CHAPTER 2

Literature Review

This paper presented a literature review in green supply chain management, supply chain management practices, green innovation, green innovation practices, tailored logistics, and applying lean principles in products and services sectors. In this review, the most relevant and current topics of Green Innovation were discussed, focusing on the impact of supply chain issues on operation, green innovation related to logistics activities from a top-view perspective, uncertainty in the supply chains, supply chain strategies and transport, current supply chain practices and transportation, and supply chain integration and collaboration.

This paper analyzed the existing concepts of green innovation and green strategy collaborated with lean principles that were very effective in a manufacturing environment and applied the concepts to the pharmaceutical service provider environment. Many factors were considered. A concept model was developed and tested in theory to gain knowledge concerning potential costs reductions and improved environmental impact in a pharmaceutical distributor.

2.1 Theory and Concept

2.1.1 Green supply chain management

Researchers defined the green concept in supply chain management from different perspectives and purpose for sustainable growth. The definitions of green supply chain management (GSCM) depend on the researcher's definition in a relatively new areas and corporate management practices. In the study of Srivastara (2007) defined GSCM as integrating environmental thinking into SCM, including product design, material sourcing and selection, manufacturing processes, delivering of the final product to the customers as well as end-of-life management of the product after its

useful life and argues that GSCM ranges from reactive monitoring of the general environment management programs, to proactive practices implemented through various Rs (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Remanufacture, Reverse logistics, etc.). Hervan, Helms and Sarkis (2005) defined GSCM in their paper as equation graphically, where reverse logistics "close the loop" of a typical forward supply chain and includes reuse, remanufacturing, and/or recycling of materials into new materials or other products with values in the market place. Zhu and Sarkis (2004)'s definition of GSCM is defined as a ranking from green purchasing to integrated supply chains flows from supplier, to manufacturer, to customer and reverse logistics, which is "closing the loop" as defined by supply chain management literature .

Table 10: Green Supply Chain Management Definition

Authors	Definitions
Srivastara (2007)	GSCM as integrating environment thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the product after its useful life, which focuses on reverse logistics
Hervan, Helms and Sarkis, (2005)	Equation of green purchasing plus green manufacturing/materials management plus green distribution/ marketing and combine with reverse logistics,
Zhu and Sarkis (2004)	A ranking from green purchasing to integrated supply chains flows from supplier, to manufacturer, to customer and reverse logistics

Sources: The Author

Several studies addressed the green supply chain management concept for sustainable growth as a frame work for studying management practices in both operations and strategic contexts (King and Lenox, 2001), product design (Gupta, 1995), process design (Porter and Van der Linde, 1995a; Klassen and McLaughlin, 1996), manufacturing practices (Winsemius and Guntram, 1992), purchasing (Bowen et al., 2001), and competitive advantage in resource savings, waste elimination and productivity improvements (Porter & van der Linde, 1995). More and more businesses enhance and improve the environmental demand and concerns of their customers and mitigate the impact of their production and service activities on the environment (Bacallan, 2000). Some researches presented the link between applying green concepts in different phases of the supply chain by including inbound functions, production or the internal supply chain, outbound functions and reverse logistics, including and involving materials suppliers, service contractors, vendors, distributors and end users working together to reduce or eliminate adverse environmental impacts of their activities (Vachon and Klassen, 2006; Yu Lin and Hui Ho; 2008). Those functions led to increased competitive advantages in term of minimizing waste, achieving cost savings and improving the economic performance (Min and Galle, 1997: Rao and Holt, 2005). On the outbound logistics, green marketing, environmental-friendly packaging, and distribution have an important part to play in the link between environmental innovation and competitive advantages (Menon and Menon, 1997). Additionally, green supply chain awareness of business strategy is related to regulatory, competitive, and marketing pressures (Zhu et al., 2005).

2.1.2 Green supply chain management practices

Many definitions of supply chain management have been defined and the most acceptable definition was addressed by The Council of supply Chain Management Professionals (CSCMP) which defined supply chain management as the planning and management of all activities involved in sourcing and procurement,

conversion, and logistics management activities, including coordination and collaboration with suppliers, intermediaries, third-party service providers, and customers to facilitate integration of supply and demand management within and across companies (Council of Supply Chain Management Professionals, 2004).

The working paper of Rodrigues (2006) stated the supply chain management literature referred to Stock et al (2000) define the most significant activities factors supply in chain management as Channel Governance, Geographic Dispersion and Logistics Integration. Regarding green logistics, these three factors affect the activities of transport providers that are directly and indirectly linked to supply chains. Channel governance affects the strategic focus within the whole supply chain, and as a consequence, the way that transport is planned throughout the supply chain. Geographical dispersion has a direct impact on the economic and environmental performance of the supply chain, since the more geographical dispersed the supply chain is, the higher the external and internal costs of transport. However, there should be ways of mitigating that negative impact of geographical dispersion on the sustainable performance of supply chain and transport, such as the horizontal and vertical integration of transport flows. Logistics integration is the third but not least important factor, which according to Stock et al (2000), has a considerable impact on supply-chain performance. However, it is important to determine the impact of integration on green logistics activities. Moreover, Rodrigues (2006) referred to the most recent supply chain management practices was defined by Li et al (2005) developed a list of five sub-constructs for supply chain management practices to link them to performance. These constructs are; 1) Strategic Supplier Partnership, 2) Customer Relationship, 3) Information Sharing, 4) Information Quality and 5) Internal Lean Practices and 6) Postponement. Li et al (2005) define these sub-constructs as:

- **Strategic Supplier Partnership:** long-term relationship between companies and their suppliers. It is designed to align the strategies of the companies with their suppliers. However, when they say suppliers they mean material suppliers or they are including third logistics provider under this sub-construct. Therefore, it is

necessary to determine the impact of strategic third logistic provider partnership on green logistics performance, since it represents a different dimension of integration, the horizontal dimension. Moreover, regarding to reverse and forward flows in the supply chain, it is also important to determine the impact of vertical integration on green logistics performance.

- **Customer Relationship**: practices that have the purpose to define how companies can manage customer complaints and develop a long-term relationship with them. Third logistics providers need to define who their main strategic customers are and how they can develop a win-win relationship with them, positioning them on strategic segments, so they can satisfy their specific needs. But, it is vital to determine the impact of the customer-third logistic provider relationship on green logistic performance.

- **Information Sharing**: the extent to which strategic information is shared with suppliers. However, this concept leaves a question opened, to what extent information sharing is vital between third logistics providers and their customers, and also the impact of information sharing on green logistics performance should be determined.

- **Information Quality**: this concept is to how accurate, credible, current and adequate the information exchanged is.

- **Internal Lean Practices**: the extent to which there are practices of mistake elimination and value creation within the supply chain. This specific area will be discussed more in-depth later on in the paper.

- **Postponement**: represent the practices of delay some activities within the supply chain. It has the goal of making the supply network more responsive. This is important due to the relevance of this area and its impact on green logistics activities.

Various researches studied applying green concept in to management practices. Many countries and industry attempt to adapt green concept and implement within their organization. In South East Asia, many countries, such as Philippines, Indonesia, Malaysia, and Thailand intend to corporate their working process with

suppliers on green product designs, holding awareness seminars, helping suppliers established environmental program in term of a true partnership. Besides ensuring revenues is increase for both parties (Rao, 2002).

The extensively implementing green into purchasing concept to improve the company's environmental performance was investigated. As the study of Green, Morton and New (1998) presented the examination of green purchasing and supply policies in green purchasing activities among the UK firms. In the large Swedish companies, the purchasing managers use information tools that related to the incentives, the product characteristics, and supplier relations for green purchasing was limited and varies with the types of purchasing situations. Also, Green purchasing practices as a one part on inbound function evolved to the reduction of waste produced, material substitution through environmental sourcing of raw materials, and waste minimization of hazardous materials which required the support form suppliers to achieve goals. Hence, companies intended to focus more on managing their suppliers' environmental performance to ensure that the materials and equipments supplied by them are environmentally-friendly in nature and are produced using environmentally-friendly processes (Rao and Holt, 2005). In term of green purchasing strategies, it supports significantly towards source reduction of pollution in terms of recycling, re-use and low-density packaging, and towards waste elimination in terms of scrapping or dumping, recycling and sorting for non-toxic incineration and bio-degradable packaging. The high cost of environmental programs, uneconomical recycling an uneconomical re-use are the three most important barriers and obstacles to green purchasing. Beside, the other important issues are Lack of management commitment, lack of buyer awareness, and lack of supplier awareness, deficient company-wide environmental standards or auditing programs and lack of state and federal regulations (Min and Galle (1997)

The study of Zhu et al., (2005) evaluated and described GSCM practices in China in term of drivers, practices and performance among various Chinese

manufacturing organizations. The paper focuses on four GSCM practices, including the internal environmental management, the external GSCM including green purchasing and cooperation with customers including environmental requirements, investment recovery, and eco-design practices. Overall, GSCM practices acceptance and adoption among organizations have been limited in terms of the environmental benefits perception that operational and economic performance is less influenced, especially in beneficial ways. Without the economic payback, managers will need to somehow be able to convince the management of the strengths of the other benefits. Their researches presented one of the initial crucial steps for adopting GSCM concept and implementing in the practices required management skills and knowledge as the internal environmental management, especially the commitment from top-level managers and support from mid-level managers, will be necessary for the development of any GSCM programs in China. Moreover, the result study of Yu Lin Chieh (2007) for adoption green supply chain practice (GSCP) is affected by various factors, including technological, organizational, and environmental factors. These factors have positive influences on the willingness to adopt GSCP. Moreover, explicitness and accumulation of GSCP technology, organizational encouragement, quality of human resources, and governmental support represent a significant influence on the willingness to adopt GSCP for logistics companies. Also, GSCP technology will support technological knowledge transferring within the organization and, consequently, can raise the willingness to adopt GSCP. Logistics companies can increase the adoption of GSCP by encouraging or supporting their employees to environmental activities and by training and educating their employees to become environment-friendly workers.

Applying green concept in outbound activities extend to warehousing activities, packaging, management of waste, including reverse logistics and waste exchange that lead to cost savings and enhanced competitiveness (Rao, 2003), and transpirations activities (O'Reilly, 2007; Rodrigues, 2006). The study of Rodrigues (2006), supply chain management is a field that has usually been studied more from a market and product perspective rather than from a transport point of view. However,

some authors have recently worked in the development of the supply chain and transport relationship. Firstly, Stank and Goldsby (2000) developed a decision-making framework that positions transport in an integrated supply chain (Figure 14). Regarding to transport decision-making, decisions are made from strategic to operational level and from macro to micro level, they categorized these decisions as total network and lane decisions, mode/carrier assignment decisions, service negotiation and dock level decisions. However, they do not determine the impact of each of these decisions on Green Logistics performance, and most importantly, the decisions made at macro and strategic levels possibly have a more significant impact on Green Logistics performance. It is vital to fill this gap in the literature.

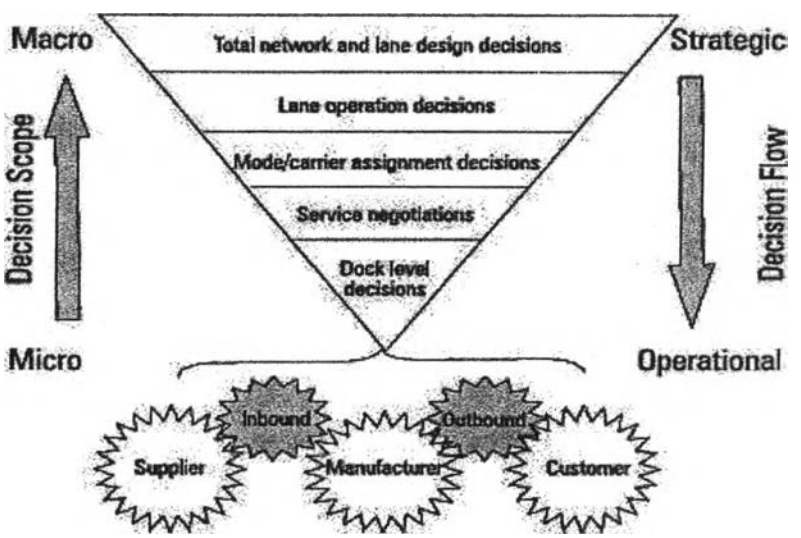

Figure 14: Transportation decision making in an integrate supply chain

Source: Stank and Gold by 2000

Another practice, back-loading refers to the use of vehicles to carry loads on the return legs of delivery journeys, with the aim of increasing vehicle utilization and improving the transport efficiency. This is clearly of relevance to this study, which is considering how delivery vehicles might be used to collect waste and/or return goods. A guide to back-loading has been provided by the Freight Best Practice program , from

which much of the text here is drawn. Vehicle utilization rates have been improving in the UK

This has been due to a number of factors, including back-loading, outsourcing of road haulage operations, greater balance of inter-regional flows, increase in average length of haul, change in trip structure (more multiple collections and drops), growth in reverse logistics and new management initiatives (supplier collection, factory gate pricing and network systems)..

McKinnon (2002) stated that "a substantial volume" of empty running would be virtually impossible to eliminate due to factors such as geographical imbalances in freight distribution, scheduling constraints and aversion to the risk of delay associated with picking up return goods, and vehicle incompatibility, where goods available for back-loading do not match the vehicle. (Key question - How common a problem is vehicle incompatibility with the goods/waste to be moved?) McKinnon and Ge (2006) assessed the potential for further reduction in empty running in the food supply chain, mainly focusing on longer distance trucking between factories, distribution centers and supermarkets. They found that suitable backloads were available for only 2.4% of the empty journey legs, representing 2% of empty truck-kms. Their analysis highlighted the operational constraints on back loading "in a sector characterized by short average trip length, tight scheduling and variable use of refrigeration." Back-loading can either be 'internal', carrying one's own goods (e.g. surplus stock, re-usable packaging, returns) or picking up products from your own suppliers, or 'external', carrying goods for a third party, providing a haulage service and generating income. The DfT (2007a) reported an internal back-loading example where a major supermarket (Tesco) used returning shop delivery vehicles to collect goods from a supplier and take them to their distribution centre, resulting in an increase of vehicle fill of 26.5% over a five-year period, a reduction in average annual distance travelled of 19.9% and a fuel saving of £750,000 per year. Boots3 also report using vehicles to pick up goods from their suppliers on the return journey and they claim to save 2.2 million kilometers of

travel on UK roads (around 1,750 tonnes of carbon dioxide) each year as a result. John Lewis 4 also reported that they undertake back-loading, saving around 1.1 million kilometers (4%) of travel on UK roads, while for their sister company Waitrose, the savings were 2.3 million kilometers (8.5%).

The DfT (2007a) also report that Tesco has undertaken onward supply, where it has used suppliers to deliver goods to their distribution centers; however, waste and return goods are not mentioned here. They also reported an external back-loading example where Thorntons, the manufacturer and retailer of chocolates and confectionery, used four of their articulated lorries to carry out night-time trucking, five nights a week from Scunthorpe to Avonmouth on behalf of a third party. Although overall fleet mileage was increased as a result, this activity provided a useful revenue stream, off-setting some 17% of its own account distribution costs.

One form of distribution activity which is particularly effective in back-loading is the pallet network system. The main feature of a pallet network is a hub through which all pallets are moved and trans-shipped. A pallet network allows members to collect another member's loads from the hub and deliver them in their designated area and to collect loads from their region and relocate them to the hub for onward delivery to the geographical areas of the other members. An in-depth survey of 17 pallet network fleets was carried out on behalf of the Freight Best Practice programme over a 48-hour period in 2004, which found that the pallet sector is achieving 72.8% vehicle fill, which compares well with the average figures in the food (53%) and non-food (54%) retail sectors.

Heriot-Watt University (2007) reported that there are now various internet-based transport exchanges which allow suppliers and haulers to be matched nationwide. They also reported that although some studies had suggested very limited potential of online freight marketplaces to improve freight management operations the actual experience of many freight trading platforms would seem to contradict this view.

However, the Rodrigues (2006) mentioned the study of bad practices of logistics that can potential cause uncertainty and refer to the study of Geary et. , al (2002)'s framework. To understand the impact of these bad practices on the green logistics performance of transport taking a holistic supply chain view, in order to determine and consider all sources of uncertainty that affect the supply chain and transport, the causes and effects of each type of uncertainty, determined where each type of uncertainty was originated in transport operations, linking the causes and effects of uncertainty taking into account the whole supply chain, with transport as an strategic activity, determined the impact of the causes of uncertainty on green logistics performance and the last concern was the ability to prioritize within that causes of uncertainty and develop solutions to mitigate their implications.

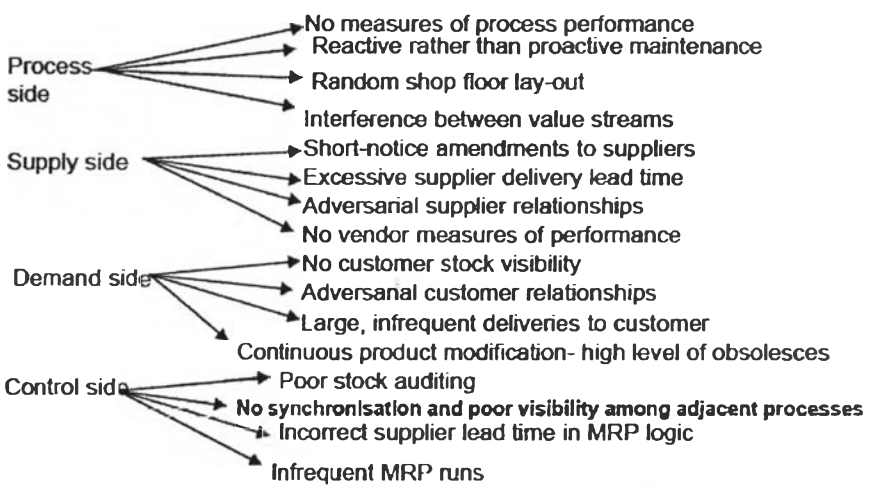

Figure 15: Examples of bad practices from the four sources of supply chain uncertainty

Source: Geary et., al (2002)

Postponement as a principle has been discussed in the academic spheres since 1950 in perspective of promoting the efficiency of a marketing system, changing in inventory location to the latest possible point in time and changing in form and identify to the latest possible point in the marketing flow. In the point of view of the distribution channel as a whole, postponement might be considered as a method for individual companies to transfer the risk of owning goods to another and interaction between the risk of product ownership and the physical activities executed to deliver the

product through time as its principle (Bucklin 1965). Also, the study of Geary et., al (2002) addressed "Postponement may relocate final configuration from manufacturer plants closer to the end customer, allowing for rapid delivery of customized products and quick responsiveness to changes in display mixes" referred to Yang et., al (2004) study. Therefore, from a Green Logistics perspective, postponement as a supply chain strategy can potentially have pitfalls and advantages. It depends on the main external factors that encourage supply chain companies to implement postponement. Also, postponement can vary accordingly to specific market realities.

Moreover, other supply chain practices such as Vendor Managed Inventory (VMI) which is a system that connects suppliers and customer inventory information that enables faster, aggregate all the transactions of suppliers for a particular customer that reducing manufacturing cost and minimize the demand of transportations (Geary et., al 2002), the VMI concept will link to green logistics practices in term of consolidation of inventory and transport flows of several suppliers as a transport optimization.

Further more Return on Green Investment (ROGI) is one of the main drivers and barrier for a corporate change of attitude and practice to implement green initiatives. The result survey of eye for transport's Green Transportation & Logistics Report 2007 presented that government compliance, improved customer and public relations, a decreased fuel bill and financial ROI were the most important drivers for transport and logistics greening. Respectively, increasing supply chain efficiency, improving investor relations, decreasing risk and a larger Corporate Responsibility agenda were also important factors in the strategic decision to go green.

2.1.3 Green innovation

The definition of "green innovation" proposed by Chen et al. (2006) is defined as "Hardware or software innovation that is related to green products or

processes, including the innovation in technologies that are involved in energy-saving, pollution-prevention, waste recycling, green product designs, or corporate environmental management. Green innovation is used to enhance the performance of environmental management in order to satisfy the requirements of environmental protection regulations. Also, in their study green innovation into two components which are green product innovation and green process innovation.

In the working paper of Bernauer et., al (2006) explained green innovation as environmental innovations encompass all innovations that have a beneficial effect on the environment regardless of whether this effect was the main objective of the innovation. They include process, product, and organizational innovations (OECD, 1997b). Adding, the empirical study results of Shan Chen (2008) showed that green core competences of firms had positive effects on their green product innovation performance, green process innovation performance, and green images. In addition, the results showed that the green product innovation performance and green process innovation performance were positively correlated to their green images. Therefore, investment in all three green areas was helpful to businesses.

2.1.4 Green innovation practices

The adoption of green supply chain management practices can be identified as an innovation process for logistics service providers (Lin and Ho, 2008). Various researches and studies defined the meaning of green innovation in different contexts. In term of innovation concept, Porter (1990) defined innovation as technologies and new ways of doing things, which is a specific tool that entrepreneurs use as the mean to exploit change or improvement as an opportunity for a different business or service. Innovation is a practice that is new to organizations, including equipments, products, services, processes, policies and projects as strategy to offer a new product or service to the customers (Kimberly and Evanisko, 1981; Afuah, 1998).

The green alternatives require technological innovation by dismantling, reducing or re-directing modern industry's environmentally-disruptive, brown products, processes and systems and replacing system (Foster and Green, 1999). Also, adopting technological innovations is the most important tool for enterprises to keep their competitive advantage (Kimberly and Evanisko, 1981) and implement innovation through technology, knowledge and relationship networks can increase the logistics service provider industry efficiency and performance (Chapman et al., 2003).

In the study of Chen (2008) presented applying green innovation among the small and medium enterprises (SME) is less than the large enterprises in term of implementing green core competence correlated with their green product innovation performance, green process innovation performance and green image among the information and electronics industry in Taiwan. Therefore SMEs require creating and developing their green core competence to strengthen the green image. In the services sector, Grove et al., (1996) presented a greening concept among services providers that mostly they contribute to the preservation of the environment by reducing, reusing or recycling resources, either collectively or individually, and thereby embrace the green initiative.

Recent researches have explored the driver and influencing factors for adopting green supply chain practices (GSCP) (Lin and Ho, 2008), which are explicit factors; technological, organizational, and environmental factors. The technological factor includes the technological knowledge transfer within the organization and increases the willingness to adopt green supply chain practices. The organizational factors are including organizational encouragement and quality of human resources, environmental uncertainty, and the factor of governmental support, including financial incentives, pilot projects, and tax breaks (Lin, 2007; Lin and Ho, 2008). The green practices can encourage through environmental activities by training and educating their employees to become environment-friendly workers and it can support technological knowledge transfer within the organization and, consequently, can raise

the willingness to adopt green practices. Additional, the government can encourage green concept by providing financial incentives, pilot projects, and tax breaks to stimulate the adoption of green practices for logistics industry (Lin and Ho, 2008). In the study of Chen et al. (2006) addressed the reactive management approach which is to commit minimizing resources, proactively approach recycling, re-usage of products and designing green products and the last approach is value-seeking by integrating environmental activities as a initiative strategy into a strategic business and operate the firm to reduce its impact on the environment.

Regulation is also a key factor influencing the organization to adopt green innovation into business process. In the working paper of Bernauer et., la (2006) mentioned and referred that the effects of regulation have been observed only for environmental process innovation (Johnstone et al., 2005), but remain unclear for environmental product innovation. For example: a study by Hemmelskamp (1999) suggests a negative influence of regulation on environmental product innovation, whereas Rennings et al. (2006) as well as Scapecchi et al. (2005) find positive effects and Cleff and Rennings (1999) find a positive effect solely for market-based regulation.

2.1.5 Tailored logistics

The concept of tailored logistics has been developed to emphasize the integration of logistics services with the core product in order to give each customer a value added product which has been tailor made according to his or her requirement. Thus the logistics service has become a key differentiator of a product in an age of mass production when there is a very limited scope of differentiation among the core products themselves.

In Figure 16, the customers see not only the product but the 'bundle' in which logistics is a very important component. In plain language the concept of tailored

logistics suggests that a firm should design its logistics services according to the customers' requirements to enhance the value of the core product to its maximum. This raises the all important question of how logistics can become the key differentiator in a firm's product or service offering.

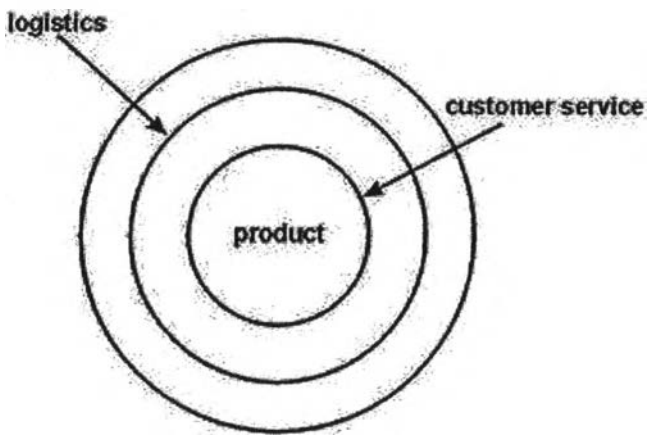

Figure 16: The 'bundled' product as the customer sees it.

Source: Fuller, JB; O'Conor, J & Rawlinson R (1993, May-June) 'Tailored logistics: The next advantage', *Harvard Business Review,* pp.87-98.

2.1.6 Applying lean principles in products and services sectors.

There are various theories and strategies of logistics addressed in production and manufacturing industries. Simultaneously, in Japan, Just-In-Time (JIT) and lean concept which quite success in manufacturing and production, a lean approach in pure service environmental is very limited (Bowen and Youngdahl, 1998; Abdi et al., 2006; Piercy and Rich 2009). Healthcare services provider apply lean thinking with flow models to liberate existing resources and allocate them for further improvements (Kollberg, Dahlgaard J. and Brehmer, 2007).

As lean thinking has their root from 1940's Japan. It has spread worldwide after competitors saw the effects from the implementation in Toyota. The main concept is to reduce cost by eliminating waste (Muda). Lean thinking has several tools

to attempt to reach the goal and get the better solutions, Tostar and Karlsson (2008), Papadopoulou and Zbayrak (2004) stated the lean definition in his paper refer to the American Production and Inventory Control Society (APICS) Dictionary (Cox and Blackstone, 1998):

Lean production is a philosophy of production that emphasizes the minimization of the amount of all the resources (including time) used in the various activities in the enterprise. It involves identifying and eliminating non-value adding activities in design, production, supply-chain management, and dealing with the customers. Lean producers employ teams of multi-skilled workers at all levels of the organization and use highly flexible, increasingly automated machines to produce volumes of products in potentially enormous variety.

Some research defined the "Lean Enterprise" model. The five fundamental lean enterprise concepts of value, value stream, flow, pull, and perfection were further discussed in Womack and Jones (1994).

2.1.6.1 Five Lean principles

There are five Lean principles when implement lean

- Specify value
- Value stream
- Flow
- Pull
- Perfection

Specify value refers to see the value of the products from the customer's perspective. The meaning for that is the customers are just interested in the final product and the ways that the company is solving it are not interesting. It is also important to understand that customers buy results not a product, a clean shirt and not washing machine. It could also be explain with a trip, the customer wants to go from one place to

another. To get there can be involved taxi check-in flying etc. Every step is reducing the value of the product.

Value stream is the sequence of processes all the way from raw material to the final customer. The process can be refining, movement to the information flow. There are three types of Muda that can be detected in the value stream. Type one Muda are those which creating value as perceived by customer, second, those which creating no value but are currently required by the product development, order filling or production system and so cannot be eliminated just yet, third, those actions which don't create value as perceived by customer.

Flow is the third lean principle and is describing the motion of the products through the company. There is an aspiration to go from batch flow with queues to single product flows. This is important when trying to keep the products moving and not in queues. To make this happen will often require major changes in the company's structure. Such changes can be the ability to show a complete display of the current workload for everyone to see. That is an excellent example of a lean technique, transparency or visual control. Flexible machines are also important to have if they are going to follow the demand and reduce the batches. When going from larger machines with a high output to a smaller, the changeover time will more often be reduced and have a more stabile recourses requirement.

Pull means that no one upstream should produce a goods or a service until the customer down streams ask for it. We can think of Pull in two ways, macro- and micro-levels. In macro level the company pushes the products to a certain point and responding to a final customer pull signal. This is a very effective way to reduce overproduction.

Perfection is the last principle and the meaning is that nothing is ever finished. There is always something that can be improved and never to be just content.

So lean thinking is nothing that can be fully implemented into a company but it is an aspiration that will lead the company into a more profitable layout.

2.1.6.2 Seven wastes

- Transport
- Inventory
- Motion
- Waiting
- Overproduction
- Over-processing
- Defects

Transport refers to movement of products or employees and is a process that the customer doesn't pay for and doesn't add value to the product. But it is a waste that can never be fully eliminated but it should be continually reduced. With high levels of transport, there will be an increased risk for damage and deterioration.

Inventory is also a waste that can't fully be eliminated. With an increased inventory, it tends to increase lead time as it is harder to find the products. There is also an increasing distance due to the fact that more space is needed for keeping products in the warehouse. This will lead to higher rent for unnecessary large facilities. But there are more problems that it leads to, the more products the company purchases the more capital investment is required. That will make it harder for the company to invest in new products, in development, or other areas of its business. There also is a risk for the products to not get sold and have to be replaced by newer products. To get rid of this

problem Lean aspires towards JIT (Just-in-time) to have the items available just in the right time it is needed. Since all the other time it is kept it is just allocating space and creating no value.

Motion refers to movement by a human or a machine. The movement could be when the employee is reaching for different articles during an assembly line or when picking. It could also be the distance robots have to move to weld circuit boards components. So it is important to have a good functional and ergonomic workplace and have an aspiration to find and continuously modify the layout to be more ergonomically. Waiting in manufacturing refers to the products which are stored in a warehouse before the production process. It is probably the second most important waste. It is directly connected to the flow and is constraining it. When the products are stacking up and waiting to be processed the lead time will suffer. There for the flexibility to change products and to have the ability to have a quick response will suffer.

Overproduction is often referred to the most serious waste and is root for many problems. When the company produces more than it is needed just to be safe, it will generate more movement than necessary. The inventory will be increased and the flexibility will be suffered. Pull is an effective way to prevent overproduction, the batches will be smaller and there will not be any processing for products that are unnecessary.

Over-processing refers to the usage of large machines or equipment. Why buy expensive machines that can be able to process a huge amount of products when you don't need it. It is better to invest in smaller and more flexible machines which are cheaper. When doing so it will lead to "pressure to run the machine as often as possible rather than only when needed, and encourages general purpose machines that may not be ideal for the need at hand.

Defects is very important to locate as soon as possible, a small part that has been noticed right away can cost a few dollars but when the final defected products

has arrived to the customer the value of product will be reduced and the cost could be increased to several hundred dollars to satisfy customer. With the Toyota philosophy a defects should be regarded as a challenge, as an opportunity to improve.

The lean concept has been successful in manufacturing for many years since Toyota Motor Corporation implemented it in their production lines. The success of lean production emanates from three major factors: minimization of non-value adding activities, efficient work systems, and applicable human resource management. Rothenberg et al. (2001) identify that lean plants aim to minimize waste and buffers, lead not only to reduce buffers in environmental technology and management, but also in an overall approach to manufacturing that minimizes waste products. Various researchers investigated applying the lean concepts in both manufacturing and service sector, the study of Piercy and Rich (2009) assessed the suitability of lean production methodologies in the pure service context which the application of lean approaches in the pure service environment remains largely untested.

The study result of applied lean approach in call service center environments of Piercy and Rich (2009) presented highly significant improvements on quality and cost positions with minimal investment through adoption of lean tools in the pure service context within adopted transformation processes. The basic of lean methodologies included value identification, mapping of value, workplace redesign and work-task changes was examined among the end-to-end change process highlights that the whole is greater than the combination of its parts – while benefits are attainable from many quality methodologies, bringing them together in a coordinated manner. Also, lean approach can be relatively easily applied, with minimal investment in training, very rapidly generating major improvement gains for adoptive companies. The benefits on offer from lean improvement are based on achieving customer demand and cost reductions are traditionally opposing goals. Focusing on the identification of the true value and the removal of demand failure (additional demand for services created by a

failure to perform the service correctly the first time), simple mapping and problem solving techniques, guided by a lean philosophy can assist companies in achieving significant improvements in operational cost and the quality of customer service they deliver.

In health care services, Kollberg, Dahlgaard and Brehmer (2007) studied applying five lean principles in the Swedish health care services are mainly tax-financed through county and municipal taxes. The county councils also charge. The authors mentioned in several case stories about lean thinking initiatives in health care sector can be found (see, e.g. Miller, 2005; Spear, 2005; Sobek and Jimmerson, 2004; Rogers et al., 2004). In a recent publication by the Institute of Healthcare Improvement two healthcare organizations in the US showed positive impact on productivity, cost, quality, and timely delivery of services after having applied lean principles throughout the organization. Their study showed that the design of measurement system is important to reflect the initiative of applying lean thinking principles and implementing in new management in both term of efficiency and effectiveness of healthcare performance. Also implementing a performance measurement system requires a new way of thinking about managing health care as a part of the larger management shift in order to plan for changes in mindsets and work places.

Lean logistics model usually apply with manufacturing and warehousing that bring the benefits to the firms. However, this research aims to bring the benefits of lean concepts for operation and logistics processes of pharmaceutical distributors.