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Consideration on the Cost of Reusable and Expendable Shipping Container Systems: A Review

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Abstract In order to reduce packaging and logistics costs for any business, it is important to identify opportunities for improvement throughout an entire logistics system including measurement of the performance and cost of packaging. Although the importance of packaging in a supply chain has been recognized by many scholars and experts, the total cost and value of packaging have not been successfully estimated. This paper reviews the recent researches and articles that tried to quantify the value of packaging focusing on the business decision between reusable and expendable shipping container systems. Three key factors such as cost, ownership, and standardization are identified and discussed in terms of impact on supply chain costs and performances. It is important to understand that the decision of a package system can change a logistics activities and even entire logistical system. Hence, the total cost and value of transport packaging should be calculated with understanding of interactions with logistical activities throughout supply chain. Identifying the opportunities and constraints of packaging changes on total logistics cost and activities must be carefully examined before implementation of a packaging system.

Keywords Reusable packaging, Expendable packaging, Shipping container, Packaging cost, Supply chain

Introduction

The goal of a business is to maximize profits, and profits are revenue after subtracting costs. In current competitive business logistics, reducing costs is often easier than increasing revenue to maximize profit. Without comprehensive financial analyses, business decision makers find it difficult to identify opportunities for improvement throughout an entire logistics system (Holmes, 1999). However, there has been little research to model and measure the performance and cost of packaging in a supply chain. Most studies have not successfully reflected the actual industry situation.

Twede (2009) argued that, although the importance of packaging in supply chains has been widely addressed and financial performance measurement of packaging have been discussed for decades, the total cost and value of packaging have not been successfully estimated. Most models and metrics (where there has been measurement) are focused on specific supply chains and a particular point of view.

The lack of the ability to quantify packaging value and measure its costs usually results in the total cost of packaging being neglected disappearing in the supply chain cost. Azzi *et al.* (2012) argued although its impact on supply chain costs and performances can be overwhelming, packaging activities are often perceived as a cost rather than a value added activities.

Most companies are not aware of the importance or nature of packaging-related costs, so they often fail to include important logistical activity costs in their total packaging cost estimations (Mollenkopf *et al.* 2005). Limited resources and the lack of reliable packaging cost information make it difficult to make packaging management decisions (Dubiel, 1996). Dubiel (1996) concluded that many companies are not aware of the importance of packaging costs and do not attempt enough to discover potential cost saving options by separating packaging costs from prime cost activities such as logistical process. He pointed out that companies do not have enough knowledge of type of packaging cost, how to calculate the true packaging cost, and how to separate prime cost (such as manufacturing cost) from packaging cost.

The perception of total packaging cost in industry largely depends on a company's own self-interest. For example, shows packaging cost criteria from several packaging suppliers' point of view: NEFAB USA (2010), John Henry Packaging Group (2010) and Security Packaging (2010).

Although these companies are all suppliers, NEFAB USA

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Table 1. Examples of packaging cost criteria from packaging suppliers

Packaging cost criteria	Company
• Costs beyond materials and machinery are not aggregated or reported • Cost of filling and handling • Repacking through supply chains • Waste disposal/recycling costs • Externalities like pollution and resource depletion	NEFAB USA (2010)
• Product cost • Packaging Inventory • Obsolescence (e.g. packaging scrap) • Packaging distribution methods (e.g. shipping distance, delivery service, etc.) • Aesthetics (e.g. shelf appeal) • Quality • Service (e.g. meeting peak order cycle) • Purchasing	John Henry Packaging Group (2010)
• Cost of raw materials • Direct Labor • Indirect labor • Material movement • Warehousing • Waste management • Overtime • Quality control • Machinery operation	Security Packaging (2010)

and Security Packaging tend to emphasize material costs and physical distribution costs while John Henry Packaging Group considers more about service and marketing costs. Many companies often fail to include some of important logistical activity costs in their total packaging cost estimations.

While calculating total packaging costs is generally subjective and some cost metrics are very difficult to quantify, identifying measureable packaging cost metrics and maintaining consistency are very important when it comes to comparing the impact of different packaging systems on a supply chain. Because of strong interactions of packaging and supply chain activities and functions, the impact of different packaging systems influence the performance metrics of the supply chain and vice versa. Performance metrics, elements of packaging activities and costs, can be driven out from an exemplary study. This paper uses the previous studies on reusable and expendable shipping container systems to find out performance metrics in different packaging system. Various comparative studies on reusable vs. expendable shipping container systems are reviewed focusing on the impact of container cost, ownership and standardization.

1. Costs of reusable vs. expendable shipping containers

A choice between reusable and expendable shipping container systems is one such strategic opportunity. Many companies consider reusable shipping container system as an alternative of expendable, one-way shipping container system, mainly for cost optimization. In the vehicle manufacturing business, where car manufacturers are always looking for a more cost effective and greener supply chain, reusable shipping containers have been a popular choice for leading companies such as GM, Toyota and Volkswagen (Nunes and Bennett, 2010). The global manufacturer John Deere & Co. reportedly invested an initial $20 million in containers to develop a reusable shipping container system (Kroon and Vrijens, 1995). Manufacturers have adopted these reusable systems because, by applying standard and ergonomic design principles, reusable shipping containers can reduce the cost of handling, materials and packaging waste (Modern Material Handling, 2006). However, there has been no published study documenting the total profitability, including logistics costs, of reusable shipping containers.

Previous studies of reusable packaging use cost inputs from the prospective users are limited to simplified logistical networks and are not an absolute indication of total costs and benefits for an end user. Mollenkopf *et al.* (2005) used a relative cost approach to compare reusable and expandable shipping containers in a case study using a static simulation methodology. The Reusable Packaging Association (2010) has developed a “Quick Economic Calculator” and “Environmental Calculator” to compare basic cost differences of one-way corrugated packaging verses reusable plastic packaging. Such methods can help guide packaging and supply chain decision-makers, but their static cost models do not reflect the dynamic nature of the supply chain and to systemically address economic trade-offs.

The accounting method needs to be considered. Holmes (1999) found that it is not easy to estimate the total cost in traditional costing systems based on volume-based allocation of overhead (or indirect cost). Traditional accounting methods distort information, so that manager cannot identify cause and effect of logistical activities and supply chain processes. Traditional approaches to accounting based upon full-cost allocation can be misleading and dangerous – and are one reason why it is so difficult to calculate true packaging logistics costs.

Decision factors for choosing a reusable or expendable packaging system

This section will focus on decision factors for choosing a reusable or expendable packaging system in a supply chain. Based on published studies on the total cost of reusable packaging system, three factors including cost, ownership and standardization are examined and discussed.

1. Impact of cost

Aside from the environmental benefits, several companies have found that reusable packaging can be a profitable logistical solution. Reusable shipping containers can improve a company's supply chain management. Manufacturers have looking for more cost effective and geometric options such as collapsible or nestable features of containers. Potential advantages of reusable packaging operations include the following:

- *Reduces packaging waste, improve product protection and cut logistical operation costs by improving cubic efficiency for transportation and storage* (Mollenkopf et al., 2005)
- *Reduces labor and environmental impacts* (Holmes, 1999)
- *Reduces costs, shorter lead times, and better product quality with implementation of ISO 14000 standards* (Hanson, 2004)
- *Applies standard and ergonomic design of reusable containers that can reduce or eliminate multiple packing and repacking processes which create unnecessary complexity of distribution network, additional handling and material costs and increase lag time* (Modern Material Handling, 2006)

The vehicle assembly industry has been the leader in reusable packaging use during the past two decades. In 1995, John Deere & Co. invested $20 million in a reusable packaging system. Global automotive companies such as Ford, GM and Toyota have applied returnable container systems successfully (Kroon and Vrijens, 1995).

Besides the initial financial investment of purchasing reusable packages, operating a reusable packaging system increases transportation costs for returns, management costs for tracking, cleaning, sorting and storage space (NEFAB USA, 2001; Mollenkopf *et al.,* 2005; Twede, 2004).

Although switching from expendables to reusable packaging containers has been a trend in some industries, there is no standard method of total cost estimation. Cost categories and the amount of details for packaging costs differ by researcher and the purpose of the study. Researchers exploring the supply chain effect of reusable packaging compared to expendable packaging have modeled different costs and activities although most cost research regarding reusable packaging management and cost evaluation is limited to material (packaging) and handling associated costs within simple logistical networks or domestic distribution. Since it is so difficult to estimate true packaging costs, and most companies do not have sufficient and reliable packaging cost information, it is difficult to make with decision whether they should switch from expendable packaging to reusable packaging.

Holmes (1999) summarized key criteria to consider reusable packaging operation for a company. Comprehensive financial analysis is the most important step to consider reusable packaging system. The decision makers need to identify opportunities for improvement throughout entire logistics system. The capital investment is significant, so this would not be possible without sound communication with key players in logistical chain including senior management staff and stakeholders.

Rosenau *et al.* (1996) outlined several cost factors that differentiate returnable packaging from expendable packaging. The Net present value (NPV) financial evaluation method is recommended because returnable packaging should improve logistics profitability comparing expendable packaging.

Mollenkopf *et al.* (2005) used relative cost approach to compare reusable and expandable packaging case study based on GM powertrain. Key metrics applied were container unit cost, cycle time, pack quantity, delivery distance, daily volume, average daily volume and peak volume. Although this research was limited to simple physical distribution of a set of automotive parts, it used a practical calculation method by simplifying cost factors of packaging and distribution activities (Mollenkopf *et al*., 2005). As shown in Table 2, they analyzed transportation, labor, recycling and disposal costs to compare packaging costs for automobile suppliers.

Honaker (2000) identified that the most important cost drivers to manage for reusable packaging system are cost per use, returnable packaging asset utilization, and average days in cycle. He considered "cost per use" to be the most important metric because this represents the total cost accumulated from the all activities associated with a supply chain. "Returnable packaging asset utilization" is related to the productivity of returnable packaging containers in the system and a measurement of utilization of containers. The "average days in cycle" relates to the total amount of time required for the complete rotation of the container.

Some industrial calculation models have been developed to

Table 2. Comparison of reusable and expendable packaging costs

Reusable packaging costs	Expendable packaging costs
Transportation cost • Base transportation rate • Delivery distance • Frequency of supply • Average daily volume • Discount rate for return transportation (R) • Number of stops (R) • Stop-off rate (R) Labor cost • Time to handle container • Labor rate • Pack quantity Recycling revenue • Recycling rate per pound • Container weight • Pack quantity • Working days per year (R) • Cycle time (R) • Container life (R)	Transportation cost • Base transportation rate • Delivery distance • Frequency of supply • Average daily volume • Discount rate for return Labor cost • Time to handle container • Labor rate • Pack quantity Disposal cost • Disposal rate (E) • Container weight (E) • Pack quantity (E) Recycling revenue • Recycling rate per pound • Container weight • Pack quantity

Note: R: Reusable container only, E: Expendable container only.

compare the basic cost differences of one-way corrugated packaging verses reusable plastic packaging. The “Quick Economic Calculator” is a cost comparison tool developed by the Reusable Packaging Association (RPA) (2010). The model uses basic assumptions and requires users to input various cost components into the model, such as purchase price, dwell time, annual number of packages shipped per year, returnable container cost per use, costs related to return containers, possible savings from packaging waste costs and labor costs. It is noticeable that this calculator does not include benefits of standardization by using returnable containers such as easier load, unload and better cube utilization. While the model uses factual inputs from prospective users, it is intended to be directional and not an absolute indication of exact cost benefits for an end-user.

Palsson *et al.* (2013) developed a theoretical evaluation model for the comparison of one-way and returnable packaging system used for the automotive part packaging and compared the environmental and economic impacts of two different packaging systems. They selected five environmental and six economic criteria and evaluated two packaging systems by calculating CO_2 emissions and costs. They provided very practical way to evaluate sustainability of a packaging system in a particular supply chain, but this paper was limited itself by taking only one case study and could not represent complexity of the international supply chain.

Dubiel (1996) insisted that the first step to compare the cost and performance comparison between reusable and one-way packaging systems is to separate the packaging process. He broke down packaging costs into ten categories as shown in Table 3. The primary categories are materials, machines, transport, storage, reusable systems, building, handling, resulting, waste disposal and other miscellanies, but the list and categories can be extended depending on organization’s specific circumstances.

Dubiel (1996) compared cost types and structures of reusable, expendable packaging in cyclic system and one-way packaging. Expendable packaging in cyclic system includes costs of recycling, disposal, packaging management and redistribution, and one-way packaging is not.

As shown in Table 4, reusable packaging requires additional costs for management such as capital lockup, repair, and cleaning compared to one-way and expendable packaging in cyclic system. However, allocation of costs and cost level for management varies depending on the particular system and management. For example, Dubiel did not include the cost for recycling and disposal for one-way packaging, but this cost cannot be ignored nowadays.

Kim *et al.* (2014) developed a stochastic returnable transport items (RTI) inventory model for a closed loop supply chain of a perishable product consisting of a single supplier and a single buyer. They examined three different cases depending on the stochastic lead time of RTIs: a) RTIs are returned early, b) RTIs are returned late, c) RTIs are returned late and shortages occur. They considered the following types of costs: inventory cost of keeping finished products and RTIs at the supplier and the buyer, cost of deterioration, shortage cost, and setup and ordering costs. The results of mathematical simulation showed that the longer lead time cause higher probability of large back orders by buyer and may lose competive-

Table 3. The breakdown of reusable packaging costs

Cost category	Detail costs	Cost category	Detail costs
Material cost	• Cost for packaging material • Cost for packages • Cost for packaging accessories	Cost for buildings	• Allocated write-offs for buildings • Allocated interest charges • Rent • Energy cost for light, heating and air conditioning • Cleaning cost
Cost for machines, appliances and tools (for manufacturing of packages and packing)	• Allocated write-offs for machines • Allocated interest charges • Energy cost • Maintenance cost	Handling cost	• Labor cost for manufacturing packages • Labor cost for packing
Transport cost (distinction between internal and external transports)	• Allocated write-offs • Allocated interest charges • Labor cost • Energy cost • Freight	Resulting cost	• Cost for redelivery, repair and delayed deliveries • Cost for settlement of damages • Cost for losses
Storage cost	• Allocated write-offs for warehousing • Allocated interest for warehousing • Allocated interest for stored goods • Labor cost	Waste disposal cost	• Collection cost • Sorting cost • Return cost • Recycling cost • Waste disposal cost (deposition, incineration) • Management cost
Cost (additional) for reusable systems	• Allocated interest charges for circulating packages • Cleaning cost • Repair cost • Deposit fees	Other cost	• Labor cost for controls • Cost for breakage and rejects • Insurance cost/premiums • Allocated risks

Table 4. Comparison of cost types and structure among different packaging systems (modified from Dubiel's study 1996)

Types of costs	Reusable packaging	Expendable packaging (in cyclic system)	One-way packaging
Cost of capital lockup Cost of repair Cost of cleaning			
Cost of recycling/disposal Cost of administration (packaging management) Cost of redistribution			
Cost of carry (cost of damage, loss etc.) Cost of transportation and distribution Cost of handling Cost of Store for packaging material Cost of production (machines, facilities etc.) Purchase cost for packaging materials			

Note: The graphs in this table are only for representing type of costs and do not indicate amount of costs.

ness of the supply chain.

Atamer *et al.* (2013) focused on pricing and production decisions by comparing two supply options: brand-new containers and returned & used containers. They compared various parameters in order to estimate the optimal acqussition fee and order quantity.

Although outsourcing from overseas is now common practice in the manufacturing business, none of the cost models have been applied to international logistics operations. This is because reusable packaging containers are more likely to be used for domestic with well-organized distribution networks. However, international applications of reusable containers may be very effective depending on the managing system and container design.

With development of international pooling networks and product/package tracking technologies such as RFID, international reusable packaging operations may be viable option in an increasing number of cases. Maleki (2011) proved that implementing automatic identification technologies can improve the management of the returnable containers effectively.

Because of continuous increases in awareness of environmentally-friendly supply chain practices and improvement in the efficiency of global logistics systems, reusable shipping containers are increasingly being considered by original equipment manufacturers and their global third-party logistics providers (3PLs). A study on environmental sustainability performance of the major global 3PLs support the idea, as many 3PLs generated substantial cost savings from their sustainability initiatives. Global 3PLs are aggressively seeking growing opportunities with their sustainability initiatives as a "market differentiation factor" (Lieb and Lieb, 2010). Accorsia *et. al.* (2014) discussed economic and environmental impacts of reusable plastic containers and conceptual development of framework for the food packaging and distribution network. There are many articles and papers that tried to quantify environmental impact of reusable packaging by utilizing life cycle assessment (LCA) and other techniques. Environmental aspect of reusable packaging is one of the most important factors, but this part should be discussed for further studies.

2. Impact of ownership

It should be noted if a reusable packaging system does not work properly; it can become a very expensive expendable packaging that increases packaging waste. As the automotive industry has realized the value of packaging system management with by trial-and-error from the past, reusable packaging systems have different financial and environmental effects, depending on the maturity of the program (Twede, 2004). The system should be managed and monitored by a pool operator with authority and responsibility especially during the collection process (McKerrow, 1996).

Designing an optimized return logistics system for returnable packaging containers starts with several important questions such as following (Kroon and Vrijens 1995, p. 63):

- *How and who should operate containers?*
- *How many containers should be needed in the system?*
- *How many and where the container depots should be?*
- *What are appropriate operation (service, distribution and collection) fees?*

Answers for these questions can vary depending on the ownership of the reusable containers.

Ownership options are an important factor to be considered because effectiveness of the reusable container application is largely dependent on efficiency of the managing system. Ownership (whether supplier, receiver (customer) or 3PL), influences a range of factors including the respective bargaining power of the parties involved, compatibility with production systems and the respective logistical capabilities of suppliers/receivers (Holmes, 1999).

McKerrow (1996) used the term "equipment pool" for any interchangeable and reusable packaging, and compared the five types of ownership: manufacturer, customer, joint, common and

Table 5. Types of ownerships of reusable packaging

Types	Ownership	Examples
Manufacturer owned	A manufacturer	Tightly closed loop system such as between a glass manufacturer and a bottling plant
Customer owned	A receiver	Some automotive assemblers
Jointly owned	An industry association or independent body	EURO pallet pool system
Commonly owned	A group of companies or cooperation	The Dutch Auction pool which is owned by co-ops of growers or fishermen
Third-party owned	An independent third party	CHEP pallet pool, IFCO fresh produce crate pool

Table 6. The advantages and disadvantages of the returnable container ownership options

Ownership types	Advantages	Disadvantages
Supplier-owned	- Reduced costs to supplier and customer - Supplier may enhance customer loyalty by reducing waste and management problems - Supplier can optimize logistics efficiency by own way	- Supplier bears Initial capital costs, tracking and maintaining costs
Receiver-owned	- Greatest potential to achieve financial benefits - Receiver can optimize logistics efficiency by own way	- Receiver bears initial capital costs, tracking and maintenance costs - higher risk
Third-party-owned	- No initial capital costs needed - Tracking and maintenance assured by contractor	- Reduced potential for savings

third party. Examples are shown in Table 5.

Holmes (1999) examined three ownership arrangements (supplier, receiver and third-party) which are affected by various factors such as bargaining power of the parties involved. Although he identified some advantages and disadvantages for each of the three ownership options in Table 6, he explained that ownership decisions depend on negotiations and different circumstances.

Dubiel (1996) viewed that finding a right decision is depending on technological suitability, meeting of ecological and legal requirements, and ultimately, the costs. He explained advantages and disadvantages for each of the three reusable systems: individual, bi/multilateral and pool as shown in Fig. 1.

The individual system does not use standardized reusable containers and works only between senders and customers, while the bi/multilateral and pool system can exchange standard reusable containers more freely. For pool system, because an outsourced pooling company controls containers, forward and return logistics are simpler than other systems.

Kroon and Vrijens (1995) summarized return logistics systems in the Netherlands into three types depending on responsibility of returnable container owner shown in Table 7. They find that most logistics operations including distribution, collection, cleaning and maintenance are handled by the 3PLs (Kroon and Vrijens 1995, p. 61).

From the perspective of 3PLs, Hofmann (2009) pointed out lack of studies in supply chain. The role of 3PL is particularly important in the international operation of returnable packaging systems, but this has not been considered because there have been lack of systems and participating partners. This has been a major disadvantage for reusable packaging systems in growing international trade.

In some cases, RPCs owned and controlled by 3PLs may lead to a significant reduction in international logistical activities such as extra handling, packaging waste and purchasing costs. For example, Eroski (Euro Pool System, 2010), a Span-

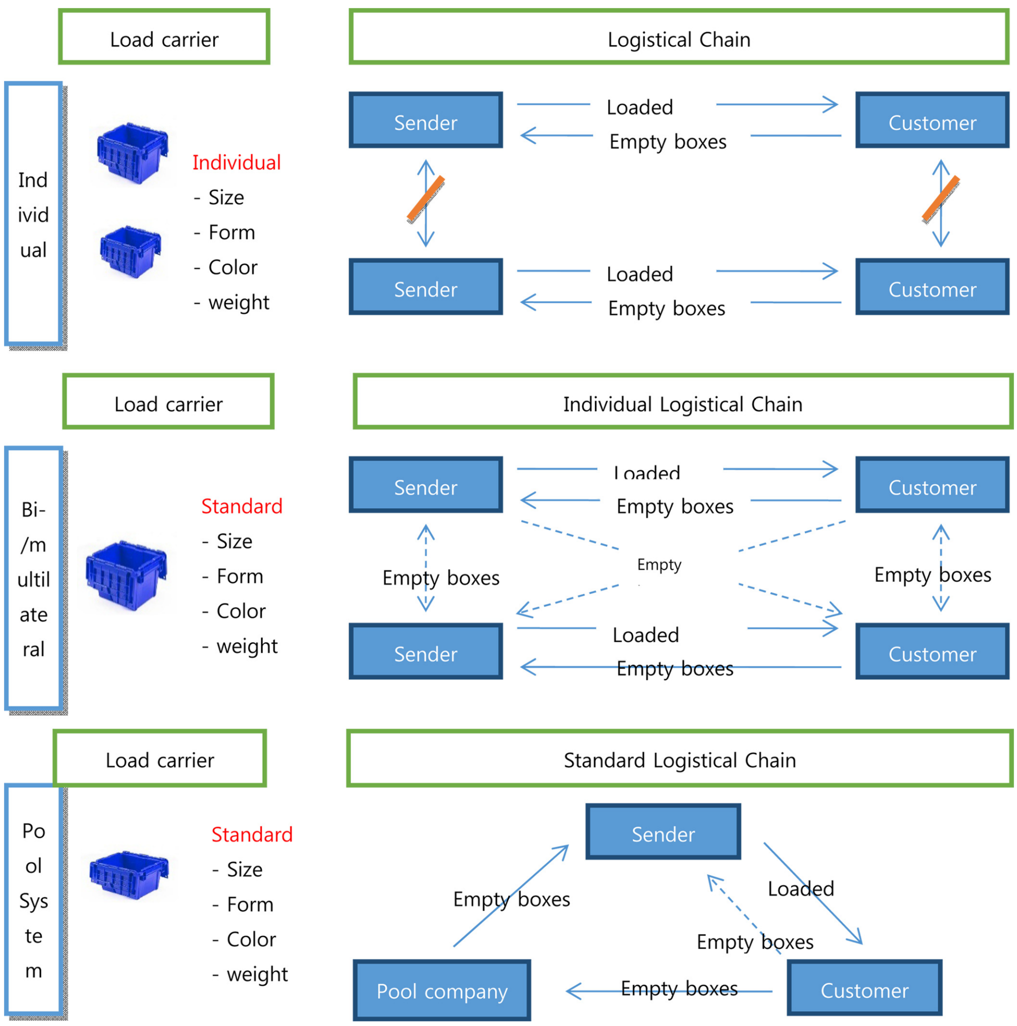

Fig. 1. Organizational levels of reusable systems

Table 7. Return logistics systems in the Netherlands

System	Essence	Partners	Responsibility	Possibilities
Switch pool	Every partner has an allotment	Sender, recipient	Every partner is responsible for his own allotment	Direct switch
		Sender, carrier and recipient		Exchange-per-exchange switch
With return logistics	Return logistics by agency	Agency, sender Carrier, recipient	Agency	Transfer system Depot system with booking Depot system with deposit
Without return logistics	Rental of the containers	Agency, sender	Sender, also for the return logistics	Rental of the containers

ish supermarket chain which has a partnership with Euro Pool System, reported the significant growth of the number of circulations of reusable crates for their fresh products from 250,000 to 55,000,000 per year between 1998 and 2009. However, it is still remained unknown how a 3PL-operated RPC system can contribute to a company in terms of profitability, sustainability and efficiency of international supply chain.

3. Impact of standardization

A primary requirement for the successful use of reusable containers is standardization of containers. Standardized packaging sizes, materials and weights enable supply chain integration. Standardized packages facilitate the automation of conveyor flow, increase efficiency of inventory control, and reduce purchase costs (Bowersox *et al.*, 2012).

The success of Eroski Co. confirms that the standardization of the packaging ensures efficient order picking and low purchasing costs. Eroski Co. claimed that an established standardized and returnable packaging system can also contribute to their future supply chain plan, automatic pick system (Euro Pool System, 2010).

Standardization of packaging can significantly reduce supply chain management cost by establishing efficient unit load systems. Unit load system affects every distribution element such as transportation, storage, packaging, shipping and handling, and is a key cost driver of 12 to 15 percent of retail sales price (Kearney, 1999).

Standardization of pallet and packaging is the first step for efficient and seamless unit load systems, but no universally accepted pallet dimensions exist. Pallet dimensions vary dep-

Table 8. Typical pallet dimensions

Region most used in	Industry most used in	Dimensions	
		mm (W×L)	in (W×L)
North America (by typical industry)	Grocery, many others	1219×1016	48×40
	Telecommunications, paint	1067×1067	42×42
	Drums	1219×1219	48×48
	Military, cement	1016×1219	40×48
	Chemical, beverage	1219×1067	48×42
	Dairy	1016×1016	40×40
	Automotive	1219×1143	48×45
	Drums, chemical	1118×1118	44×44
	Beverage	914×914	36×36
	Beverage, shingles, packaged paper	1219×914	48×36
	Military 1/2 ISO container, fits 36" standard doors	889×1156	35×45.5
	Retail	1219×508	48×20
Europe, Asia	Similar to 48×40", ISO2	1000×1200	39.37×47.24
Europe	Fits many doorways, ISO1	800×1200	31.50×47.24
	ISO0, half the size of EUR	800×600	31.50×23.62
	Quarter the size of EUR	600×400	23.62×15.75
	One-eighth the size of EUR	400×300	15.75×11.81
Asia	Japan, Korea	1100×1100	43.30×43.30
Australia	Fits for Australian Railway	1165×1165	45.87×45.87

ending on logistical environment and history of countries and industries, but a few different dimensions are widely used. Table 8 shows typical pallet dimensions and region most used in (Clarke, 2003).

Although several pallet standard dimensions are recommended and actively discussed in the International Standard Organization (ISO), packaging standards have not drawn much attention. The 600×400 mm master module based on a 1200×1000 mm pallet is the only dimension that the ISO has accepted (International Organization of Standardization, 2012).

Although this module is widely accepted by European and the US, some Asian countries have a different packaging module dimension as result of different national pallet standards, 1100×1100 mm. For example, based on the fact that the area dimensions of standard pallets for the unit load system in Korea are 1100×1100 mm and 1200×1000 mm, the footprint size of 600×500 mm has been advocated as the standard packaging module. This module is beneficial when several different sizes of packages need to be stacked together on a pallet as well as improving the exchange process of different sizes of pallets during the international shipping and handling. A new standard packaging module could improve dimensional integrity in the various international distribution environments (Kim *et al.*, 2009).

Pereira (2008) emphasized the important of packaging dimension standards. He studied the modular packaging system for fruit and vegetables and found out that two major factors, packaging standard sizes and the ability to interlock, were most important to improve stability and security of loads. He recommended a pallet standard size of 1000×1200 mm and divided it into modules 600×400 mm, 400×300 mm and 300×200 mm (Pereira, 2008).

Peres (2008) recommended using two basic foot prints for packaging dimension standardization: 600×400 mm and 400×300 mm. He pointed out that the vital element of the total cost of the packaging is not simply the cost of the containers, but the cost involved in the supply chain systems. For example, in the US, a reduction of 14 percent in the cost of transporting grapes, and of 9 percent in the cost of oranges, is expected if distribution systems improve cube utilization throughout the supply chain.

Global automotive companies are considering standardization of pallet and packaging dimensions because this can eliminate unnecessary packing and repacking processes. Although U.S. automotive companies have well established returnable packaging systems, which use the basic footprint size of 48×45 inches, these have been a major obstacle for efficient global logistics. Due to different pallet and packaging footprints, many costly activities such as transferring from one pallet to another only increase overall logistics costs and decrease efficiency of logistics. Recently, AIAG (American Automotive Action Group), a globally recognized and opinion leading organization of automotive OEMs and suppliers formed a working group to establish a global pallet footprint and recommended footprint of 1140×980 mm pallet as the global standard pallet for automotive industry (Automotive Industry Action Group, 2010). The importance of packaging standardization in supply chain is currently regarded as one of the biggest issues in automotive logistics among industry experts (Automotive Logistics, 2010).

Furthermore, global standardization of pallets and packages can increase business opportunities for 3PLs like CHEP, Goodpack and iGPS. For example, CHEP, a multi-national pallet rental company, recently launched a global container and IBC pool business. Global pallet and packaging rental companies which already established their own pallet and packaging standards will need less investment while having more efficiency to run pool systems if packaging, pallets and other logistical means are globally standardized.

However, the trade-offs of standardization of packaging in logistics should not be ignored. Although standardized reusable packaging could fulfill logistical requirements and work well in marketing and environmental perspectives, replacing current transport packages requires major investments in packages and in the distribution network. For many cases, “all-embracing integration” concept can be a problematic and difficult to implement in real world. Adaptability and constraints of packaging standardization differ depending on companies and industries, for this reason, possible trade-offs of standardization must be carefully considered (Jahre and Hatteland, 2004).

Packaging standardization is a crucial element to improve efficiency of returnable packaging system in a supply chain and can help to integrate a supply chain. For international supply chains in the automotive industry, standardized reusable packaging can facilitate smooth and integrated packaging and logistics interfaces from suppliers to assembly plants. Hence, impact of packaging standardization on international automotive supply chains should be identified and financially studied.

Conclusion

Total packaging costs cannot be measured and justified without understanding logistics costs and performance interrelationships between packaging components and logistics activities. In many cases in industry, the packaging cost is only considered as a material cost. It is important to include packaging cost in total supply chain cost, so that packaging managers can evaluate and compare packaging options and identify the value of packaging in the supply chain.

This study explored decision factors for choosing a reusable or expendable packaging system in a supply chain. Based on published studies, three key factors including cost, ownership and standardization are discussed. This study demonstrates the importance of assessing the financial performance of shipping container systems, so the industry can significantly reduce its risk when making such packaging decisions.

There are more factors to decide if reusable packaging can be a viable option to replace expendable packaging, especially in a global supply chain. Environmental factors, for example, can be a decisive factor for some company or in a particular supply chain.

Packaging is more than a material cost, but is related to many business activities such as logistics and marketing. Improper use of packaging and packaging design could cause numerous unnecessary logistics activities and costs. Furthermore, reducing packaging cost does not necessarily reduce logistics cost. Without identifying accurate packaging costs and their interactions with logistic systems, managers have a hard time to identify the cause and effect of packaging changes on total logistics costs. There are far more key opportunities and constraints for implementing a packaging system.

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