Packaging development in a core production perspective - a case study at Volvo Cars

Olsson, Annika; Bjöörn, Urban; Jönson, Gunilla

Published in:
Conference proceedings POMS

2008

Packaging development in a core production perspective

- a case study at Volvo Cars

Annika Olsson*, Urban Bjöörn and Gunilla Jönson

****Corresponding author Annika Olsson***

Department of Design Science, Division of Packaging Logistics, Lund University

Box 118

221 00 Lund

Sweden

annika.olsson@plog.lth.se

Abstract – 008-0472

Business success is the result of focusing enhancement of the total performance of the supply network. While all products need packaging in different stages in the supply network, packaging producers deliver into a "core" network. Thus they are seldom an integrated actor of the core supply network. Consequently, the more the package and product development can be functionally combined, and integrated to the supply chain system, the greater the possibility of being competitive. This is accepted theoretically, however, industrial consequences are not yet highlighted since empirical knowledge about packaging effects on the entire production and supply network is limited.

Keywords: *Packaging Development, Process Integration, Supply Network, Action Research*

Abstract Number: 008-0472

Packaging development in a core production perspective

- a case study at Volvo Cars

Authors: Annika Olsson, Design Sciences, Lund University
annika.olsson@plog.lth.se and +46 46 2229734; Urban Bjöörn, Volvo Car Corporation ubjoorn@volvocars.com and +46 31-596493 Gunilla Jönson, Design Sciences, Lund University, gunilla.jonson@plog.lth.se and +46 46 2229444;
POMS 19th Annual Conference La Jolla, California, U.S.A. May 9 to May 12, 2008

Introduction

Business success is the result of companies focusing on the enhancement of the total performance of the supply chain or network, through which improved value to customers is obtained. Meanwhile do customer demands shift rapidly and product differentiation has become one way of satisfying these shifting demands. The product differentiation put requirements on more complex structures in the development and production of for example assembled products. These complex structures involve several processes with different actors to develop, produce and deliver products to the customers. Supply chains are therefore no longer to be regarded as linear constructs with definite starting and ending points, but as complex systems, or networks.

Products need packaging in different stages in the supply network during production and deliveries. Packaging producers on the other hand, most often has a role as a supplier to the “core” product producing supply chain, thus they are a peripheral part of the supply network. At the same time, packaging has become an increasingly important factor for business success and plays an important role for the effectiveness and efficiency in the entire supply network. Thus, packaging has evolved from being considered a cost and a necessary evil to becoming an integral part of quality perception. It is, therefore, no longer possible to separate the product and the package in product development and production, throughout the supply network. In conformity, Sonneveld (2000) stresses the need for integrated product and package development, and Olsson et al. (2007) further suggest the integration to the logistical system. Consequently, the more the package and the product can be functionally combined, and integrated to the logistical system, the greater the possibility of them being competitive in the entire supply chain or network (Harckham, 1989).

Theoretically this reasoning is accepted and understood. However, the industrial consequences are not yet highlighted since the knowledge about packaging effects on the entire production and supply network is not well recognised empirically.

The aim of this article is therefore to empirically highlight the benefits regarding the integrated packaging and logistics development as a concurrent activity with product development for increased effectiveness and efficiency in the core production, from suppliers to final assembly

The empirical basis for this study is several years of action research in the Volvo Cars organization, where one of the authors has taken an action research perspective on a project for increased cost focus and efficiency at the car assembly production plant, in Torslanda Sweden.

The paper starts out by elaborating on theoretical implications of product, packaging and logistics integration in the supply network. Thereafter the methodology and case description is elaborated and the empirical results are presented. The analysis shows how the empirical evolution of integration follows the theoretical reasoning. The paper, elaborates on the integration of the empirical findings to the theoretical framework presented. The conclusion merges the theoretical reasoning with the empirical findings of our study.

Different phases of process integration for increased efficiency

A holistic system view, including concurrent development and integrated production is emphasised because packaging logistics is becoming increasingly important in the development of sustainable business in supply networks. Without an understanding of the influence of packaging on the performance of the supply network, a valuable component in solving the supply network challenges for sustainable development will be lost (Olsson, Nilsson, & Jönson 2007). The theoretical framework below describes different levels and perspectives of integration of packaging activities and competencies into such a network.

Isolated packaging competencies

In practice, packaging has been part of human life since the beginning of time, and the need for packaging has evolved with the development of modern society. The primary function of a package is, according to Jönson (2001), to serve as an interface and a barrier between the product inside the package and the surrounding distribution environment. Poor packaging thus result in damaged contents, more returns, and higher cost of material handling, transport and warehousing.

In the 1990s packaging development was guided compelled by legislation to take the full responsibility for the entire life cycle of the packaging to include all steps from extraction of raw material to landfill, after packaging disposal. After this initiative the emphasis for packaging has evolved into an understanding that packaging is part of a whole system which includes the product as well as the distribution and use of packaging. The packaging must therefore be developed to ensure distribution, efficiency, provide value to the user, and finally be recovered in the best possible way (Abrahamsson et al. 2000; Jönson 2001).

Different definitions have been elaborated on packages. These definitions state that packaging contains, protects and preserves, but they also indicate the link to the processes around packaging, such as transport, distribution, storage, retailing and end-use. All definitions also propose integration of the elements of packaging into the supply chain and involvement of different supply chain actors around the packaging system. In other words, the definitions all indicate the need to regard the packaging system as integrated in the supply chain system and not as an isolated unit. Lambert et al. (1998), recognize that packaging decisions require the use of a systems approach in order for the “total cost” in the entire system to be understood, while Bowersox and Closs (1996) have identified that few firms actually handle packaging from a systems approach.

Integrated competencies and processes

Twede (1992) suggests that packaging innovation is a team effort that requires input from several company functions. Complementary research in the packaging field has proven that packaging development cannot be regarded as a single process, isolated from other activities related to the product or the package. Therefore, in the context of product development, Bjärnemo et al. (2000) describe packaging logistics as follows: *“The interaction and relations between the logistical system and the packaging system that “add on” values to the combined, overall, system”*.

In accordance Johnsson (1998), argue for a more dynamic integration between packaging and logistics to be a potential for major advantages, since the package and the logistics system have to support each other. A packaging decision taken for example in the production, affects not only the packaging system, i.e. the integrated product and packaging, but also the interacting logistics processes. The same logic implies that a logistics decision affects not only logistics processes but also the interacting packaging system in those processes (Twede 1992; Twede & Parsons 1997). By such support there will be a possibility to influence costs and effectiveness in the whole logistics process by considering the package as a prime element in that process. Package design will influence the efficiency of the entire supply network in terms of functions, features, information and cost aspects.

Dowlatshahi (1999) further suggests logistics requirements for packaging to be incorporated with marketing and manufacturing requirements at the design stage. He further concludes that the disregard of packaging and logistics requirements will result in inefficiency in the overall product and systems performance as well as resulting in higher operational and usage costs. With an understanding of how logistics and packaging decisions impact the overall supply chain system or network, it is possible to take holistic packaging perspective decisions, such as changing the packaging system or the logistics activities, or both, in order to enable increased overall supply chain efficiency (Hellström & Saghir, 2007).

Combining resources

Competence in this paper refers to the strategic competencies and resources needed in an engineering organization to ensure handling of complex issues, such as development and production of assembled products. Packaging resources are often organized as an isolated function or dispersed in the organization on several functions that have connections to different packaging activities, e.g. purchasing, production, shipping functions. The implementation of concurrent product and packaging development involves working in cross-functional teams were resources from different functional areas are combined (Klevås 2005). The integrated competencies can be combined through a defined cross-functional team organization or through a project organization that takes resources from the different traditionally organized functions. Independent of organizational form, the resources need to be combined in order to achieve tight connections between the product, the packaging and the logistics activities. It is established that the product, the package and the logistics system are interdependent and affect each other (Klevås 2005; Olsson, Nilsson, & Jönson 2007; Saghir 2004). Changing one of them means affecting the others and thereby the entire system. Klevås (2005) indicates that integrating the packaging function with both the product development function and the logistics function will enhance the entire supply network overview and thus make more efficient overall solutions.

Cross-functional processes

By regarding the package design in a concurrent perspective, the suggestion for the integration of cross functional processes have been developed by researchers in the field

(Olsson, Nilsson, & Jönson 2007; Saghir & Jönson 2001). In addition design for logistics has been suggested previously in the area of concurrent engineering, were the designer's functional requirements as well as the logisticians' requirements are included and integrated in the core product development process (Dowlatshahi, 1999). To add the packaging activities to previous research, Klevås (2005) introduces the concept of design for packaging logistics, meaning that the packaging *and* logistics are integrated in the core product development process.

There is a close relationship between product and package and an exhortation for integration of the product, the packaging and the logistics activities into the core processes of a firm. The integrated product and package are also proven to have great impact on the efficiency of the supply chain or network. With the package function organised both in the product development team and in the logistics function, the integration of packaging and product development will be more successful thanks to the input provided by the supply chain overview (Klevås, 2005). The development processes as well as the supply chain processes represent different activities distributed over time, and the integration of the product and packaging development processes, the supply chain process and the product and package as a system can be visualised as in Figure 1.

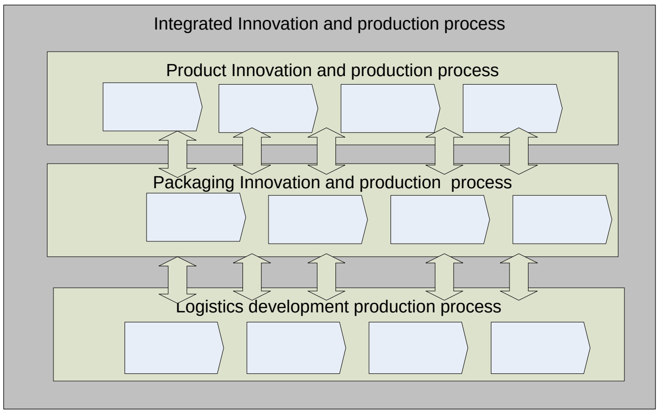

Figure 1: The integration of the innovation and production processes, for an entire supply network (adapted from Olsson et al. 2007).

Methodology

This study represents a qualitative study, where the research objective was to follow and participate in the change process towards integration of the packaging development into the logistical processes as well as into the production process at a car assembly plant. According to Greenwood & Levin (1998) the first step in action research, where the case company is involved in the process, is to define a common problem or point of interest between the researcher and the organization, as in this case the development of the packaging logistics integration in the production process at Volvo Torslanda.

The reason for using qualitative research in this study is to emphasize the understanding of dynamics in the studied context, as Eisenhardt (1989) suggests. Qualitative research stresses an interpretative approach to understanding the phenomenon being studied. This understanding stems from deep and rich descriptions of the system studied (Foote Whyte, Greenwood, & Lazes 2002; Gummesson 2000; Olsson 2007).

Although the study was carried out during the past decade, the retrospective analysis adopts a perspective all the way back to the 1970s. The primary source of data collection is the researcher, who was integrated as a researcher during his employment in the corporation from the early 70'-ies and to the present time. The researcher has been an active participant in the projects as well as in the change processes and the entire research process can be regarded as an action research study

Case Organization and Data Collection

Volvo Cars is a company about 75 years old. Up to 1999 it was owned by AB Volvo, Sweden, but in March 1999 it was bought by the Ford Motor Company, USA. Volvo Cars has three assembly plants in Europe, namely Torslanda and Uddevalla in Sweden and one in Gent in Belgium. In 2002 the company produced 398 631 cars. Safety, quality and concern for the environment are three core values that permeate the company and its products (Volvo Pocket Facts, 2002).

The case organization in this research is the production plant at Torslanda in Sweden, and the unit of analysis is a project that was introduced in the 1970s, intensified in the 1980s and continued during the 1990s and 2000s. The project was driven by cost reductions and the possibilities to receive products efficiently at the assembly line. It was recognized that the handling at the intake at the Volvo Cars plant in Torslanda was not meeting demands. Therefore it was necessary to develop the logistics at the intake of products at the Volvo Cars plant in Torslanda, Sweden to provide efficiency in the handling of goods. One major market change took place in the mid- eighties when customers were given the possibility to select details for their cars. This began with colour adjustments of exterior parts, but very soon selection was extended to more and more parts. For example, in 1984 the selection of sun protection increased from 4 to 24 alternatives and of rear view mirrors from 4 to 96. This explosion of products needed at the assembly line required increased attention in order to ensure efficiency and effectiveness in deliveries at the same time as car production was increasing.

The empirical phases of integration

The results in the longitudinal action research study can be divided into phases according to the theoretical framework presented in this article. The evolution from unstructured work and isolated competencies, to an integrated cross functional organization of activities is clearly found in the empirical data of our study.

Phase 0 - Unstructured work

At the start of our study the assembly line handled 5 m^3 of products that arrived each day at the plant. The products were randomly packed in wooden boxes, corrugated board boxes etc., depending on the suppliers choice of packaging. In addition a great number of damages due to poor packaging had been identified and goods had to be returned with costs attached. At this point in the study (in the 1970s), no data collection to get specific information to avoid repetitive damages on the product/package interface was carried out. Neither specific cost calculations were made to understand the consequences of damages. But the costs for the handling operations were identified as not acceptable as the number of damages were so great that the production was influenced. In addition handling costs were too high, as every type of package needed special handling. An investigation at the receiving department showed that the personnel at the assembly had to repack 100% of the incoming products, to ensure that the products were meeting standards and were properly prepared for the assembly line. The estimated packaging costs were up to 10 % of the total logistics cost, but one single package could influence the total logistics cost with about 65%. It was recognized that lowering of logistics costs had to involve the packaging and the idea to combine packaging and logistics competencies were introduced.

The identified exponential increase of products, due to the possibility for customers to select details in cars, also made it impossible to continue the repacking procedure. The whole operation needed attention to ensure efficiency and effectiveness in deliveries at the same time as car production increased.

Phase 1 – Isolated competencies

The company identified the importance of getting a system that had a standard common denominator, in order to reduce the costs implied by packaging on the logistics system. The common denominator was decided to become the unit load, i.e. the packaging system, which would be the base from which it was possible to create a system for deliveries to the assembly plants. The initial project was driven by persons managing the department for arriving goods, where the increased damage costs were identified. The project competencies had little material knowledge, packaging knowledge and technology insight in general. As a result the development was slow and steps taken were not registered, making systematic analysis impossible. Packaging related activities was isolated from the activities carried out to make production logistics more efficient. This indicates a lack of understanding and recognition of the packaging aspects and its importance on the system. Initially in the project, a number of test packages that were built and used in the deliveries from different suppliers were photographed, to show the suppliers where problems occurred. The unit load was the common denominator and preliminary instructions were written based on the experiences with incoming goods, documented through photographs. In addition packaging tests were made in house. Sensitive products that could cause problems were evaluated in laboratory premises using impact and vibration tests just to learn to understand the product and package behaviours. The way the tests were set up in this immature phase, made it impossible to make statistical analyses of the test shipments carried out, since the available material for test packing was limited, and relevant packaging competencies were missing. As a result one pallet after the other was sent out to different suppliers, without the possibility to follow up results on the long term. Between each test shipment changes were made to the packaging based on experiences made from the tests, but documentation was disregarded.

Phase 2- Integrated competencies and processes

When a new car model increased transports to the assembly line with 50% in the 1980s, the interest arouse to include the packaging and logistics competence early in the product development teams as the cost consciousness had great attention. In this second phase it became obvious that the need for product, packaging and production competence was important in improving the flow of products to the assembly line and in the production itself. The flow of products was mapped and the activities were systematically clocked. Based on the data collected, computer models to calculate the cost of different packaging alternatives were developed in order to make it possible to decide the quantities needed in each batch, to make the assembly line efficient. In addition, it was important to analyze the forces that the products were exposed to during the transports before assembly, in order to make it possible to identify preferred packaging designs. Material knowledge was consequently needed to guide the engineers in the selection of packaging materials for the distribution of products. With the enhanced packaging competence, check lists were developed to provide basic understanding and new initiatives were taken to develop special packaging units.

The engineers working in the production saw the benefit of bringing the packaging project into their logistical work. In addition, development was concentrated to building of unit loads that could be brought from suppliers to the assembly line at Volvo Cars without individual handling of packaged products. This meant that attention was paid to packaging designs for all products that should be distributed. The products were packed with or without individual packages in patterns on the pallets in order to bring stability to the loads. At the same time the packaging materials, in both individual packages and in unit loads were minimized, still providing easy opening at the assembly line.

Phase 3 - combination of resources

In the assembly department, multi disciplinary teams with material, packaging design and time studies competencies, were allocated. The teams had to co-operate with the logisticians to develop a packaging system that fitted the Volvo pallet. The engineers, started to apply ergonomic requirements on the handling activities. In addition, safety became an issue.

The unit load approach and the combination of different resources in the teams, made it possible to make better prepared products for assembly. The multidisciplinary project work made it possible to pre-assemble some products and deliver sensitive products in units that could accept higher individual packaging costs for protection, still lowering the total cost. The packages were prepared to be handled by robots and the precision demands on the packages increased. The placement of individual parts in the unit loads were based on models built by the engineering and packaging teams in cooperation.

As product data, packaging data etc. were collected, the engineers could present drawings to the suppliers with instructions how to pack, store and transport. One example of standard packages developed placed on a unit load pallet is shown in Figure 2.

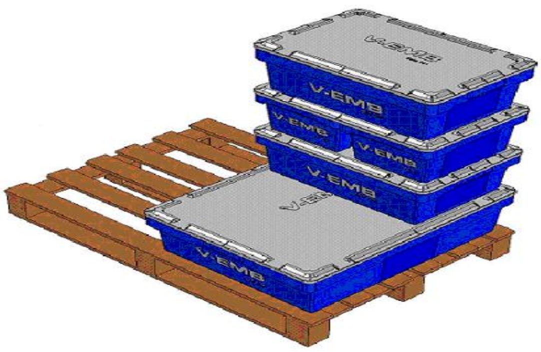

Figure 2: Small standard boxes fitted to the pallet

Another example of cost efficient packaging developed is the plastic crate with conic walls shown in Figure 3.

Figure 3: Plastic crates with conic walls at left compared to vertical walls at right

It is however, shown that the numbers of factors that influence the packaging design are many and that data are still not sufficient for the final selection step. Therefore the building of multidisciplinary packaging and logistics competences must continue as simulation programs available today are not sophisticated enough to include all factors.

Phase 4 – Process integration in the supply network

This fourth phase, to bring together resources and competencies from products, packaging, transports, storage and production, facilitated the increase in production and the possible increased alternatives in deliveries. The combined resources facilitated cross – functional process work that provided better quality of products arriving at the line and the total costs were lowered in the entire network. This also led to a decrease in returns. In the cross-functional process work, the production engineers engaged themselves increasingly in cost evaluations to decrease manual work as much as possible and still cut costs. The logistics costs for deliveries to the assembly line today are estimated to be 6-7% of the total cost of the car compared up to 10%, 20 years earlier. Packaging makes up about 1% of this cost (Andersson, 2003). The integrated process work included cross-functional time studies, to record all activities from packaging, opening to time used before the products went into the car. This is an effect from efforts to reduce work environmental exposure for the workers across functions and processes.

The cross functional processes included in the supply network can be visualised in Volvo Cars simulation programs (Figure 4). The processes starts at the assembly, where all activities involving packaging are analyzed, then the unpacking operation is studied and the work continues down the chain concerning all factors shown in the figure to get data.

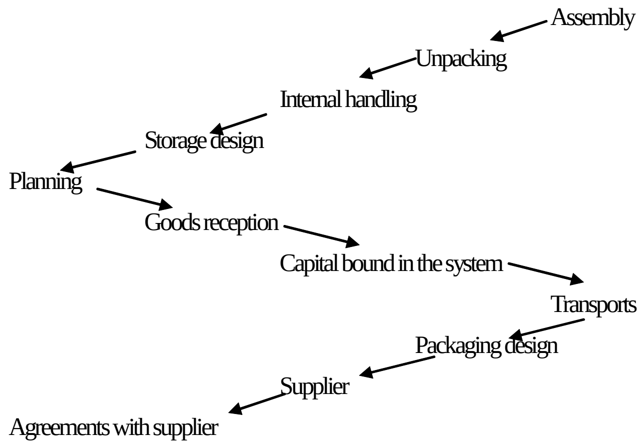

Figure 4: the interrelationship between packaging, logistics and business

Different supply networks or cross-functional process routes, naturally give different costs. The complexity of the calculation can be described as a "Fish net". If you change one factor all costs in the network change. Due to the network complexity simulations are used to make calculations of processes in the network. Therefore simulation programs are continuously developed, when new knowledge about crucial factors is achieved. It is further identified as important to involve packaging and logistics in any engineering design work. In addition to cost calculations, the programs have made it possible to test the routes in a factory in order to evaluate the best flow. The simulations also make it possible to handle each individual package and unit load to ensure that quality and high cost products arrive at the right time at the assembly line, rather than as part of the general flow, thus keeping costs down. The integration of packaging and logistics resources into the core processes of development and production is identified in order to receive a more efficient assembly production. Another benefit of such integration is that the package ought to be adapted to all actors in the network. That means when companies create networks it becomes important to integrate packaging that fits all actors and their supply chains. The package should furthermore be adapted to the product in order to protect the product well and decrease damages. For the entire network the package should be integrated with the technology development, since the package needs adaptation in production as well as in information. Furthermore, adaptation of the package to the transport conditions is needed when the market is global. When the transport volumes increase, environmental considerations must be taken as well as considerations about increased costs, efficient volume utilization and weight vehicle utilization.

Conclusions

The evolution from unstructured work and isolated competencies, to an integrated cross functional organization of activities is clearly found in the empirical data of our study. The empirical evolution is supported by theories of integrating product, packaging and logistics resources and processes in the development and production of complex assembled products, in order to achieve effective and efficient supply networks.

The main conclusion is that the combined packaging and logistics resource and process integration create the most efficient solution from a holistic systems perspective in the studied product supply network. The objective to contribute to the understanding of the influence of the interaction between the packaging and logistics competences to the efficiency and effectiveness of the supply network has been achieved at the aggregation level studied. The interdependency between resources and the understanding and co-operation between engineers and logisticians, has actually facilitated new developments that had not been recognized at the beginning of the project.

The packaging and logistics competence today is brought in already when a new car model is initiated, this to ensure that packaging and logistics aspects are not forgotten in the early development. The positive experience from joint packaging and logistics development that reduced costs from in the 1980s, confirm the importance of coordinated cross functional work with combined resources in integrated processes.

References

Abrahamsson, M., Stahre, F., Hultkrantz, O., Lumsden, K., Jönson, G., Orremo, F., & Wallin, C. 2000, *E-commerce and Logistical Consequences*, Department of Design Sciences, Packaging Logistics, Lund Unversity.

Andersson, L. 2003, ”Vad styr kundens valk av emballage”, Master thesis, Packaging Logistics, Lund Institute of Technology, Lund University, Lund, Sweden.

Bjärnemo, R., Jönson, G., & Johnsson, M. 2000, "Packaging Logistics in Product Development", J. Singh, S. C. Lew, & R. Gay, eds., Gintic Institute of Manufacturing Technology, Singapore, pp. 135-146.

Bowersox, D. J. & Closs, D. J. 1996, *Logistical Management, The integrated supply chain process*, International edn, McGraw-Hill, New York.

Dowlatshahi, S. 1999, "A modeling approach to logistics in concurrent engineering", *European Journal of Operational Research*, vol. 115, no. 1, pp. 59-76.

Eisenhardt, K. M. 1989, "Building Theories from Case Study Research", *Academy of Management Review*, vol. 14, no. 4, pp. 532-550.

Foote Whyte, W., Greenwood, D. J., & Lazes, P. 2002, "Participatory Action Research - Through Practice to Science in Social Research," in *Participatory Action Research*, W. Foote Whyte, ed., SAGE Publications Inc., pp. 19-55.

Greenwood, D. J. & Levin, M. 1998, "Introduction - Action Research, Diversity, and Democracy," in *Introduction to Action Research - Social Research for Social Change*, SAGE Publications Inc., pp. 3-13.

Gummesson, E. 2000, *Qualitative Methods in Management Research*, 2th edition edn, Sage Publications Inc, Thousand Oaks, California.

Harckham, A. W. 1989, *Packaging Strategy Meeting the Challenge of Changing Times* Technomic Publishing Inc. Pennsylvania USA.
Hellström, D. & Saghir, M. 2007, "Packaging and Logistics Interactions in Retail Supply Chains", *Packaging Technology and Science*, vol. 20, pp. 197-216.

Johnsson, M. 1998, *Packaging Logistics - a value added approach*, Doctoral thesis, Department of Engineering Logistics, Lund Institute of Technology, Lund University, Lund, Sweden.

Jönson, G. 2001, *Packaging Technology for the Logistician*, 3d edn, Department of Design Sciences, Packaging Logistics, Lund University, Lund.

Klevås, J. 2005, "Organization of packaging resources at a product-developing company", *International Journal of Physical Distribution & Logistics Management*, vol. 35, no. 2, pp. 116-131.

Lambert, D. M., Stock, J. R., & Ellram, L. M. 1998, *Fundamentals of Logistics Management.*, International editon edn, Irwin/McGraw-Hill, Boston.

Olsson, A. 2007, "Transformation to a customer-oriented perspective through action learning in product and service development", *Action Learning: Research and Practice,* vol. 4, no. 1, pp. 45-59.

Olsson, A., Nilsson, F., & Jönson, G.2007 "The evolution of the packaging logistics area", Conference Proceedings NOFOMA, University of Iceland, Reykjavik.

Saghir, M. 2004, *A platform for Packaging Logistics Development - a systems approach,* Doctoral thesis, Department of Design Sciences, Division of Packaging Logistics, Lund University, Lund.

Saghir, M. & Jönson, G. 2001, "Packaging Handling Evaluation Methods in the Grocery Retail Industry", *Packaging Technology and Science*, vol. 14, no. 1, pp. 21-29.

Twede, D. 1992, "The process of logistical packaging innovation", *Journal of Business Logistics*, vol. 13, no. 1, pp. 69-95.

Twede, D. & Parsons, B. 1997, *Distribution packaging for logistical systems - A literature review*, First edn, Pira International, Surrey, UK.