment creation usually takes place in the retail distribution centre.

Bar Code
EAN/UCS (q.v.) system of parallel lines (bars) of varying width allowing a series of digits to be scanned by an optical reader.

Box Pallet
A pallet with a corrugated card 'box' which retains the load in transit and drops down around 150 mm on display to hide the pallet.

Category
A distinct, manageable group of products/services that consumers perceive to be interrelated and/or which can serve as substitutes to meet a particular consumer need.

Central Warehouse
A warehouse which performs central functions within a distribution system, for example keeping stocks of products for the other warehouses.

Code 128 (UCC/EAN-128)
A variable length, bi-directional, continuous, self-checking alphanumeric bar code with a data-set of 105 characters in each of the three individual subsets; each character consists of three bars and three spaces representing 11 modules in width. Uses a Function One Version for numeric application in higher density.

Cross-Docking (CD)
A distribution system in which merchandise received at a warehouse or distribution centre is not put into stock but immediately prepared for shipment to retail stores. Close synchronisation of all inbound and outbound shipments is crucial. In pallet-level cross-docking, entire pallets are received from the vendor and moved directly to the outbound trucks without further handling.

Direct Store Delivery (DSD)
A method of delivering merchandise from the manufacturer directly to the retail store, bypassing retail warehouse facilities.

Distribution Channel
The route which the goods follow from the supplier to the end user, determined by the type of trading parties (e.g. wholesaler, retailer).

Efficient Consumer Response (ECR)
Common collaborative initiative of suppliers and retailers to optimise the joint supply chain to create additional consumer value in terms of lower cost, better service, higher quality and larger variety.

Efficient Promotion (EP)
Suppliers and retailers working together to plan and / or implement promotions to reduce excess costs and improve promotions.

Efficient Replenishment (ER)
Suppliers and retailers working together to ensure provision of the right product, at the right place, at the right time, in the right quantity and in the most efficient manner possible.

Efficient Store Assortment (ESA)
Suppliers and retailers working together to define store assortment in order to maximise efficiency and profitability of space.

Electronic Data Interchange (EDI)
The computer-to-computer transmission of business information between trading partners. The information is usually organised in standard file format or transaction sets following guidelines established by the Uniform Code Council (UCC) (Q.v.) for the grocery industry. Standards have been developed for all regular business-to-business communication covering purchase orders, invoices, notices of shipment and transfer of funds. By eliminating the clerical, mailing and other costs associated with paper-based information, EDI reduces costs, delays and errors. The practical use for ECR is laid down in EANCOM/UCS specifications.

European Article Numbering (EAN) Association
Europe based global organisation responsible together with the Uniform Code Council for the numbering and communication systems, including EAN, UPC, EANCOM, UCS, EAN

Just-in-time (JIT)
The movement of material to the necessary place just-in-time for consumption or use. The implication is that each operation is closely synchronised with the subsequent ones to make this possible.

Lead time
Cycle time between order placement and delivery of goods, usually expressed in days.

Manufacturer Distribution Centre (MDC)
A point in the manufacturer's part of the supply chain where product flows from factories are interrupted and where load disassembly, reassembly and storage can take place prior to shipment to the next point in the supply chain.

Module (ISO 3676)
A reference measurement to which the dimensions of the components of the distribution system can be related arithmetically.

Modular System (ISO 3676)
A system consisting of components which are related to the module.

Network
A distribution system of warehouses and transport routes to manage the flow of goods through the supply chain.

Order Constraints
The minimum and maximum level set for a purchase order, based on economic quantities agreed between retailer and supplier, usually expressed in pallets or weight.

Order Cycle Time
Time involved from the placement of an order until the goods are delivered (see also lead time).

Pallet
Portable platform for assembling, sorting, stacking, storing, handling and transporting goods as a unit load.

Pallet exchange
Industry practice of having a carrier – when it drops off palletised freight at a consignee – takes back empty pallets, which are to be taken to another shipper.

Pick and pack
Taking goods out of stock and packing them according to customer requirements. Picking can be performed at primary, secondary and tertiary levels (e.g. a pallet)

Pick by line
Individual store orders are grouped to one bulk replenishment order. At manufacturer distribution centre (MDC) each replenishment order is assembled separately. Single tertiary units are broken down, i.e. handling at secondary item level, at retailer distribution centre (RDC) and re-allocated to individual stores for consolidated shipment

Pick by store
Individual store orders are assembled at the manufacturer distribution centre (MDC). Each order is cross-docked intact, i.e. handling at tertiary item level, at the retailer distribution centre (RDC) and allocated for consolidated shipment to store.

Plan Dimensions (ISO 3394)
The dimensions of the rectangle defined on a horizontal surface by the four vertical planes intersecting at right angles which enclose a transport package free-standing on that surface.

Primary Packaging (94/62/EC)
Packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase.

Replenishment
Return of a shipment to the party who originally delivered it to the carrier.

Replenishment system
The act of providing customers with fresh quantities of a product.The way in which delivery to customers takes place. (e.g. delivery in response to supply orders: ordering system. The delivery is on the basis of the sales, stocks, stock standards, stock locations and lead times of the customers: CRP)

Retail Distribution Centre (RDC)
A consolidation warehouse in the retail part of the supply chain, where product flows from manufacturers are received and where load disassembly, storage and reassembly can take place prior to shipment to store.

Reuse (94/62/EC)
Reuse shall mean any operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled; such reused packaging will become packaging waste when no longer subject to reuse.

Roll cage sequencing
Store-layout oriented picking into roll cages in a retail warehouse.

Safety stock
The stock which serves to offset differences between forecast consumption and actual consumption and between expected and actual delivery times. In calculating the safety stock, account is taken of such factors as service level, expected fluctuations of demand and lead time.

Secondary Packaging (94/62/EC)
Packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics.

Shelf replenishment
The activities involved in placing secondary or primary items on display and their movement to the display area.

Stockkeeping Unit (SKU)
1. In Europe an SKU is a uniquely identifiable product available for sale at a specific point in time.

2. An item in a particular geographic location. For example, one product stocked at six different distribution centres would represent six SKU's (US).

Supply chain
All business activities needed to satisfy the demand for products or services from the initial requirement for raw material or data to final delivery to the end user.

System (ISO 3676)
An entity consisting of interdependent components.

Tertiary Packaging (94/62/EC)
Packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packagings in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers.

UCC/EAN-128 (also known as UCC-128)
Bar code symbols and data formats used for primary and secondary product identification. Primary identification consists of two formats: the serial Shipping Container Code and the UPC Shipping Container Code. The Serial Shipping Container Code is an 18-digit code for the unique identification of individual mixed merchandise shipping container, typically used in conjunction with an EDI Advance Shipping Notice transaction. The UPC Shipping Container Code is a 1-digit code used to identify a standard pack or standard case.

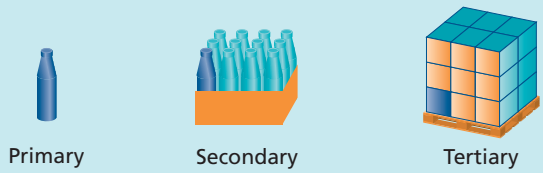
Unit Load (ISO 3676)
A load consisting of items or packages held together by one or more means, and shaped or fitted for handling, transporting, stacking and storing as a unit. The term is also used to describe a single large item suitable for the same purpose.

Value Chain Analysis (VCA)
A financial tool for identifying and quantifying cost-reduction opportunities within the supply chain.

Vehicle Optimisation
Method to optimise loading and utilisation of transportation vehicles.

Figure 40: Packaging levels

Three packaging levels



Source: A.T. Kearney, Efficient Unit Loads project

10.2. Additional Data and Figures

Dimensional proliferation of secondary unit loads

To assess current dimensional proliferation project team members were asked to provide secondary unit load length, width and height for every SKU passing through their system. A selection of the results is given below. A proliferation of 25% means that on average four different articles (SKUs) are packaged in secondary unit loads having the same length, width and height (see Figure 41).

European versus Industry pallet

Figure 42 shows some of the advantages and disadvantages of using Industry versus Euro pallets in replenishment (transportation) and the RDC. The numbers, based on IGD (Institute of Grocery Distribution) DPP data, are averages, and are only indicative as they may differ significantly for different products (+ means more advantageous).

In support of some of the percentages in Figure 42:

- Figure 43 shows the impact on travel distance between picking faces when 1000 mm and 800 mm are respectively presented to the aisle by Industry and Euro pallets. One figure shows the theoretical impact and the second that applicable in a warehouse with racking columns (These diagrams serve as a thought provoker – they are examples which may or may not apply to particular layouts).
- Figure 44 shows that Industry pallets, because they carry 25% more than Euro pallets, can have a significant impact on overall stock levels
- Figure 44 also shows how handling efficiency can favour either the Industry pallet or the Euro pallet depending on the handling method used.

Figure 41: Proliferation of unit load dimensions

Manufacturer	A[1]	B[1]	C[1]	D[2]	F[3]	G[4]	H[4]	Average
Active SKUs	143	350	3,622	2,077	174	26	21	1,069
Different lengths	26	4	314	129	19	2	11	84
Different widths	28	4	264	129	25	3	11	77
Different heights	26	48	353	136	57	3	11	106
Different plan dimensions	33	4	738	329	54	3	11	195
Different load dimensions	37	96	958	420	75	4	11	267
Proliferation[5]	**25.8%**	**27.4%**	**26.4%**	**20.2%**	**43.1%**	**15.4%**	**52.4%**	**25.0%**

Retailer	A	B	C	D	F	G	Average
Active SKUs	10,584	14,140	5,839	13,437	9,542	4,769	9,719
Different lengths	96	112	96	483	517	223	255
Different widths	65	93	65	355	416	186	197
Different heights	133	108	142	499	536	204	270
Different plan dimensions	973	1,762	910	3,800	3,748	1,860	2,176
Different load dimensions	4,204	6,854	2,848	6,329	5,541	3,200	4,829
Proliferation5	**39.7%**	**48.5%**	**48.8%**	**47.1%**	**58.1%**	**67.1%**	**49.7%**

Source: A.T. Kearney Survey, Efficient Unit Loads project

[1] Dry Grocery Food
[2] Dry Grocery Non-Food
[3] Fresh Food Processed
[4] Beverage
[5] Proliferation = $\frac{\text{Number of different pack dimensions}}{\text{Number of active SKUs}} \times 100\%$

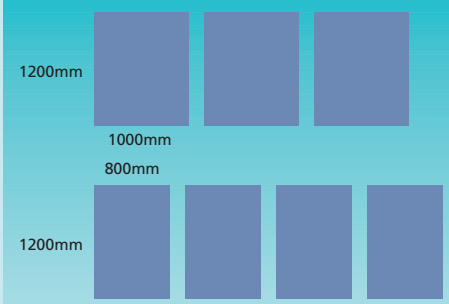
Figure 42: Comparative advantages of Industry versus Euro pallet

Activity/Cost	Industry pallet	Euro pallet
• Receive (Unloading)	+25%	
• Put away (To storage)	+25%	
• Replenish	+25%	
• Select order by case > Put away outgoing load and drive next carrier to first slot > Driving between slots > Picking of cases > Checking after selection	+25%	+25% to 50%
• Warehouse space costs		+10%
• Inventories (Interest)		+10%
• Order picking space cost		+25% to 50%
• Transportation costs (warehouse to store)		+1.5%

Source: A.T. Kearney Survey, Efficient Unit Loads project

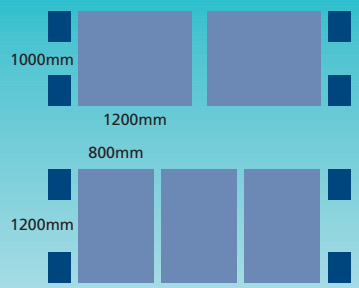
Figure 43: Driving distances in warehouse

Driving between slots
a) no columns (theoretical approach)



Travel distance increases by around 25%

Driving between slots
b) columns (practical situation often encountered)



If 200mm can be taken from the gangway with Euro pallets, then travel distance is reduced by 50% and space/cube efficiency increases by approx. 20%

Figure 44: Stock effects and unloading

Stock effects

- Total stock = cycle plus safety
- Assuming split is 40% cycle and 60% safety stock and replenishment ordering is by full pallet loads
- As the Industry pallet is 25% bigger, then the average cycle stock is +25%
- So on average the use of Industry pallets means +10% in total stock compared with Euro pallets

Unloading

- Unloading of a single pallet provides a 25% benefit to the Industry pallet
- But the use of the Euro (long) forks to carry three Euro pallets or two Industry pallets gives an advantage to the Euro pallet

10.3. Modular Space Utilisation Analysis

Description of the analysis

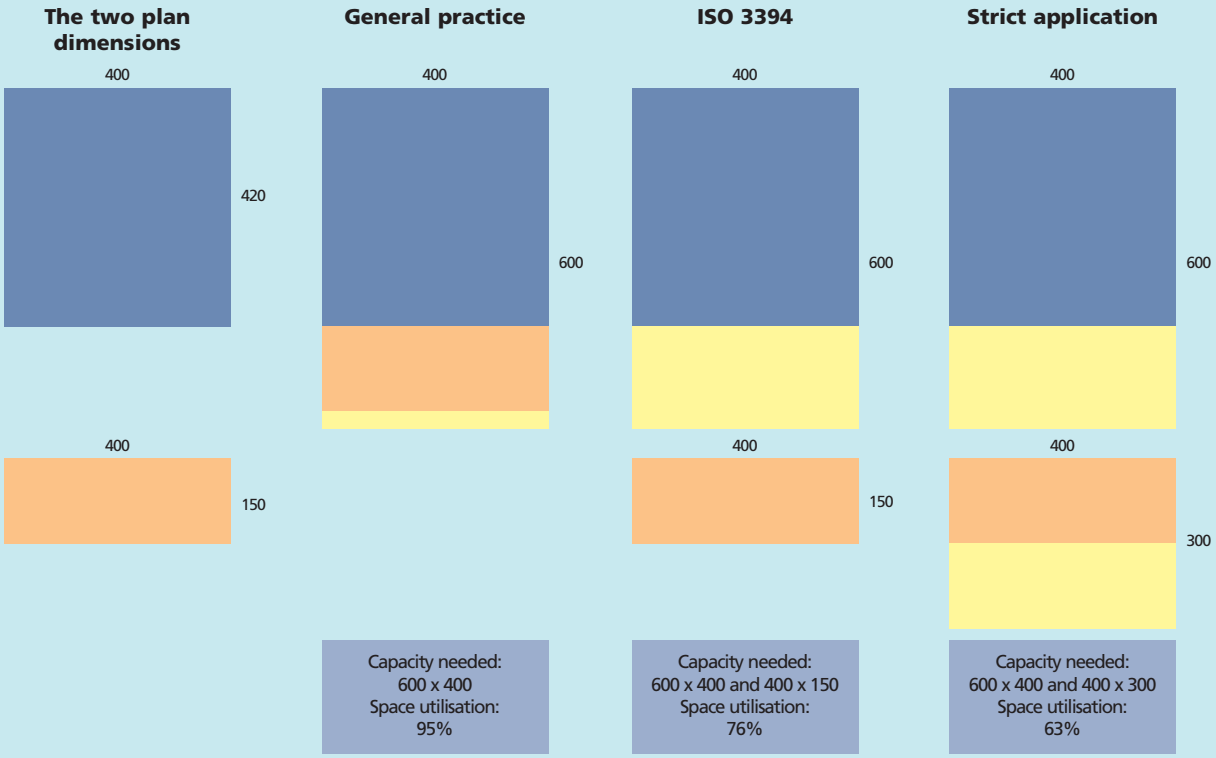
Modular space utilisation is an important effectiveness and efficiency driver throughout supply chains. The most critical activity with respect to modular secondary space utilisation is assortment creation. The supply chain point where this activity usually takes place is the RDC, since on average in Europe more than 80 percent of the total product volume is delivered via this point. The study therefore focused on unit loads passing through RDCs, assessing the average space utilisation by modular class. "Space" for this analysis refers to the plan dimension (length x width) of a unit load and not to the volume. Two ways of deriving modular classes were used in this analysis:

- A strict way of deriving, in modular form, multiples and sub-modules of the 600x400 master module. Multiples are obtained by doubling the shorter edge whereas sub-modules are derived by cutting the longer edge in half. The resulting nine modular classes are shown in the first column of Figure 46
- Applying the plan dimensions recommended in the ISO standard 3394. All 25 modular classes are shown in the first column of Figure 47.

The study covered four major retailers (retailers A, C, D and F in Figure 41) in four different European countries, most categories and all unit loads passing through the respective RDC. Since the throughput volume of unit loads larger than 1200x1000 mm did not exceed one percent of the total, those unit loads were excluded from the study. Most unit loads in the modular classes 1200x1000, 1200x800 and 800x600 mm used pallets, only few unit loads in **600x400** mm used Quarter Euro pallets. Secondary unit loads are therefore comprised of smaller modular classes **600x400** mm. To compensate for seasonal variations, the observation time was set to twelve months. All active SKUs were sorted into modular classes assuming:

- The modular classes represent spaces available in the supply chain
- Each modular space has to accommodate one unit load and any extra space needed for bulging, reaching and gripping
- Length and width are maximum dimensions, no plus tolerance is allowed
- The minus tolerance is given by the next smaller module
- Only one unit load can be accommodated in each modular space. This assumes the worst case scenario (see Figure 45).

Figure 45: Accommodation in modular spaces



Source: A.T. Kearney Survey, Efficient Unit Loads project

Once sorted, average lengths, widths and heights can be determined for every modular class, assigning the correct statistical weight (picks per year) to each single dimension. A comparison of the average plan dimension (average length x average widths = average space used) with the maximum space available in the respective modular class provides the average space utilisation:

$$\textbf{Average space utilisation} = \frac{\textbf{Average space used}}{\textbf{Maximum space available}} \times 100\%$$

Figure 46: Modular space utilisation strict model

Module dimension (mm)	Average number of SKUs	Picks in % of total	Throughput volume in % of total	Surface utilisation % max. surf.	Average length (mm)	Average width (mm)	Average height (mm)
1,200 x 1,000	4	0.02%	1.10%	77.90%	1,027	911	738
1,200 x 800	149	0.51%	16.77%	52.42%	925	544	643
800 x 600	524	2.81%	18.09%	58.00%	687	405	314
600 x 400	1,658	11.17%	25.93%	63.48%	480	318	207
400 x 300	4,039	26.36%	27.45%	67.96%	356	229	172
300 x 200	2,463	18.64%	7.20%	60.03%	259	139	137
200 x 150	695	6.46%	1.01%	62.09%	175	107	113
150 x 100	266	11.31%	0.61%	67.43%	110	92	95
100 x 75	45	22.71	1.83%	65.77%	71	70	191

Modular space utilisation:

- All modular classes **64.7%**
- Main five modular classes **64.0%**
- Secondary modular classes **64.9%**

Source: A.T. Kearney Survey, Efficient Unit Loads project

Results

Figure 46 and Figure 47 clearly indicate poor space utilisation: unit loads on average are far from compliant with the modularity principle. Average lengths and widths fall short of the maximum possible in each modular class. The overall measured space utilisation leaves significant room for improvement. As the analysis has been based on the worst case scenario, the actual space utilisation will be somewhat higher. The results in detail are:

- The average modular space utilisation is 64.7 percent for the strict modular classes and 68.0 percent for the ISO modular classes
- The increase in complexity from nine modular classes (strict) to 25 modular classes (ISO) therefore only results in an increase in space utilisation of 3.3 percentage points
- More than two thirds, 65 percent, of the total volume are picked on secondary unit load level
- Most of the throughput volume, 95 percent in the strict classification and 84 percent when applying the ISO standard, is compatible with only five modular classes: 1200x800, 800x600, 600x400, 400x300 and 300x200 mm
- The modular space utilisation for the five main modules does not differ significantly from the average taken over all classes

Figure 47: Modular space utilisation ISO 3394 modules

Module dimension (mm)	Average number of SKUs	Picks in % of total	Throughput volume in % of total	Surface utilisation % max. surf.	Average length (mm)	Average width (mm)	Average height (mm)
1,200 x 1,000	4	0.02%	1.10%	77.90%	1,027	911	738
1,200 x 800	110	0.20%	14.55%	83.42%	1,054	760	1,181
1,200 x 600	25	0.23%	1.90%	49.23%	839	422	302
1,200 x 400	14	0.07%	0.31%	56.70%	838	325	223
800 x 600	524	2.81%	18.09%	58.00%	687	405	314
600 x 400	1,530	10.61%	25.20%	64.89%	479	325	207
600 x 200	118	0.54%	0.71%	73.88%	494	180	203
600 x 133	6	0.01%	0.01%	65.21%	429	121	169
600 x 100	5	0.01%	0.00%	76.97%	479	96	113
400 x 300	3,059	18.52%	21.40%	74.77%	352	255	175
400 x 200	653	4.99%	4.72%	88.39%	375	188	181
400 x 150	205	2.11%	1.09%	82.88%	358	139	141
400 x 120	124	0.74%	0.24%	72.40%	339	103	127
300 x 200	1,770	9.01%	5.19%	76.63%	263	175	171
300 x 133	222	1.70%	0.47%	78.60%	263	119	117
300 x 100	247	7.26%	1.34%	82.78%	260	96	101
200 x 200	225	0.67%	0.21%	85.09%	192	177	127
200 x 150	222	0.80%	0.19%	84.93%	176	145	126
200 x 133	97	0.47%	0.11%	91.51%	190	128	127
200 x 120	135	0.98%	0.19%	88.39%	181	117	123
200 x 100	146	3.47%	0.48%	80.54%	176	91	108
150 x 133	62	0.32%	0.04%	84.61%	136	124	107
150 x 100	118	2.52%	0.17%	84.05%	141	90	74
133 x 120	67	0.26%	0.02%	73.44%	121	97	96
120 x 100	158	31.39%	2.25%	50.13%	79	76	166

Modular space utilisation:

- All modular classes **68.0%**
- Main five modular classes **71.5%**
- Secondary modular classes **68.3%**

Source: A.T. Kearney Survey, Efficient Unit Loads project

Figure 48: Maximum weights and dimensions of trucks in the European Union

Country	Weight of vehicle[1] (ton)	Length of trucks (m) (2,3 & 4 axle)	Length of trailer combinations (m)		Width	Height
			1/2 trailer	1/1 trailer		
Austria	38	–	16.50	18.35	2.50 – 2.60	4
Belgium	44	12	16.50	18.35	2.60	4
Denmark	48	12	16.50	18.50	2.55 – 2.60	4
Finland	60	12	16.50	22	2.60	4
France	40	12	16.50	18.35	2.50 – 2.60	no limit
Germany	40	12	16.50	18.35	2.55 – 2.60	4
Greece	40	12	16.50	18.35	2.50 – 2.60	4
Ireland	40	12	16.50	18.35	2.50 – 2.60	4.25
Italy	44	12	16.50	18.35	2.50 – 2.60	4
Luxembourg	44	12	16.50	18.35	2.50 – 2.60	4
Netherlands	50	12	16.50	18.35	2.55 – 2.60	4
Norway	50	12.40	12.40 – 17	12.40 – 18.50	2.50 – 2.60	4.50
Portugal	40	12	16.50	18.35	2.50 – 2.60	4
Spain	40	12	16.50	18.35	2.50 – 2.60	4
Sweden	60	12	16.50	24	2.60	4.50
Switzerland	28	12	16.50	18.35	2.50 – 2.60	4
United Kingdom	35	12	16.50	18.35	2.50 – 2.60	4.2
Council Directive 96/53/EC	40/44	12	16.50	18.75	2.55 – 2.60	4

Source: A.T. Kearney Survey, Efficient Unit Loads project

[1] Maximum allowed irrespective of truck or trailer combination

- The only other modular classes of importance in throughput volume terms are 400x200 and 300x100 mm. These two reflect the shop shelf influence on dimensions of secondary unit loads: replenishment units for small facings
- About one third of all picking activities involves dimensions equal to or smaller than 120x100 mm. This picking only covers a small fraction of all products (SKUs). It is worthwhile mentioning that some retailers combine those small units into larger (mainly reusable) unit loads for shipment from distribution centre to outlet
- A very small volume passes through retail systems on Industry pallets. This is explained in part by the under-representation of the beverage category in the sample and the fact that none of the four sampled retailers have major operations in the Netherlands or in the United Kingdom.

10.4. RTI Product Suitability

Figure 49: RTI Product Suitability Template

Criteria	Weighting	Positive Statements				Neutral		Negative Statements				Total
	1 – 5	1	2	3	4	5	6	7	8	9	10	
1. Can the primary packaging be fitted into the secondary RTI without adaptation?		No adaptation needed		Little adaptation needed		Partial adaptation needed		Major adaptation needed		Adaptation not possible		
2. Will the secondary RTI protect the primary product?		Complete protection		Reasonable protection		Partial protection		Hardly protected		No protection		
3. Are product size and quantity suitable for the secondary RTI under consideration?		Fully suitable		Mainly suitable		Partially suitable		Hardly suitable		Not suitable		
4. Is the attainable unit count per secondary RTI suitable for the outlets?		Fully suitable		Mainly suitable		Partially suitable		Hardly suitable		Not suitable		
5. Will the fully loaded secondary RTI weigh less than the maximum allowed for secondary unit loads?		Always		Mostly		Partially		Hardly		Never		
6. Does the product have strong seasonal variations with periods of no or little production?		No variation		Little variation		Average variation		Large variation		Enormous variation		
7. If variations occur, can they be compensated by other products suitable for this secondary RTI?		Fully compen-sated		Mostly compen-sated		Partially compen-sated		Hardly compen-sated		Compen-sation not possible		
8. Are other products in the same or related category suitable for this secondary RTI?		All products		Most products		Some products		Few products		No products		
9. Does the secondary RTI support all mandatory replenishment techniques?		Supports all		Supports most		Partially supports		Supports some		Supports none		
10. Does the secondary RTI enable integrated supply chain solutions?		Offers wide range		Mostly enables		Partially enables		Some possibilities		Does not enable		
11. Is the secondary RTI compatible with other unit loads in the system?		Fully compatible		Mostly compatible		Partially compatible		Hardly compatible		Not compatible		
12. How long, on average, will the secondary RTI be loaded with product during one usage?		< 10 days		< 20 days		< 30 days		< 50 days		> 50 days		
13. Can the secondary RTI be used for selling presentation?		Always		Mostly		Partially		Hardly		No		
14. Are the marketing aspects compiled with/fulfilled?		Always fulfilled		Mostly fulfilled		Partially fulfilled		Hardly fulfilled		Not fulfilled		
15. …												
16. …												
Overall	1 – 5	1	2	3	4	5	6	7	8	9	10	
	Weighting	Positive Statements				Neutral		Negative Statements				Total

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Final Thanks

The European ECR Executive Board (ECR Board) was established to accelerate implementation of ECR within member companies and across the European grocery industry.

In Autumn 1995, the ECR board commissioned the Efficient Unit Loads project, the third in a series of topics dealing with the supply side of ECR.

- EDI – Electronic Data Interchange
- ER – Efficient Replenishment
- EUL – Efficient Unit Loads

EUL's mission was to improve efficiency and effectiveness in current and future supply chains by promoting harmonisation and integration of transport and storage items and to consider how a European framework for the development and management of reusable transport and storage items could be established.

A team of manufacturers and retailers was established and A.T. Kearney was selected to support and coach the team throughout the project.

This report outlines the findings and suggestions to the European grocery industry and to individual companies seeking insight and direction in their own ECR initiatives.

It has been our great pleasure in contributing to this project and report on the challenging subject of EUL. Efficient Unit Loads, often mistakenly viewed as a technical and functional issue, are actually of key strategic importance. EUL are essential to the success of ECR, as they relate, in particular, to the overall physical infrastructure of the supply chain.

We would like to encourage all team members of the EUL project to continue working together, in the spirit of cooperation and trust and to actively promote EUL both inside and outside their own company and country.

On behalf of A.T. Kearney we would like to express our special thanks to all project team members, our project secretary, our co-chairs, our facilitators from the sponsoring organisations, our board mentor and to the whole ECR Board. They have given us their full support in dealing with this critical and strategically important subject throughout this project.

H. L. Henner Klein

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