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# DEMAND-DRIVEN LOGISTICS FROM A PACKAGING PERSPECTIVE

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## **ABSTRACT**

During the last decade there has been a shift of focus from supply management towards demand management in logistics literature and practice. This article sets out to investigate what impact such a shift has on logistics, especially from a packaging perspective. An extensive literature review has been conducted, focusing on the top three journals in logistics as well as in operations management (JBL, IJPDLM, IJLM, JOM, IJOPM and POM). The results of the literature review show that there has not been much focus on the impact of the increased demand focus on operational logistics. In particular, the results indicate a lack of attention to packaging effects due to the increased demand focus. Two interview studies have been conducted in the telecommunication industry and in the automotive industry. Both studies demonstrate that there are packaging-related issues which, based on a shift in focus from supply to demand, have changed the handling and requirements of packages and logistics as a whole. Implications for research and management are provided at the end of the paper.

*Key words: demand chain management, packaging, demand, physical distribution, operational logistics*

## **Introduction**

During the last decade there has been a shift of focus from supply management towards demand management in logistics literature and practice. In logistics literature this has led to a greater focus on effectiveness (Mentzer, Min, & Bobbitt 2004). In the supply chain this increased awareness of customer needs means that the starting point is the customer, as opposed to starting at the supplier and working forward (Heikkilä 2002) i.e. going from push to pull. Two factors contributing to an increased demand focus are globalization and use of the Internet, which both provides new opportunities in the way resources and assets can be shared worldwide and targeted in more dynamical ways which also impacts the demand perspective. Other factors are that companies are continuously increasing their awareness of the importance of satisfying customer needs (Hoover et al. 2001) and that there is an ongoing power shift forward in the supply chain (Dubelaar, Chow, & Larson 2001). From a pragmatic point of view, trends in several industries indicate this change of focus. The retail industry might be one of the strongest examples where the power shift from suppliers to the major retail companies has occurred during the last decade (Bowersox, Closs, & Cooper 2002). This change is occurring in other industries as well. For example, studies at Trelleborg Wheel Systems and Sony Ericsson Mobile Communications indicate increasing customer demand in terms of increased product and delivery customization. From the pragmatic point of view, the trend towards increased demand orientation is clear. However, while the vast majority of the current literature is focused on conceptualizing and theorizing the demand perspective, the operational effects on logistics and packaging are limited to transportation, warehousing and planning. The connection to operational aspects such as smaller batches, more frequent deliveries, information capture and processing, material handling and control, are less emphasized. From our empirical studies it has been found that there is a need for research on the real effects of this supply/demand shift on an operational level. In this article we thus set out to investigate how this shift affects operational logistics activities from a packaging perspective. This perspective is suitable as packaging influences and affects every logistics activity. In addition to logistics, the six main functions of packaging (containment, protection, apportionment, unitization, convenience, and communication) also affect the areas of marketing, production, environment, and IT.

## **Method**

Based on discussions with representatives from industry on different occasions a need to explore operational effects on logistics and packaging due to the shift from supply focus to demand focus was recognized. An initial, rather short, literature review indicated that a gap also might exist in the current literature in this area. Thus, this study started out with an extended literature review of the field of logistics concerning the operational effects a demand perspective had on logistics and packaging. Complementary to the literature review empirical material was assessed through two interview studies, one at Trelleborg Wheel System and one at Sony Ericsson.

The initial literature review of logistics, packaging and demand-oriented articles led to an extensive set of keywords to be used in the extended literature search. The keywords were matched with the articles' abstracts in order to find articles of relevance. A journal search was conducted in order to examine research of high relevance, quality, and impact on the discipline and in which operational issues within logistics were dealt with. The choice of journals was based on significance in the field regarding e.g. relevance, quality, and impact on the disciplines (Emmelhainz & Stock 1989; Fawcett, Vellenga, & Truitt 1995; Stock 1997). This journal search led to the choice of three leading logistics journals and three leading operations management journals during a period of ten years. The journals were *Journal of Business Logistics*, *International Journal of Physical Distribution & Logistics Management* and *International Journal of Logistics Management* in the field of logistics, and *Journal of Operations Management*, *International Journal of Operations & Production Management* and *Production and Operations Management* in the field of operations management. A classification of the articles found led to a total of 178 articles that were analyzed and used. From this classification 27 % were related to material handling and physical distribution, 6 % were packaging related, and 67 % regarded strategic demand management issues.

Semi-structured interviews were also conducted; with people working in different departments and on different hierarchical levels in two companies. The questions were focused on customer relations, but also leaving discussion space open for including a wider spectrum of issues regarding the demand issues on logistics and packaging operations at the studied companies.

### **Literature review**

The current literature addresses a shift in focus from supply chain efficiency towards customer demand satisfaction (Heikkilä 2002). Most of the literature reviewed are conceptual or deal with issues from a (top) management perspective. In particular, the following issues are raised:

- Differentiating strategies. Due to an increased level of satisfying customer demand, customization of products and services is becoming the norm leading to a situation where companies need and are fully able to differentiate themselves. The conceptual articles reviewed deal with product differentiation (Fisher 1997), agility (Power & Sohal 2001), decoupling point (de Treville, Shapiro, & Hameri 2004; van der Vorst, van Dijk, & Beulens 2001), and quick response (Sabath 1998).
- Responsiveness. Zhang, Vonderembse, & Lim (2003) put forward manufacturing flexibility as a critical dimension for responsiveness.
- Joint forecasting and information sharing. Whiteoak (1999) emphasizes joint forecasting and information sharing between firms as a way for manufacturers to increase predictability and manage variability of demand. Furthermore, Smáros et al. (2003) highlight better planning as a valuable aspect of information sharing and Catalan and Kotzab (2003) state that information sharing and supply chain cooperation may improve responsiveness. In addition, Angulo, Nachtmann and Waller (2004) found out through a simulation model that the average inventory levels increased throughout a supply chain when forecasts were shared. On the positive side, they report that the outlet fill-rate was greatly improved, because more inventory was needed to reach the desired fill rates.
- Supply chain collaboration and integration. Heikkilä (2002) highlights the need for good relationships. van Hoek (1998) investigates the role of postponement to achieve virtual integration.
- Supply chain visibility. Real time information is proposed to help firms reduce demand amplification (van Hoek 2001) and improve responsiveness (Catalan & Kotzab 2003). To access consumer demand, Whiteoak (1999) suggests automatic identification. Kärkkäinen, Ala-Risku and Holmström (2003) concluded that information and control in real time reduced distribution costs through merge-in-transits.

Even though it is rather rare, the current literature also brings up some operational issues i.e. related to material handling, physical distribution and other handling-related issues, of the shift of focus. Concerning product customization and manufacturing strategy, Spring and Dalrymple (2000) state that as engineering activities become part of repetitive operations, the integration among functions and activities become more critical. They also address that increased customization highly influences production planning, process technology flexibility and materials arrangement. Childerhouse, Aitken, & Towill (2002) suggest and test an operational model for designing and analyzing demand chains. Another concrete concept developed through information sharing affecting physical processes in logistics, such as transportation, inventory, and ordering, is vendor managed inventory (VMI). According to Angulo, Nachtmann and Waller (2004) availability, reliability and completeness of information are challenges for vendors and if it can be handled well, benefits are to be gained.

Inventory issues in the context of increased customer satisfaction are dealt with too. Ballou and Burnetas (2003) provide guidelines for items that should be traditionally managed and for those where virtual inventory management fits better. The combination of these approaches leads to a balancing focus with lower safety stocks at each location and consequently the opportunity to lower overall

inventory levels. Related to multiple inventories, Evers (1997) concludes that emergency transshipments enable advantages in satisfying volatile demand over geographical dispersed markets and as a result safety-stocks levels can be reduced, and fill rates increased.

The current literature on operational logistics that best served our purpose was related to packaging. Jahre and Hatteland (2004) examined implications for integration and standardization of packages and physical distribution. They found that adapting a packaging system to a certain customer's demands may result in inefficient operational logistics, because the system may be inappropriate for other customers. This inappropriateness may reduce the capability of logistical flexibility regarding deliveries in large. They conclude that fulfilling various customer demands may call for a differentiated packaging solution, such as asset-specific investments and modified material handling. However, too differentiated might not be cost-efficient. Lee and Lye (2003) found a negative impact on the logistics operations by adapting customer demands regarding differentiation when they compared mobile phones for different customers. The efficiency of mobile phones varied, because of customer-driven packaging decisions. Applying the most efficient features to the least efficient package, major improvements were calculated.

Customizing products leads to an increased number of products. In a Dutch study about a pharmaceutical company, Strijbosch, Heuts, and Luijten (2002) observed that the number of product types, e.g. packaging shapes, increased dramatically. To manage the increasing complexity, the authors suggest cyclical packaging planning. Proposed benefits were for instance reduced set-up costs, stability and reduced lead times. To achieve cyclical planning three steps are put forward, which include create families of articles, determine packaging sequence and determine order-up-to levels.

Sales packaging should fit both logistical and marketing related demands, but there is a risk that the former are neglected because the marketing department is most often responsible for sales packaging decisions. In a mail survey Prendergast and Pitt (1996) found that the main functions of sales packaging were to protect and contain the product. Attracting customer attention was important too, but neither apportionment (including handling) nor unitization were regarded as key aspects.

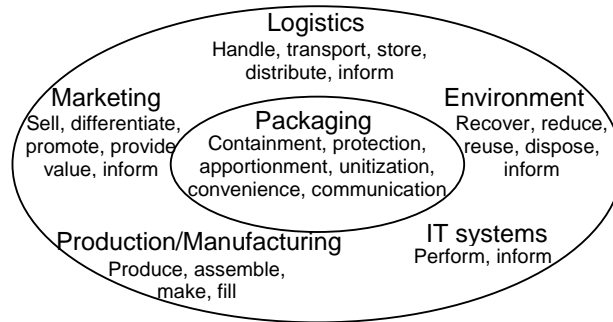
Environmental demands affect operational logistics and packaging. Livingstone and Sparks (1994) investigated Scottish exporters knowledge and approaches to new environmental packaging laws in Germany. The most common adjustments, to adapt to the requirements from the new legislation, were to redesign labels and packages. Min and Galle (2001) studied environmental purchasing in US firms. They stress that many firms need laws or customers demand to act on green purchasing. They further identified that green purchasing affects packaging and secondary operational logistics

Increased customer demands for environmental concern and smaller quantities in deliveries affect shippers' attitude to invest in a returnable packaging system. Rosenau et al. (1996) first bring up increased costs for disposal and environmental legislation as reasons for shippers' increased interest in returnable packaging. Then they mention the increased use of just-in-time in logistics systems as a reason for smaller quantities in deliveries, which *"as well as reducing inventory, this reduces the number of packages in the logistical cycle, reducing the potential investment in returnable packaging."*

### **Our packaging perspective**

Packaging is a suitable starting point for our analysis. It influences and affects every logistics activity (Bowersox & Closs 1996; Saghir 2004) and thus affects both efficiency aspects e.g. efficient handling and effectiveness e.g. marketing aspects and communication. Lockamy III (1995) in his assessment of strategic packaging decisions lists six main functions of packaging, which are: 1) containment, 2) protection, 3) apportionment, 4) unitization, 5) convenience, and 6) communication. Dealing with packaging issues there are direct effects involved arising from packaging material costs, packaging material characteristics, and reuse and disposal costs. In addition, different levels of packaging can be identified i.e. primary, secondary and tertiary. The various levels and their interactions should be regarded as a packaging system (Saghir 2004). The packaging functions can also be set into a wider perspective including indirect effects the packaging has on areas such as logistics, marketing, environmental issues, production/manufacturing, and IT systems. Figure 1 provides an illustrative overview of our packaging perspective.

Figure 1: Our packaging perspective and its effects on vital areas. Modified from Saghir (2004 p.61).



### **Empirical insights**

From the interview studies the notion of increased customer pressure and demand was clear. In the tire and wheel industry, people at Trelleborg Wheel Systems (TWS) described increasing customer demand in terms of increased product and delivery customization. Some customers required that when delivered the wheels should already be painted with the right color code, fully assembled and with the correct pressure. Regarding delivery customization, the time windows for delivery has shrunk due to customers' increased focus on just-in-time schedules. Furthermore, within TWS the demands are increased downstream the supply chain i.e. the deliveries from manufacturing facilities in Asia is deemed to focus on efficient unloading instead of today's focus on efficient filling. From the interviews at Sony Ericsson (SE) it was also expressed that the customers are increasing their demands on e.g. lot sizes, delivery times, customized packages, printing, and visualization on case packaging. The number of packages per pallet has changed due to increased customer demand and has now become a customization issue, which generally cause extra efforts in planning as well as during the actual deliveries. In conclusion, the insights gained from the interviews show a change occurring from supply focus towards increasing customer demands in both scale (accurate deliveries, specific lot sizes) and scope (extra services, assembled products, customized packages).

### **Analysis**

In order to address demand-driven changes on operational logistics the packaging perspective (see figure 5.1) is set on what is proposed in the demand oriented literature. This assessment is important in order to address key aspects and propose changes and adjustments of operational logistics.

The particular customer context is important for operational logistics. National or local cultural variations affect customer requirements about packaging and consequently affect logistics. Our interview studies indicated that it is essential to understand and translate packaging requirements into practice and match them with the supply chain. The study at TWS revealed that their facilities in the Asian countries earlier were focused on maximizing fill rate of containers to Europe and thus, neglected the unloading aspects. Due to increased focus on customer demand in the supply chain emphasis was changed to unloading rather than on fill rate. This example indicates that the more demand-driven a firm wants to become, the greater the number of cultural characteristics which must be considered. The packaging solutions can fulfill such demands.

Customer demands on the different levels of the packaging system affect logistical efficiency in the supply chain. First, the packaging functions of apportionment and unitization can be improved by adjusting the packaging system to its particular supply chain context. The literature review combined with results from the interview studies indicate that each product cluster should have a suitable packaging solution that e.g. eases handling, and thus facilitate high efficiency, but on the other hand, too many adjustments make for an inflexible, i.e. less effective, supply chain. Second, the unitization of the packaging system needs to be considered when customer demands are concerned. Experiences from SE indicate that due to increased customer demand the number of products per pallet ordered is changing from what it was a few years ago. Before, SE would distribute a number of products, which was optimal from a packaging and transportation fill-rate perspective. However, based on the customers now diverging ordering patterns the variety of number of products per pallet is customized. Finally, if packaging should be recovered or disposed, reverse logistics impacts need to be considered and how it affects the reverse supply chain. In the recycling process information on the package can ease the process of identifying its material type.

The packaging system should be adjusted to the product characteristics, because it has direct impact on operational logistics. The trade-offs between customized product and thus packaging regarding volume/design and standardization should be emphasized due to increased concern for demand aspects. Focusing on a lean supply chain for commodity products and availability for unique ones (Childerhouse, Aitken, and Towill 2002) may be released by the determination of a suitable packaging solution. Increased demand focus for unique products may call for rapid response and short delivery

lead times. To handle this logistically products and packaging primarily need appropriate features within apportionment, unitization and containment. Increased demand focus for standardized commodities needs to facilitate efficient handling and convenience regarding ease of use and brand identification. SE identified a change in customer demands regarding product and packaging design. During the last five years such changes have appeared, such as inclusion of SIM cards in each package when the products are packed leading to more customized products.

Customized design may increase on the expense of standardization when applying a demand focus. The interview study at TWS showed that standardized packaging design facilitates responsiveness because of factors such as efficient handling and the possibility of joint packing of various articles, while meeting customer demands is set aside. Customized design, on the other hand, offers suitable packaging according to customer demands, but responsiveness may be less efficient than for standardized packaging. Therefore, a qualification criterion for packaging design is customer understanding, which also is supported by Lee and Lye (2003), who discuss increased packaging influence on supply chains.

Information technology and its interface with packaging are of importance when examining secondary effects of packaging in the logistics context. Packaging may be regarded as an information link between the physical flow and the IT system. The validity and reliability of parts of the logistical information in the IT systems is based on information gained from product flows, which typically is based on the actual movement and registration of packages e.g. POS data, inventory in- and out-check points etc. Consequently, the packaging provides information functions that are crucial. In several industries barcodes have come to be obligatory, however from a demand oriented perspective there is a call for auto-ID e.g. RFID technology and other information enriching facilities that can be integrated with the product or its package. In these cases packaging should be designed in order to function in any situation, whether the demand is for information in order to track and trace, to follow the temperature of a package in a chill chain or to inform a customer of containment and handling tips. Furthermore, with this up-to-date information, the logistical flows have the possibilities to perform more effectively, which is of interest as supply chains are differentiated. Knowing where each item of transportation packaging is located facilitates a rapid response and efficient handling, and less out-of-stock situations are likely to occur. However, costs in production equipment investment needs to be considered as well as costs in investments in IT systems and RFID equipment, e.g. readers and tags. Increased attention to customer demands also may lead to new, modified or differently used load carriers. The need for faster responses, customized volumes or changed handling at some point of the supply chain all end up affecting load carriers at various levels. One evident example is merge-in-transit which means consolidating goods in transit from several supply locations into one final customer delivery (Kärkkäinen, Ala-Risku, & Holmström 2003). The authors claim it to be a cost-efficient delivery method. Thus, customer demand for a few deliveries can be solved by using the load carriers (trucks) in a different way. Evidence of new packaging due to demands on the logistics system to reduce damaged goods, is borne out by a large Swedish firm which replaces tertiary packaging pallets with a small plastic loading ledge (Jonsson & Mathiasen 2004). The fill rate in the trucks thus increased up to 40%, because of elimination of air in-between loads. Furthermore, returnable packaging was not needed. Consequently, adjusting the packaging system to customer demands improved both customer satisfaction and effectiveness.

### **Conclusions**

The contributions of this article are twofold. First, the article discovers impacts on operational logistics when focus on demand aspects increases in supply chains. Second, it is found that packaging aspects are dominating aspects in assessing operational logistics.

We argue for the following aspects to be of importance when adjusting operational logistics activities to demand-driven changes in order to increase efficiency and customer satisfaction: Adjusting the packaging system to; the particular customer/consumer context it is used in; the supply chain (levels of packaging i.e. primary, secondary, tertiary etc.); the product characteristics (standardization vs. a) customized volumes, b) customized design). Information enrichment through packaging and new types of packages/load carriers (e.g. ledge for loading) or differently used (e.g. merge-in-transit) load carriers.

These results have implications for both academia and industry. Implications for research are that it adds initial knowledge to the gap identified about impacts on operational logistics when demand aspects are considered in business. For managers a packaging perspective may be highly valuable in the process of transforming logistics to an increased demand oriented business. Since our research indicates that packaging is influenced to a great extent by the level of satisfying customer demand the results point to a need for management to reconsider packaging issues as they apply a demand-driven business.

To conduct further research on the topic more empirical evidence should be collected. Both an empirically broad study with focus on statistical generalization of certain aspects and an in-depth study with focus on details would add important knowledge to impacts on packaging and operational logistics when companies change focus from supply chain efficiency to customer satisfaction.

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