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Entrepreneurial applications of the lean approach to service industries

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Service industries have grown significantly in recent years, especially in the advanced economies. The applicability of the Toyota system for manufacturing excellence to other industries has been widely studied. This paper seeks to contribute to this growing body of research by exploring the applications of the Toyota approach, particularly the lean system in the service sector. The paper examines the information systems that have enabled benefit in the service industries, to include vendor-managed inventory systems and variants, and then compares the benefits from information systems in support of supply chains. We also review why enterprise systems provide more opportunities in aiding the implementation of the lean systems. We present a case study of a South Korean supply chain system to demonstrate the entrepreneurial application of such approaches.

Keywords: supply chains; lean manufacturing; entrepreneurial

Introduction

The Toyota system for manufacturing excellence was a critical factor in enhancing Japan's global presence as a highly efficient producer of quality products subsequent to World War II. The Toyota Production System, based on Kanban control, was introduced to academic research by Sugimori, Kusunoki, Cho, and Uchikawa (1977). This extraordinary innovation was tremendously important in the history of manufacturing, making terms such as Kanban, just-in-time (JIT), lean manufacturing, and agile manufacturing common.

Lean manufacturing, a bundle of techniques pioneered by Toyota in the 1950s, focuses on the supply chain side of production. It has become a common philosophical approach to supply chain organisational design in the automobile industry as well as a practical approach to production excellence. The key principle of lean manufacturing is to cut out waste by eliminating activities that do not add value, by making sure that this principle is applied throughout the supply chain, by creating continuous flows of product without bottlenecks, by producing to order (demand-pull rather than supply-push), and by emphasising quality. This approach typically leads to the elimination of backlogs and more synchronised production to forecast. Lean

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manufacturing approaches have been credited with improved customer service as well as reduced procurement and plant-floor costs (Bradford, Mayfield, & Toney, 2001).

Agile manufacturing systems focus on providing value to customers at the retail end of a supply chain, especially relative to on-time delivery, developing systems capable of rapid response to market and technology changes, and using these systems to gain competitive advantage in turbulent markets (Helo, 2004). Supply chain performance is enhanced by matching supply and demand, thus reducing costs at both end of the supply chain while improving the customer satisfaction through better on-time performance. This requires reducing uncertainty within the supply chain as much as possible. However, uncertainty is often impossible to eliminate. Some products have short life cycles and high demand uncertainty by their nature (i.e. fashion-driven). This type of market requires fast response to demand changes. Other products have longer life cycles with less demand uncertainty (commodities). For commodity products, cost reduction is more important. Agility means using market knowledge and information technology (IT) to exploit profitable opportunities in a volatile market place (Mason-Jones, Naylor, & Towill, 2000; Naylor, Naim, & Berry, 1999).

Toyota's methods have been applied in a variety of manufacturing contexts. Spear (2004) cited Alcoa as saving $1.1 billion over the 1998–2000 period, while simultaneously improving the safety, productivity, and quality. Gnamm and Neuhaus (2005) reported the application of lean techniques to a dysfunctional factory in Germany, where the workers were given freedom to redefine the factory, including daily meetings with quick feedback, and worker determined performance levels. The results were highly successful, with yield increasing 4% in 3 months, and profitability moving from a loss of 15% to a profit of 15% in just over 1 year.

Recently, the service industries have shown considerable growth and the applicability of new approaches to service firms has been widely discussed in the literature (Hines & McGowan, 2005; Nooteboom, 2007). Apte and Goh (2004) presented a case study to illustrate how the lean manufacturing principles can be applied to information-intensive services.

Cuatrecasas (2004) described a step-by-step methodology to evolve from a production system to a lean production system. Emphasising the importance of contingencies to the applicability of lean production to the service sector, Ahlstrom (2004) suggested that lean production might be more applicable to some services than manufacturing because of the contingencies that stem from the characteristics of services. Clearly, Toyota's methods, lean approach in particular, have led to a rethinking of service operations.

In this paper, we intend to contribute to this growing body of research. Towards this end, we present diverse examples of entrepreneurial applications of both lean and agile methods in and beyond manufacturing, compare ideas about the fundamental principles in their implementation, and evaluate the use and potential of IT to support them. These benefits are demonstrated with a review of a real-world application case in third party logistics.

Supply chain management in the twenty-first century

Electronic business has brought us an entirely new business climate, with the ability to electronically generate retail data. Many service organisations and retail outlets generate masses of data. Grocery stores have large amounts of data generated by their purchases. Bar coding has made checkout so that it is very convenient for retail establishments. Wal-Mart and other

retailers have extended electronic data generation to include radio frequency identification, allowing tracking of the physical location of the product real time. The electronic age involves data on a very large scale.

There are about five representative forms of lean supply chain coordination in the electronic business environment. These systems certainly apply to the service sector in the broad sense. Successful retail organisations in the twenty-first century consider service to the customer to be their focal point (Furrer & Sollberger, 2007). IT systems applied across supply chains are enablers so that retail organisations can provide a better service.

Traditional supply chains

There have been a variety of control schemas that have evolved to control supply networks. The traditional uncoordinated supply chains of the 1980s, with no information sharing, but independent inventory control policies, led to the infamous 'bullwhip' phenomenon (Sterman, 1989). The bullwhip phenomenon occurs because of overestimation of demand induced by the lumpiness of orders from downstream elements of the supply chain. An obvious first step in reducing the inefficiencies caused by the bullwhip effect was to increase information sharing across the supply chain (Hariharan & Zipkin, 1995). The use of bounded ordering policies was suggested as an additional means to reduce the bullwhip effect (Gavirneni, Kapuscinski, & Tayur, 1999). In a short season environment, Fisher and Raman (1996) suggested the benefits of improved forecasting and production planning. More complete information sharing and coordination systems were also studied, with Cachon and Fisher (2000) and Chen, Federgruen, and Zheng (2001) being only two examples.

Efficient consumer response

The first type of coordination among supply chain members is information exchange, to include action plans to enable forecast alignment for long-term capacity planning (Holweg, Disney, Holström, & Småros, 2005). This improves the visibility and thus makes the demand more predictable. Barratt (2003) reviewed the efficient consumer response (ECR) effort of the 1990s in the grocery industry to transform business practices through four strategies:

(1) efficient promotions;
(2) efficient replenishment;
(3) efficient store assortment;
(4) efficient product introductions.

The focus was to gain improved performance through trust-based relationships between elements of the supply chain, based on more efficient information sharing. The goal was that production would be more demand-driven (Brockman & Morgan, 1999).

Some streamlining of the grocery industry supply chain has been reported (Hoffman & Mehra, 2000), although in some cases inventories actually increased through the use of ECR (Brown & Bukovinsky, 2001; Frankel, Goldsby, & Whipple, 2002). One source of distortion can arise when retailers give false data to distributors or manufacturers in an effort to assure more secure supplies.

Faster transfer of information across organisations has not avoided all problems. Kaipia, Holmström, and Tanskanen (2002) identified problems to include slow item level replenishment as opposed to fast order placement. Retailers in the grocery industry carry tens of thousands (if not hundreds of thousands) of specific stock-keeping units. In this complex environment, an order may be placed after the product is sold. Furthermore, small items are often delivered in bulk packages, which can lead to difficulties. On the supplier side, short lead time and high service-level requirements squeeze out most reaction time. If extremely accurate information at a detailed level is not available, the system almost guarantees stock-outs. Avoiding such stock-outs through higher inventories in turn eliminates most of the benefits of a well-managed inventory system.

Vendor-managed inventory

Vendor-managed inventory (VMI) involves supplier assumption of management of retailer inventory (Andel, 1996). This is channel coordination. Based on the advanced information through electronic data interchange (EDI) or Internet, the supplier controls the stock at the retailer. Waller, Johnson, and Davis (1999) analytically established superior performance of VMI over traditional supply chain systems. Kulp (2002) argued that VMI would optimise the overall profits of the supply chain, as it is superior to traditional local inventory management. Cetinkaya and Lee (2000) cited the ability of VMI to gain efficiencies through shipment consolidation. Achabal, Mcintyre, Smith, and Kalyanam (2000) argued that both retail customer service levels and inventory turnover would be improved through VMI, with more accurate forecasting and more effective distribution of inventory in the supply chain. VMI would allow retailers to expand the assortment of products they carried in a given retail space, thus improving brand profitability for both retailer and vendor.

VMI has been adopted by many firms, including Procter & Gamble and Wal-Mart (Cooke, 1998). It was also applied in grocery operations (Peck, 1998). Tyan and Wee (2003) reported that VMI enabled the Taiwanese grocery industry to reduce costs while improving service levels. However, problems were found in some firms, and VMI was seen to be abandoned in some cases. Fry, Kapuscinski, and Lennon Olsen (2001) reported that VMI worked well in some situations, but not others. Barratt (2003) cited VMI's major weakness to be insufficient visibility over the entire supply chain in some cases. VMI was found to work well when manufacturers supplied large volumes of frequently replenished products under relatively stable sales conditions. But high levels of demand volatility were found to lead to excessive inventories, the same problem that existed in traditional retail inventory control through the bullwhip effect.

VMI has been difficult to implement because of the need for information systems and business processes to be compatible. Kaipia et al. (2002) cited the need for high levels of trust (to enable sharing of the necessary information detail), integration of information systems, and the requirement for standard product identification systems. In shortage situations, the supplier has to prioritise customers, leaving some without inventory. Kraiselburd, Narayanan, and Raman (2004) found that VMI performed better when manufacturer effort was a substantial driver of consumer demand and when consumers were unlikely to purchase substitutes in cases of stock-out, but when substitution was attractive, VMI could lead to poorer performance than traditional retailer-managed inventory. Choi, Dai, and Song (2004) demonstrated that local service levels were insufficient to measure system-wide performance and suggested alternative measures.

Continuous replenishment

Continuous replenishment (CR) was proposed to implement automatic replenishment programmes, where sellers restocked retailer inventory based on the actual product usage and stock-level information provided by the retailer (Key & Park, 1997; Stank, Daugherty, & Autry, 1999). Wal-Mart piloted CR in 1995 (Barratt, 2003) and has been used by large US and UK retailers. Retailers made point-of-sales data available to suppliers, making it possible to base inventory decisions on sales forecasts rather than inventory level variations. CR enhanced VMI by requiring supply chain members to share more information and data, and to utilise common systems and use common performance measures. This promoted joint decision-making, accountability, and incentives for performance. CR has been cited as successful in improving customer service levels and inventory turnover (Vergin, 1998). However, because CR does not necessarily cover inventories throughout the supply chain, it still can include gaps. Manufacturer prediction of future retail events is the major missing feature of CR. Excess inventory seems to be shifted from retailers and distributors to manufacturers. While CR improved VMI, further benefits were available.

Collaborative planning, forecasting, and replenishment

Collaborative planning, forecasting, and replenishment (CPFR) was the next step, applied in the drug, grocery, apparel, and other industries (Ireland & Bruce, 2000). The manufacturer and retailer exchange marketplace information to develop customer-specific plans to substantially reduce inventory. Promotion schedules, point-of-sale data, and inventory data are shared to enable shortening lead times and integration of forecasting and replenishment. Thus, total visibility is obtained, and changing demand patterns can be considered. Barratt (2003) credited Warner-Lambert, Wal-Mart, SAP, Manugistics, and Benchmarking Partners with initiating the first CPFR pilot.

The way in which information is exchanged early yields a number of benefits (Fliedner, 2003). For retailers, these include increased sales, faster response times to orders, and higher service levels despite lower inventories which in turn lead to lower costs from obsolescence and deterioration. Manufacturers benefit through increased sales, higher fill rates for orders, faster cycle times, lower capacity requirements, and lower product inventories. There are fewer stocking points needed over the supply chain; there is improved forecast accuracy and overall lower expenses over the system. These benefits have been reported in actual implementations of CPFR. Nabisco/Wegman Foods implemented a pilot case, increasing sales from 36 to 50% (Loudin, 1999). Fliedner (2003) reported a number of reported savings in practice over a variety of CPFR implementations.

Micheau (2005) described the implementation of a system by Boeing and Alcoa, which includes the features of CPFR. The problem in that case, involving Alcoa supplying aluminium products for Boeing airplanes, included rail transportation which involved unreliable delivery dates. The presence of minimum quantities in multiple bundles distorted forecasts. The two companies planned several supply chain elements to overcome difficulties. Information systems were integrated, allowing real-time information exchange. Operations were tightly linked between the supplier and manufacturer. Lean manufacturing principles were applied. Close cooperation led to an atmosphere with high levels of trust. Boeing sent weekly electronic forecasts and inventory counts to Alcoa and used its enterprise resource planning (ERP) system to

generate electronic purchase orders for raw materials. Alcoa implemented a VMI system and improved the forecast visibility in their system. Alcoa also had to change its order entry process to accept Boeing orders. The electronic forecasting system was credited with expediting information exchange. Boeing carefully checked its forecasting, and identified modifications to data obtained from their enterprise systems, which were needed to provide Alcoa with more accurate data. The greater degree of forecasting accuracy obtained enabled Alcoa to make more efficient production decisions. A blanket purchase order for a year was used to override the ERP-generated purchasing system. Forecasts were aggregated by week.

CPFR has encountered some barriers. As with VMI, systems need to be compatible across organisations, and the more the organisations involved, the more restrictive this requirement is. Furthermore, Choi, Dooley, and Rungtusanatham (2001) emphasised the complex, emerging phenomenon where the market drives supply chain development rather than prior planning and design. The development of demand may diverge from what was anticipated, and new supply chain players may emerge with time.

Alternative systems

Holweg et al. (2005) applauded the wealth of available supply chain strategies for supply chain partners to collaborate, and recognised the presence of successful implementations of CPFR, but also note that there has not been widespread adoption. They attributed slower than expected progress due to the lack of common understanding and the difficulty in integrating external needs with internal production and inventory control. They argued that supply chain collaboration effectiveness depended upon the degree of integration of internal and external operations and the level of matching demand patterns and product characteristics in terms of geographical dispersion.

Table 1 presents the descriptions, application areas, and problems for the five variant systems used in this paper.

The evolutionary development of supply chain coordination is apparent from Table 1. EDI has been very useful in aiding coordination for more efficient overall supply chain management in ECR. VMI provides a closer linking across the supply chain, with upstream supply chain elements taking greater responsibility for downstream inventory management. CR involves greater visibility in the data exchanged, allowing more centralised inventory control. Sharing plans for promotions and other special demand factors in turn results in the greater collaboration found in CPFR. It appears that the best-laid plans of closely coordinated systems are thwarted, however, by demand volatility. As any regular air traveller understands, a tightly constrained system can lead to chaos when things vary from the predicted (as most regular air travellers know). The more a system is optimised, the less robust it is with respect to change.

Lean techniques beyond manufacturing

The Toyota principles have also been applied outside of manufacturing. Abernathy, Dunlop, Hammond, and Weil (2000) discussed how retailing organisations have been reducing inventory in markets such as clothing, books, and car repair. The key to implementation of lean retailing is to measure the inventory and the demand by specific product rather than in aggregate. Other applications have been reported in insurance and apparel.

Table 1. Supply chain coordination systems.

System	Description	Applications	Problems
Traditional	Independent inventories Communication by purchase order	All types of businesses	Bullwhip (Sterman, 1989)
ECR	Independent inventory management, sharing information electronically	Grocery (Hoffman & Mehra, 2000)	Distorted data can be counterproductive (Brown & Bukovinsky, 2001; Frankel et al., 2002) Fast orders but slow replenishment (Kaipia et al., 2002)
VMI	VMI downstream (channel coordination)	Procter & Gamble, Wal-Mart (Cooke, 1998) Groceries (Tyan & Wee, 2003)	Need good data visibility, predictability (Barratt, 2003) Need compatible systems, trust (Kaipia et al., 2002) Does not work as well if substitutes readily available (Kraiselburd et al., 2004)
CR	Automatic replenishment based on real-time data Forecasting	Wal-Mart (Barratt, 2003) Improved customer service levels with better inventory turnover (Vergin, 1998)	Manufacturer cannot predict the special retail events, excess inventory shifted from retail to upstream (Vergin, 1998)
CPFR	More complete data sharing, enabling vendor forecasting of downstream demand Joint planning	Drug, grocery, apparel (Ireland & Bruce, 2000) Warner-Lambert, Wal-Mart, SAP, Manugistics (Barratt, 2003) Nabisco/Wegman Foods (Loudin, 1999) Boeing/Alcoa (Micheau, 2005)	Need compatible systems (Kaipia et al., 2002) Difficult to keep up in dynamic market-driven demand (Choi et al., 2001)

Lean principles helped Jefferson Pilot Financial in the life insurance industry, where financial consultant processes were re-engineered into lean teams (Swank, 2003). Linked processes were placed near each other, implementing cellular manufacturing ideas. Procedures were standardised, and re-work was reduced. A common tempo was developed to customer demand, and workloads were balanced, segregating operations to reduce the complexity. Jefferson Pilot was able to cut average time from application to issuance of life insurance policies in half, with labour costs reduced by 26%, reissue rates from errors reduced by 40%, and overall premium generation increased by 60%.

Zara is a Spanish clothier dealing in a worldwide supply chain (Ferdows, Lewis, & Machuca, 2004). The initial intent of their operation was to avoid reliance on any one customer. They have developed a lean system offering a large variety of clothing, but avoiding large inventories by relying on quick response. They produce very low inventories of product lines and wait to see what customer demand will be for each specific product. By keeping all design, warehousing, distribution, and logistics in-house, they are able to quickly ramp up to respond to strong demand, delivering larger volumes for successful products worldwide in 15 days. This is accomplished through heavy use of bar coding to expedite information exchange, and designing their

product flow to be coordinated. They have heavily invested in robotics to enable them to produce complex products, while outsourcing simple production steps.

Womack and Jones (2005) credit lean consumption with solving customer problems by ensuring that all goods and services work, assuring that customers get what they want, when it is wanted, and where it is wanted. In order to make such a system work, factors of production, such as inventory and costs, need to be measured accurately and in a timely fashion. This enables more enlightened decision-making. Fujitsu Services, an international IT services company, was able to cut calls concerning repeat complaints by 80% in 18 months by applying these principles.

In the health-care industry, lean methods have been applied in many cases (Spear, 2005). There have been nearly 100,000 deaths due to medical errors annually in US hospitals, with as many as 8.8% of patients becoming injured or ill as a consequence of treatment. Lean methods can reduce problems as shown in Table 2.

These gains were obtained by treating all processes as a series of ongoing experiments, which is accomplished by measuring and comparing the results with standards. This step also requires that all processes be explained in detail to avoid ambiguity. Problems identified are immediately addressed. Rather than working around problems, their causes are identified and countermeasures established. Successful methods are disseminated after assuring that it is appropriate for each process. Experimentation is encouraged at all levels of the organisation.

Gottfredson and Aspinall (2005) addressed the problems that system complexity can have on businesses. Complexity affects the entire value chain, primarily by distorting the understanding caused by bad economic data, leading to overoptimistic sales expectations. Simplification through lean methods was credited with reducing costs by 35% and lifting revenues by 40% for one fast food establishment. A telecommunications company offered so many options that their sales force could not quickly nor accurately respond to queries for service because they had to wade through over 1000 code options. Simplification, a principal component of the lean approach, can immensely improve such operations.

Table 2. Health-care lean applications.

Hospital	Countermeasure	Result
LifeCare Hospitals	Avoid femoral lines Change disinfectant Transparent dressings Closer monitoring of infections	Reduced transfusion infections 87%
Monongahela Valley Hospital	Avoid femoral lines Require complete kits to assure full protective garb Require labs to call immediately when positive culture identified	Reduced infections dramatically
UPMC Health System	Ensure hand-washing Improve barrier kits Supervise new people	Reduced infections dramatically
Allegheny General Hospital	Remove femoral lines within 24 h Investigate all infections Use biopatch dressings	Reduced infections dramatically

Lean aspects of enterprise systems

Enterprise systems (ERP) have had a major impact on business. They integrate an organisation's data, providing one source so that the entire organisation shares data whose accuracy is checked by all of its users (Olson, 2004). The efficiency provided by integrated ERP systems is gained in most part from the need to enter data only once. ERP systems thus naturally share some of the features of lean systems. ERP systems also provide functionality in a variety of ways, to include advanced planning systems (Villegas & Smith, 2006) and manufacturing planning and control systems (Wacker & Sheu, 2006).

Initial ERP applications often did little to obtain efficiency on plant floors. Problems with early ERP systems were complex bills of materials, inefficient work flows, and unnecessary data collection. Switching plant-floor management in ERP systems to demand-pull (lean) systems was cited for overcome these limitations (Bradford et al., 2001).

There are differences in emphasis between ERP and lean manufacturing. ERP emphasises planning based on sales forecasts. Lean manufacturing ties production to actual customer orders. Lean manufacturing emphasises continuous improvement (Bartholomew, 1999). ERP tracks every activity and material price, which often generates many non-value-added transactions, contrary to the lean philosophy's emphasis on speed and smoothed production. Some ERP users have dealt with this difference in philosophy by turning off ERP logs and reports that involve push motivation rather than pull motivation. Other companies prefer change of ERP software.

Many ERP vendors have expressed lean features of their systems, but not all customers have been convinced that ERP provides comprehensive support to lean ideas. Bradford et al. (2001) surveyed 14 ERP vendors, all of whom indicated that their product supported at least one lean manufacturing feature. Specific lean manufacturing features that vendors have included are demand smoothing, mathematical models to synchronise daily production to demand, Kanban replenishment calculation, and exception reporting.

One of the most important motivations for manufacturing firms to implement ERP has been to improve interactions and communication with suppliers and customers. Thus, ERP has a role in supporting supply chain activities. It has been reported in a study of over 400 Midwestern manufacturers that 20% of the firms surveyed had already implemented supply chain extensions to their ERP systems, and another 25% were planning to do so (Mabert, Soni, & Venkataramanan, 2000).

Typical ERP installations can also impose some restrictions on this communication. Internally focused ERP systems can constrain supply chain coordination (Davenport, 1998). ERP systems should be able to provide useful integration over supply chains in the long run, but in the short run could hinder logistical operations (Bowersox, Closs, & Stank, 1999). ERP systems make integrated information available within organisations that adopt them. However, unless all business units in the supply chain use the same system, ERP systems can be barriers to communication. Some suggest that units across supply chains would benefit by adopting a single vendor (Baron, 1999). This could work well in the long run, but imposes very high costs on vendors if they are required to spend millions of dollars on a system in order to do business with one client. That is precisely what some automobile manufacturers have done in the past. Many of the problems of communicating across ERP systems relate to data incompatibility, as well as different software tools.

Table 3. Characteristics of different categories of organisational openness.

	Traditional Company	Extended Enterprise	Cooperative Enterprise
Profile	Profit focus	Agile	Lean
Strategy	Cost minimising	Adaptive	Value maximising
Goal emphasis	Efficiency	Flexibility	Effectiveness
Operations	Limited sharing	Collaborative, open	Selective sharing
Planning	Push orientation	Joint performance measures	Moving from push to pull
Relationships	Limited sharing	Extended alliances	Qualified relationships
Technology	No linkage of ERP	Linked systems, Internet ERP	ERP and selected SCM software

Adapted from Edwards et al. (2001).

Part of the problem relates to system openness. Supply chains require open systems. ERP systems were developed on the assumption that a relatively small proportion of the workforce would need access to information (Edwards, Peters, & Sharman, 2001). This led to a pricing mechanism where license fees for each user were set at a high level. Edwards et al. (2001) gave a framework of three enterprise categories, as shown in Table 3.

Benefits of ERP supply chain systems

Kelle and Akbulut (2005) reported the results of their model analysing the typical inventory cost savings of optimal joint policies with safety stock coordination. Joint optimal policies were found to always result in total system cost savings over the supply chain. Even when one party dominated, the weaker party still experienced savings. The joint optimal policy was found to be close to the buyer's optimal JIT policy. Large savings were found in coordinating safety stock policies.

While theoretically open supply chains linked across organisations would have major advantages, currently this degree of openness is rare. Edwards et al. (2001) found that 6 of the 11 companies they interviewed felt that their transaction processing systems hindered the linkage development. There are benefits to be gained, however. Those organisations moving toward more open systems have been reported to gain advantages in ordering and logistics operations (Curry & Kenney, 1999). The Internet offers a rich information infrastructure for making negotiation, knowledge sharing, and transaction processing much easier and faster. Traditional firms can be pushed aside by more effective and competitive Internet-based supply chain groups (Tapscott, 1999).

Key trends in supply chain management support within ERP

Akkermans, Bogerd, Yucesan, and Van Wassenhove (2003) conducted a Delphi workshop of 23 Dutch supply chain executives of European multinational firms. That study resulted in three major issues with significant support:

(1) further integration of activities between suppliers and customers across the entire chain (87% support);
(2) how to maintain flexibility in ERP systems to deal with changing supply chain needs (57% support);
(3) mass customisation (39% support).

Current ERP systems require greater openness to support the first issue. Vendors have moved to increase their ability to support the Internet operations. However, there is an inherent trade-off between control and openness. This relates to both of the two most important issues identified. ERP systems do support mass customisation by providing standard interfaces (given that the same system is used by all supply chain participants).

Third-party logistics case

HISCO Inc. is a 3rd Party Logistics (3PL) company operating with a group of cold and dry storages at strategic locations throughout South Korea. HISCO also has a supporting trucking line. It serves companies with logistical needs over a number of different industries, to include dairy companies, furniture manufacturers, discount stores, and the US 8th Army in South Korea.

In order for a 3PL company to successfully service its client companies, it needs warehouses and transportation lines and supporting software systems such as ERP. A complete understanding of the clients' business among employees of the 3PL company is critical for the success of both parties in the logistic partnership. Often 3PL companies are able to accurately anticipate the costs involved in obtaining required facilities and software, but are surprised by the significant time and cost needed to educate their employees of the clients' business. We examine how HISCO (3PL) and Lotte-Mart (the client) developed a mutual solution for educating HISCO's employees of Lotte-Mart business by utilising JIT, Kanban, and vendor-management techniques.

Lotte-Mart serves an estimated 350,000 customers each day through its 43 retail locations across Korea. It cooperates through 690 goods vendors and 224 grocery vendors. Instead of having 914 vendors making trips to 43 retail locations, Lotte-Mart used HISCO's dry and cold storage facilities as a distribution centre for goods and groceries (Figure 1).

Although utilising HISCO's facilities as distribution centres (DCs) reduced the number of trips that vendors were required to make to service Lotte-Mart's needs, there was another problem for both the 3PL and the client company to solve. In order for the 3PL to sort, pick, and load supplies that vendors have unloaded at the DC, not only the labour cost increased, but the cost to train their employees about specific processes of the clients business also increased. Moreover, the client was

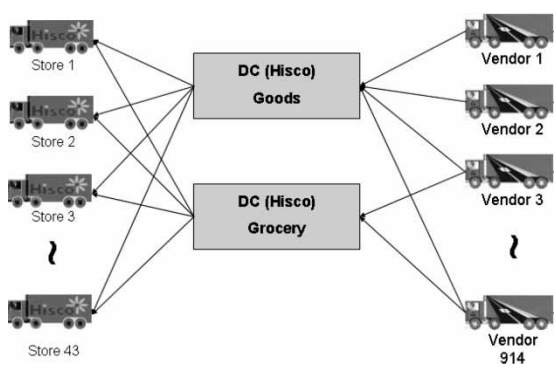

Figure 1. Hisco cross-docking.

hesitant to reveal their suppliers' information to the 3PL since this is one of the most important proprietary information for a discount store company.

Solution through Toyota methods and VMI

Contemporary supply chain management has benefitted from a number of efficient concepts. JIT principles have been widely successful in some manufacturing operations, based on the principle of not stocking inventory at a point until it is needed (Takahashi, Myreshka, & Hirotani, 2005). Kanban cards are a means to implement the movement of material within a JIT system, with a message delivered to providers when a new supply of materiel is required from the next stage upstream in the supply chain (or the prior station in a JIT production line).

HISCO developed a JIT solution, asking the vendors not to store any inventory at DCs. HISCO used a cross-docking system to receive vendors' goods through the South Gate of the DC, using Kanban processes where the vendors load carts (VMI) with tags of each store locations. HISCO trucks pick up full carts at the North Gate end without HISCO employees having to sort, pick, or load them. All HISCO employees have to do is to slide the full carts into trucks and have them delivered to 43 store locations. Vendors arrive at the centre and load these carts throughout the day and HISCO's trucks pick them up at 11 a.m and 5 p.m. Both vendors and HISCO receive the information on the items, quantity, and delivery location through EDI transfer.

Benefits

By utilising the lean management tools of JIT, Kanban, and VMI, HISCO and Lotte-Mart were able to significantly reduce their expenses. First of all, by having the vendors sort and pick the materials they transport in through VMI, the labour expense has decreased from $67,000,000 to $7,000,000. Second, by utilising JIT and Kanban system at HISCO, each retail location was able to save about half of the storage space that they otherwise would be using. Without the JIT and Kanban systems, Lotte-Mart would have been spending $90,000,000/year for warehouse rent at HISCO.

HISCO also experienced an unexpected benefit. For the client company, one of the drawbacks of using a 3PL company is to give out too much information of their core business. Further, when the contract has been in place for some time, it is very difficult to switch 3PL companies, even if 3PL performance decreases, because of concerns about having to go through the training period, which leads to higher costs. In the HISCO case, Lotte-Mart was able to receive at least a good 3PL service without having to reveal its supplier information. An unexpected benefit from adopting lean management tools is that it gave flexibility of switching to different 3PLs for client companies because of the maintenance of an arm's length relation with the 3PL.

Conclusions

Lean systems have been very important in improving manufacturing efficiency in response to rapidly changing global economic conditions. Lean methods work best to level upstream production. Agile methods focus on assuring the ability to respond to volatile customer demand downstream. These systems have also been applied to service industries. Lean principles essentially focus on the inside of the organisation in a high-quality manner and tap human resource

input to the maximum. Lean systems are instrumental in enabling organisations to survive and prosper in the twenty-first century.

IT is a very important enabling tool in lean systems. Supply chains represent the global linking of the best organisations available to support collaborating firms. There are a variety of supply chain methods to link supply chain elements. This paper reviewed information technologies and systems that have enabled benefits in retailing, to include VMI systems and variants. Utilising ERP systems provides more opportunities in aiding the implementation lean of principles.

ERP is not just for manufacturing. Since 2000, ERP vendors have vastly expanded services offered to service industries, to include governments, universities, hospitals, etc. Supply chain coordination is a feature of newer, more open ERP systems. Coordination over ERP-linked supply chains offers tremendous opportunities for shared benefits, as shown by the real-world entrepreneurial case of HISCO. The downside is that it requires significant investment by all supply chain participants in order to attain compatible systems.

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