MASTER'S THESIS

The Development of an Order Delivery Strategy for a Multinational Firm

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Abstract

The purpose of this study was to develop a new order fulfillment strategy for LG Electronics Nordic AB. This order fulfillment strategy is called order delivery strategy (ODS) which aims to strike an appropriate balance between order batching and logistics customer service. Whether or not a balance can be achieved on both dimensions at the same time is questionable. However, the author has balanced these dimensions with the help of his own form of analysis which provided specific delivery days for LG's existing customers. With this main objective in focus, another aim was to investigate what consequences ODS implementation can have on the company's supply chain performance.

To conduct this study the author examined two forms of data. The first research data consisted of interviews with employees at LG. The second data was collected from LG in the form of order data. The author analyzed both forms of data which helped facilitate the concept behind ODS.

The results implicated that an ODS implementation improves order picking, order management and logistics customer service at LG. More specifically, the company's current order fulfillment strategy was analyzed where ODS provided less frequent deliveries to their existing customers. In addition, the findings suggest that LG should focus on medium class customers in Sweden as this does result into the most transportation cost savings and less frequent deliveries.

The principal conclusion is that the company should keep their current order fulfillment strategy. However, they should complement this strategy by implementing ODS since it does improve supply chain performance leading to more prosperous results. It is also recommended that LG should follow up their current order fulfillment strategy and ODS every six months.

Sammanfattning

Syftet med denna studie var att utveckla en ny strategi inom kundorderuppfyllelse (order fulfillment) för LG Electronics Nordic AB. Denna kundorderuppfyllelsestrategi kallas strategi för leverans av order (order delivery strategy, ODS) som syftar till att finna en lämplig balans mellan order ackumulering och logistik kundservice. Huruvida en balans kan uppnås på båda dimensioner samtidigt är tveksamt. Däremot har författaren balanserat dessa dimensioner med hjälp av sin egen form av analys som föreskrivs särskilda leveransdagar för LG: s befintliga kunder. Med detta huvudmål i fokus, var ett annat mål att undersöka vilka konsekvenser ODS genomförandet kan ha på företagets leverantörskedja.

Att genomföra denna studie har författaren undersökt två former av data. Den första forskningsdatan bestod av intervjuer med anställda på LG. Det andra materialet samlades in från LG i form av orderdata. Författaren analyserade båda formerna av uppgifter vilket hjälpte till att underlätta konceptet bakom ODS.

Resultaten indikerade på att ett ODS genomförande ger logistiska kostnadsbesparingar och mindre täta leveranser. Detta förbättrar också orderplockning, orderhantering och logistik kundservice på LG. Närmare bestämt har bolagets nuvarande kundorderuppfyllelsestrategi utredds om ODS tillhandahöll mindre leveranser till sina befintliga kunder. Dessutom tyder funnen information på att LG bör fokusera på medelstora kunder i Sverige, eftersom detta leder till mindre transporter och kostnadsbesparingar inom transport.

Den viktigaste slutsatsen är att företaget bör behålla sin nuvarande kundorderuppfyllelsestrategi. De bör dock komplettera denna strategi genom att genomföra ODS eftersom det förbättrar prestandan i försörjningskedjan vilket i sin tur leder till bättre resultat. Det rekommenderas också att LG bör följa upp sin nuvarande kundorderuppfyllelsestrategi och ODS var sjätte månad.

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1 Introduction

This chapter provides the background and underlying logic of the research for this dissertation by highlighting the importance of supply chain performance, logistics customer service and order batching. Subsequently, it emphasizes on the objective of the study, followed by the research problem and research questions. Finally, the delimitations are presented, concluding this chapter with an overview of the structure of this dissertation.

1.1 Background

The present day trend towards globalization has created countless new business opportunities for companies on the market. At the same time, however, this trend has facilitated participation of potential competitors on all fronts. As a result, it is no longer enough for companies to focus on the core competencies of the business but companies are also required to constantly improve and re-evaluate their business processes.

One of the business management processes in logistics which has come under great scrutiny in the recent years by corporate executive and academics alike is the importance of effectively managing the flow of materials and its information across organizations. This process is referred to as supply chain management (SCM) (Coyle et al. 2003) where corporate managers "*must be involved in managing the network of all upstream firms that provide input (directly or indirectly), as well as the network of downstream firms responsible for delivery and after-market service of the product to the customer"* (Handfield & Nichols 2002, p.8). Furthermore, it is necessary that all organizations manage their supply chain network efficiently as it will result in the efficient transfer of goods. This involves the product being delivered in the right quantity, in the desired form, with the appropriate documentation, at the right time and subsequently provided to the end user at the lowest possible cost (ibid).

Supply chain efficiency plays a significant role for all organizations, as corporate executives have started to pay more interest to the costs that are associated with it. According to industrial professionals, the total supply chain costs correspond to the majority of operational expenses for most organizations, whereas in some industries; these costs represent nearly 75 percent of the total operating budget (Handfield & Nichols 2002). Therefore, one can conclude that supply chain management holds the opportunity to improve this flow of material and information across the supply chain, while reducing supply and logistics costs.

As a result of continuous improvement in supply chain management, practitioners and researchers have called for an increased understanding of the flow of materials and information across a supply chain related to its overall performance and costs. Researchers have responded to these calls, by shifting the focus to issues related to supply chain performance and the consequences it can have on companies' performance and costs (Handfield & Nichols 2002). Despite, the increase in theoretical and empirical knowledge within the field of supply chain performance, there are but a few correlations that exist in what impact supply chain modification has on its performance. This paper will therefore deal with this problem by investigating how altering one small part of the supply chain can have certain consequences on supply chain performance.

1.2 General problem

As mentioned earlier, the world today is undergoing a profound change due to globalization. Companies are now required to strive for incremental and continuous improvements to steadily sustain a market position. It has become clearer that companies across industries and around the globe regard SCM as intrinsic to their success because it provides a competitive edge. Logistics professionals have also indentified the importance of SCM and are constantly challenged by companies to manage the movement of products across the supply chain in a timely and cost-effective manner fulfilling logistics customer service requirements. According to Rushton et al. (2006) logistics customer service requirements are essential in SCM as they deal with providing reliable and on-time deliveries, where the customers are interested in the length of time they will have to wait to receive their delivery. Often, customer have an upper time limit for their desired delivery date, if the delivery time exceeds that, a customer will either go elsewhere for his requirements, or even cancel his order entirely (Rushton et al. 2006).

However, in the current business climate, companies still deal with accumulating some quantity of orders at one step in the process or organization in the supply chain before it is released to the next process step or to the other supply chain constituencies. This is recognized as order batching which minimizes the efficiency in a supply chain by prolonging the total elapsed time required to complete an order process. Therefore, it is essential for companies to make certain that the rationale behind order batching is an economic one where they wish to take advantage of lower transportation rates by accumulating orders to create larger shipment quantities. In such circumstances, the savings associated with the order batch approach must be worth the additional time required for delivery to customers since it can affect on important performance dimensions such as customer service, order time cycle and execution costs (Handfield & Nichols 2002).

In order to decrease costs, the challenge lies in building a strategy which will batch orders together while maintaining a level of logistics customer service which the customer demands. To set forth this challenge, the author has planned to develop a new order fulfillment strategy which will strike an appropriate balance between logistics customer service and order batching. According to Croxton et al. (2009), an order fulfillment strategy can be defined as the way how firms respond to customer orders. Furthermore, while developing a new order fulfillment strategy requires a network or a process that must allows a firm to meet customer request while minimizing logistics costs. This is essential as it is the customer's order that set the supply chain in motion, and fulfilling them efficiently and effectively is the first step in providing reliable customer service (Croxton et al. 2009).

1.3 Research problem and purpose

Thus far, the evidence presented in this thesis has established that improvement in supply chain performance is crucial for the company's success. As such, the order fulfillment strategy should be robustly designed and optimally controlled. Firms in pursuit of competitive advantage and superior performance must initiate new research strategies within supply chain in order to find new methods of improving it. In particular, it has come to the attention of the author that there exists a gap in the balance between successfully batching orders together and fulfilling logistics customer service requirements. Filling this gap has proven to be a difficult task as there is limited research available on order batching and its

connection to logistics customer service and supply chain performance. In order to resolve this issue, the author has decided to develop an order delivery strategy (ODS) shown in figure 1.1. This order delivery strategy will aim to batch orders in a way that will fulfil logistics customer service requirements. Most importantly, this thesis will also take into account the consequences an ODS implementation can have on supply chain performance. Accordingly, given the authors interest in this issue and to address the lack of related literature, the research problem for this study is

"To develop a new order fulfillment strategy for LG that will strike an appropriate balance between logistics customer service and order batching"

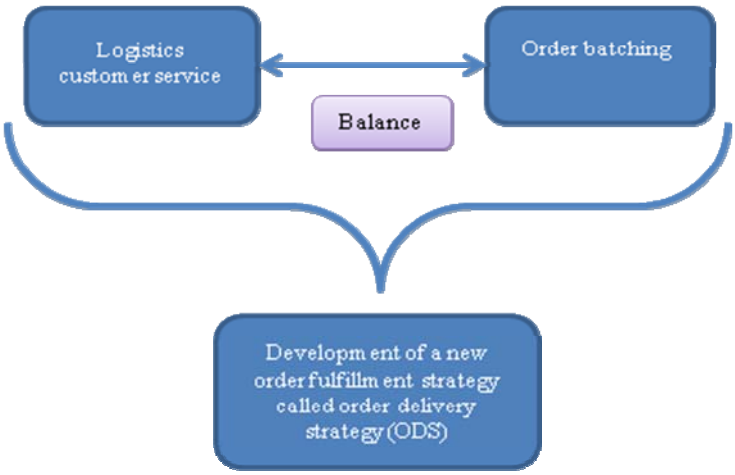


Figure 1.1 Illustrates the research problem in the study which has led to the development of an ODS.

This issue first came up when the author was assigned the responsibility to carry out a project for LG Electronics Nordic AB (LG). The project involved optimizing outgoing order quantities (batching orders) from LG's warehouse in Jönköping to their multiple retailers and customers in the Nordic countries. After a few meetings and discussions with LG, it came to authors understanding that an order fulfillment strategy should exist that deal specifically with order batching and logistics customer service. Therefore, the main objective for this thesis is to develop an ODS which will balance order batching and logistics customer service. With this main objective in focus, another aim is to investigate what consequences ODS implementation can have on LG's supply chain performance.

1.4 Research questions

The general and research problem presented earlier indications that the project will deal with an order fulfillment strategy. It is therefore important to have research questions which will support the current research problem. Cooper and Schindler (2003) highlight the importance of research questions by stating that they exist to make a stated purpose more actionable and should together provide the necessary information an author needs to solve the given research problem. The research problem is therefore divided into two more specific research questions.

RQ1: How should an ODS be modeled and managed in order to batch orders and fulfill logistics customer service requirements?

RQ2: What are the consequences of an ODS implementation on LG's supply chain performance?

According to AvShoshanah et al. (2005), the goal of an effective supply chain organization is to optimize the end-to-end order fulfillment process while achieving the lowest total cost. The first research question will follow the same approach and will deal with the development of a new order fulfillment strategy (also known as ODS) which will batch orders and fulfill logistics customer service requirements.

The second question aims to explore the consequences that an ODS implementation can have on LG's supply chain performance. This will involve those supply chain performance areas which can have an effect after the implementation of an ODS.

The results of this research will benefit LG by providing them with a new ODS. This ODS will not only fulfill its overall objective but will provide specific delivery days for LG's customers. The form of ODS which has been developed during this study has not existed before. It is a brand new tool which the author has developed by performing his own form of analysis from his working experience and preexisting knowledge. To carry out this research, the author was limited to some areas of logistics which will be discussed in the next section.

1.5 Delimitations

Due to the complexity of ODS development in a supply chain; the investigation of all aspects impacting upon these are beyond the scope of this present thesis. As Miller and Dess (1993, p.579) suggested, "*no single research effort can fully satisfy all possible criteria*". Therefore, certain delimitations exist in this study to demarcate this area of research in order to finish this study in the given time frame.

The author has decided to limit himself to certain theories that are relevant for this research. These will involve some areas of supply chain management, with significant focus on outbound logistics, supply chain performance, order picking (order batching), order management, logistics customer service and order fulfillment.

Moreover, since the author will present thesis results to the company; their feedback and opinion will be provided to the author regarding ODS. However, due to the time constraint, the author does not have the possibility to interact and receive a customer perspective regarding ODS. Customer perspective can alternatively be a possibility for future investigations on ODS.

1.6 Outline of the dissertation

In order to achieve the explicit objective in this study, the thesis is divided into five chapters, each representing a different stage in the research process.

Chapter 1 introduces the research problem, and research questions at hand to clarify the purpose of this study. This chapter highlights the importance of the phenomenon of interest and briefly describes the related theoretical background.

Chapter 2 will review the pertinent literature for this research which will provide better knowledge and insights of the research problem under investigation.

Chapter 3 aims specifically to describe the research design and methodology which is employed to carry out this research.

Chapter 4 describes briefly about the company LG and the form of order fulfilment strategy they utilize today.

Chapter 5 provides a comprehensive analysis of the qualitative and quantitative data and shows the results of the study. It discusses the ODS in detail and the impact it can have on company's supply chain performance.

Chapter 6 will finally represent the contributions made by this research. Here, conclusions will be drawn from the research findings. Implications will be extrapolated from findings to practitioners and academic researchers as well as for LG, in relation to implementing an ODS. This will also include study limitations and future research avenues.

2 Theoretical Framework

The current chapter has two main purposes; firstly, to generally clarify the theoretical framework of the core concepts that exist in supply chain management. Secondly, to extensively review the extant literature that is more related to order batching, logistics customer service and the purpose of this thesis. This review and analysis will provide an overview of what has been done as well as identify what lacks in the existing research. This will also serve as a guideline for the remaining chapters in this thesis.

2.1 Overview of Theoretical Framework

The layout in this chapter will follow the presented framework in figure 2.1 below. This has been developed by the author to provide a better understanding of the different topics associated with this study. These theories aim to support and will function as a guideline for the development of an ODS.

In this chapter, areas like supply chain management will be first discussed, followed by the logistics sub-area (Outbound logistics flow). The most important order theories will then be mentioned which includes order picking, order management, order cycle and order fulfilment. Other theories and logistics terms will later be discussed that will be used in the remaining chapters.

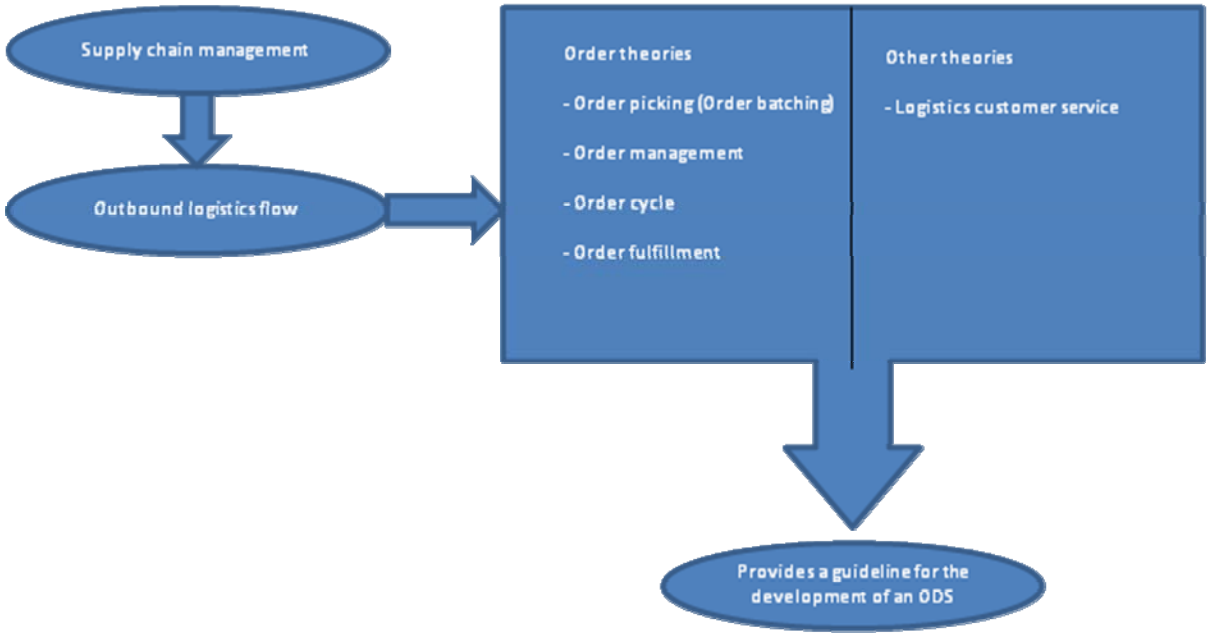


Figure 2.1 Disposition of theoretical framework chapter.

2.2 Introduction to supply chain management (SCM)

With the ever-shortening product life cycles, tougher competition, and demanding requirements for customer service, it is crucial for companies to consider the complete scope of supply chain management, from the suppliers of raw material to in-store demand for products (Davis 1993). The supply chain management concept is relatively new in the research literature which lacks a clear definition among scholars, industry managers and researchers. However, various definitions of a similar nature exist in literature where the author intends to first describe SCM in general and then select the most up-to-date and best definition related to this study.

2.2.1 The supply chain illustrated

Handfield & Nichols (2002) define a supply chain using a two-part explanation. First, the chain exists there to link together multiple organizations which provide goods and services to the end customer. Second, it involves the material and information flow which is carried in both direction of the supply chain. However, Steven (1989) defines a supply chain as more of a system that also includes activities such as planning, coordinating, and controlling material of parts and finished goods from the supplier to the customer. With depending on so many activities in a company, businesses depend on their supply chains to provide them with what they need to survive and thrive. Furthermore, it is important to realize that every business fits into one or more supply chains and has a role to play in each of them.

A supply chain is rather complex because it usually involves several linkages between many organizations. Due to this complexity, companies started to adopt SCM in the early 1980 to properly manage and control their supply chains (Oliver and Webber 1982). Prior to that time the word “Supply Chain Management” was seldomly used and would be called different terms such as- “logistics” and “operations management” in the business field. However, it was not until the 1990s that organizations started to consider SCM as the combination of art and science that goes into improving a company’s way to finds the raw component it needs to make a product or service, and deliver it to the customer (Weth 2007).

It is important to define SCM in order to get a better understanding of what it involves. The most up-to-date definition for SCM according to Council of Supply Chain Management Professionals (www.cscmp.org) that describes this form of art and science is as follows:

“*Supply chain management is part of the logistics management which encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies*”.

In another definition, supply chain management is regarded as “*a pipeline or conduit for the efficient and effective flow of products and materials, services, information, and financials from the supplier’s suppliers through the various intermediate organizations or companies logistics network between the original vendors and the ultimate final customer*” (Coyle et al. 2003, p.15).

The most recent proposed definition related to supply chain management is the one adopted for the understandings within the objectives proposed by this study. The given definition clearly defines how important it is to have an effective flow of materials, services, information, and financials from the supplier to the end customer. The whole supply chain and this form of flows are illustrated in figure 2.2. It shows an overview of how supply chain operates and the prosperous results it can generate for companies that wish to improve it. The output of an efficient supply chain is an improvement in customer satisfaction and profitability which would provide a competitive advantage for most companies (Mentzer et al. 2001). This form of competitive advantage is crucial for company's success, as the trend for efficient supply chain management is accelerating up the corporate agenda, and there does appear to be some evidence for this. For example, many companies appoint supply chain directors, and there is competition between supply chain rather than simply competition between individual firms (Christopher 1998). It is therefore essential for each company to constantly improve and reevaluate their supply chains. This involves redesigning part of the supply chain where there is a possibility for improvement and development.

To get an either better understanding what supply chain involves, the actors and its structure will be discussed in the next section.

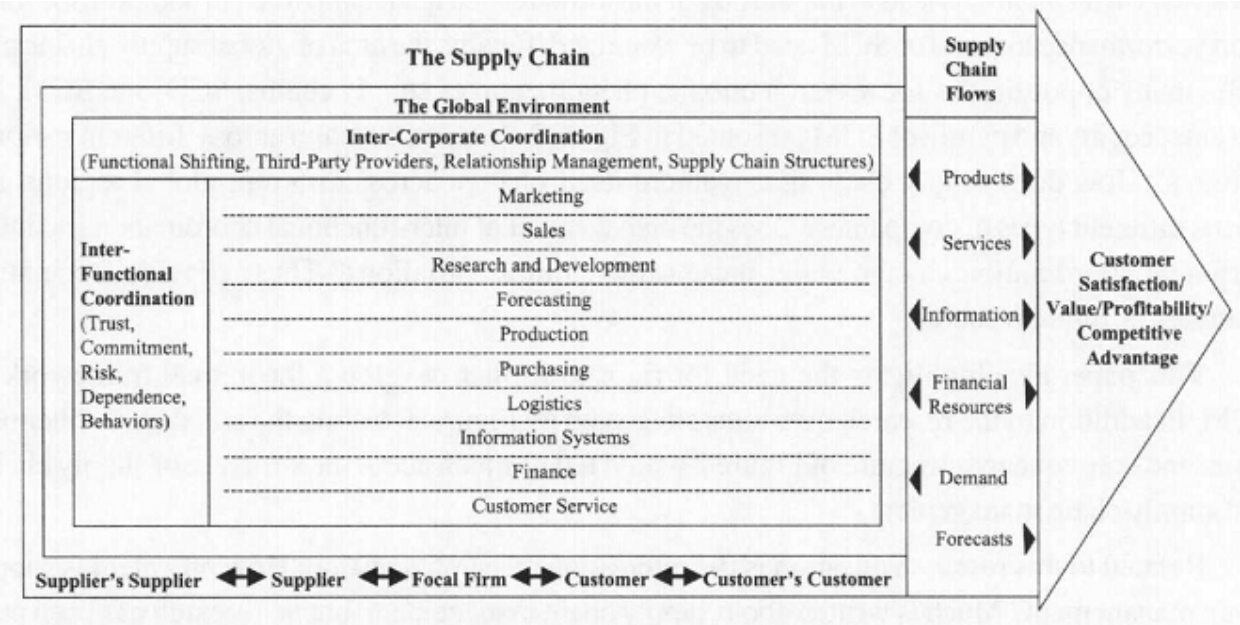


Figure 2.2 illustrates the overall supply chain. Adopted from Mentzer et al.(2001).

2.2.2 Actors and the structure of supply Chain

In a basic structure, a supply chain is an arrangement of suppliers and customers in a company. These basic groups of participants (supplier and customer) form a simple supply chain. Extended supply chains involve three additional types of participants. First there is the supplier's supplier or the ultimate supplier at the start of an extended supply chain. Then, it consists of the customer's customer or the ultimate customer at the final end of the supply chain. Finally there exist number of organizations and companies who are service providers to other companies in the supply chain. The role of service providers is to provide supply

services in the form of logistics, finance, marketing, and information technology (Hugo 2006).

According to Hugos (2006), supply chain consists of a combination of companies which perform different functions. These companies are suppliers, manufacturers, distributors, retailers and customers which are usually involved in a supply chain.

Suppliers
Primarily, the value network begins with suppliers whose objective is to provide the basic ingredients to start a supply chain for instance raw materials, ingredients, commodities, sub assemblies, and so forth. In nearly all organizations, limited group of suppliers exist to provide 70-80 percent of the incoming raw materials from which the finished product or service is generated. The first link is essential to initiate the process without making the chain of supply an endless connection (Poirier 1996).

Manufacturer
The second linkage involves the manufacturer, converter, or processor whose task is to build, assemble, convert, or furnish a product or service that is clearly identified as the consumable in the supply chain network. This link is called “Manufacturer” since it seeks to transform a form of input to an output in the network (Poirier 1996).

Distributors
The chain requires another constituent to get the product to the consumer. This usually includes a distributor which transports the finished product from manufacture through a warehouse or distribution center to a retailer. Some networks however include wholesaler who take the responsibility for breaking larger loads and delivering the product to smaller outlets. According to Poirier (1996), there exist an opportunity to cut inventories, warehouse space, reduce costs and cycle times by redesigning traditional distribution systems for greater effectiveness. Additionally, every network that he studied and redesigned resulted in space and inventory reductions (Poirier 1996).

Retailers
Retail outlets receives the responsibility to offer the product to potential consumers. These outlets are distributors which include grocery stores, department stores, discount outlets, club stores, superstores, and mass merchandisers from which the final purchase is made. Thereafter, consumers make the final decision in choosing and purchasing their products of choice which they require (Poirier 1996).

Customers
Customers or consumers are any organizations or a group of people that purchase and use a product. There are two forms of customers, where the first type of customer purchases the product in order to incorporate it into another product. This product is then sold to another customer. Second types of customers are those that will be the final end user of the product which might either utilize it or consume it (Hugo 2006).

Service providers
Service providers hold the responsibility to provide service to suppliers, manufacturers,

distributors, retailers and customers. They develop special expertise and skills that focus on a particular activity required by a supply chain. For this reason, they are able to perform these services cheaper and faster than suppliers, manufacturers, distributors, retailers and customers could do own their own. Some common service providers are companies that provide transportation and warehousing services (Hugo 2006).

Furthermore, in order to provide tangible business value, many manufacturers and service providers aim to produce their products and services in both an efficient and effective manner (Tan 2002; Sengupta et al. 2006). In order to succeed with this and build a competitive advantage, companies must integrate with their suppliers and customers (Ragatz et al. 1997; Frohlich & Westbrook 2001; Kim 2007). Therefore, the theory behind supply chain integration will be discussed in the next section.

2.2.3 Supply chain integration

It is essential for companies to discover everything about their competitors and repeatedly scrutinize their channels to those of their competitors to determine areas of potential competitive advantage (Kotler & Keller 2009). According to Porter, the bond between firm's value chain and customer's value chain provides possibilities for the firm to improve its competitive advantage. One of the objectives for supply chain management is to improve competitive performance by integrating companies' internal operations with the external functions of suppliers, customers and other channel members (Kim 2006a). Gunasekaran et al. (2008) agrees with Kim (2006a) also stating that the most recognized strategy for improving competitiveness is through supply chain integration. Figure 2.3 illustrates the structure and the evolution of the integrated supply chain since the 1960s.

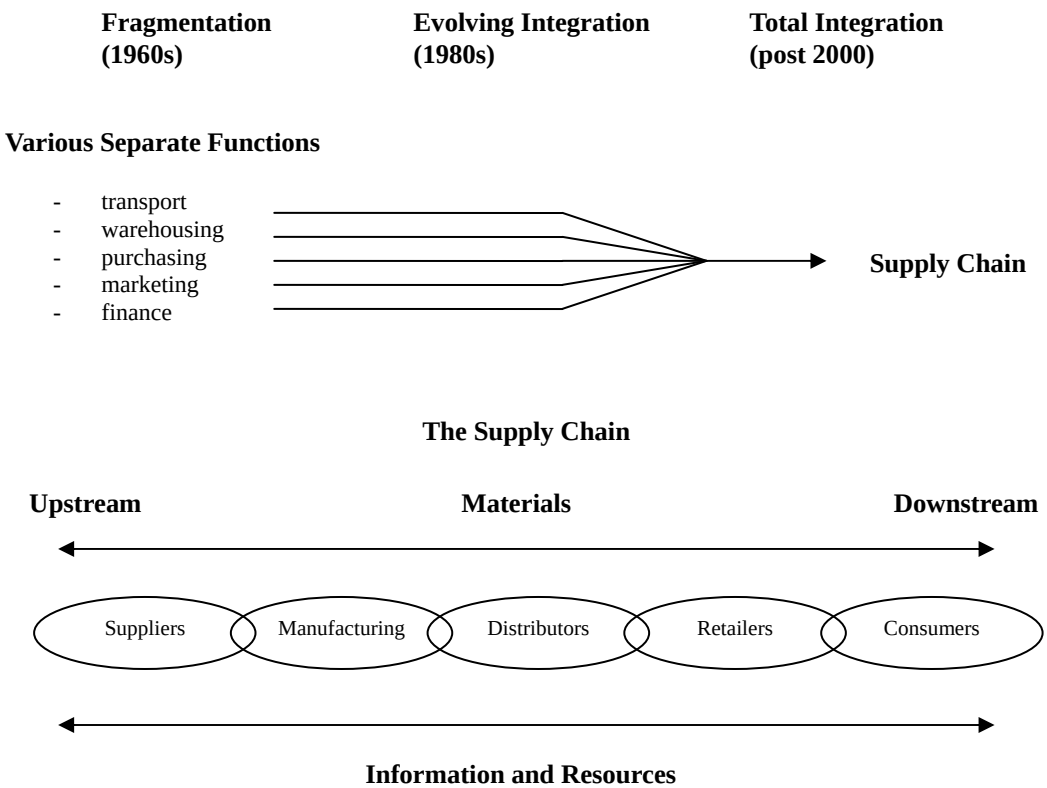


Figure 2.3: The evolution of the integrated supply chain. Adapted from Christopher (1998).

As mentioned in the previous section, the supply chain is a chain of network that consists of suppliers, manufacturers, distributors, retailers, and customers. This network manages and coordinates the financial, information, and material flows between the members of the supply chain at an operational level (Akkermans et al. 2003). Financial flows include activities, such as payment schedules, credit terms, and ownership arrangements. Information flows deal with order tracking, order transmission and material flows coordination; and material flows which represents physical product flow from supplier to customers, and also includes the reverse flows for product returns, servicing, and recycling (Akkermans et al. 2003).

Additionally, three pillars are needed to support the network: the first pillar include the firm's capabilities in knowledge management, logistics, and new product development. The second pillar is the organizational structure which consists of performance measurement, reward schemes and management approaches; and the final pillar which is enabling technologies which include information technologies and processes (Akkermans et al. 2003).

An integrated model including the supply chain members, operational level and network pillars is illustrated in Figure 2.4. The purpose of this system is to improve and maintain the activities between different network members and simultaneously receive support and coordination from the network pillars.

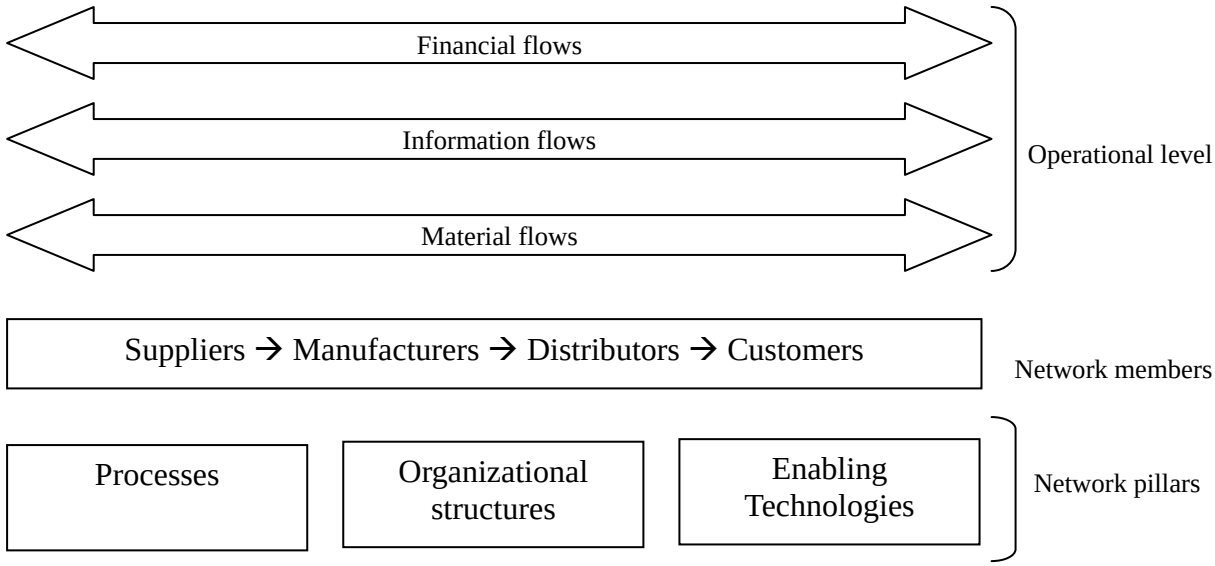


Figure 2.4 An integrated model of the supply chain. Adopted from Akkersmans et al. (2003).

A company can realize the benefits of an integrated supply chain through efficient linkage among various supply chain activities. The supply chain integration strategy aims to produce value for the firm's customers and pulls suppliers and customers into the value creation process (Tan & Kannan 1998; Vickery et al. 2003). Furthermore, the most successful and powerful competitors are those who connect their customers and suppliers together into integrated network (Frolich & Westerbrook 2001). Four strategies were introduced in 2001 by Frolich & Westerbrook (2001) to identify supply chain integration as depicted in Figure 2.5. The first strategy is limited to only integrate internal processes by automatising and standardizing each internal function of the firm. However, it is ideal for companies not to

only integrate internally but also externally towards their customers and suppliers. (Kim 2006b). The second strategy involves the firm integrating with their suppliers, which is possible through information sharing and strategic linkage with suppliers. The third strategy deals with firms that are integrated with their customers (Frolich & Westerbrook 2001). The last strategy is when a firm is fully integrated where demand and supply integration proceeds in both directions. In this study, the third strategy will be applied later on and therefore will be discussed in detail.

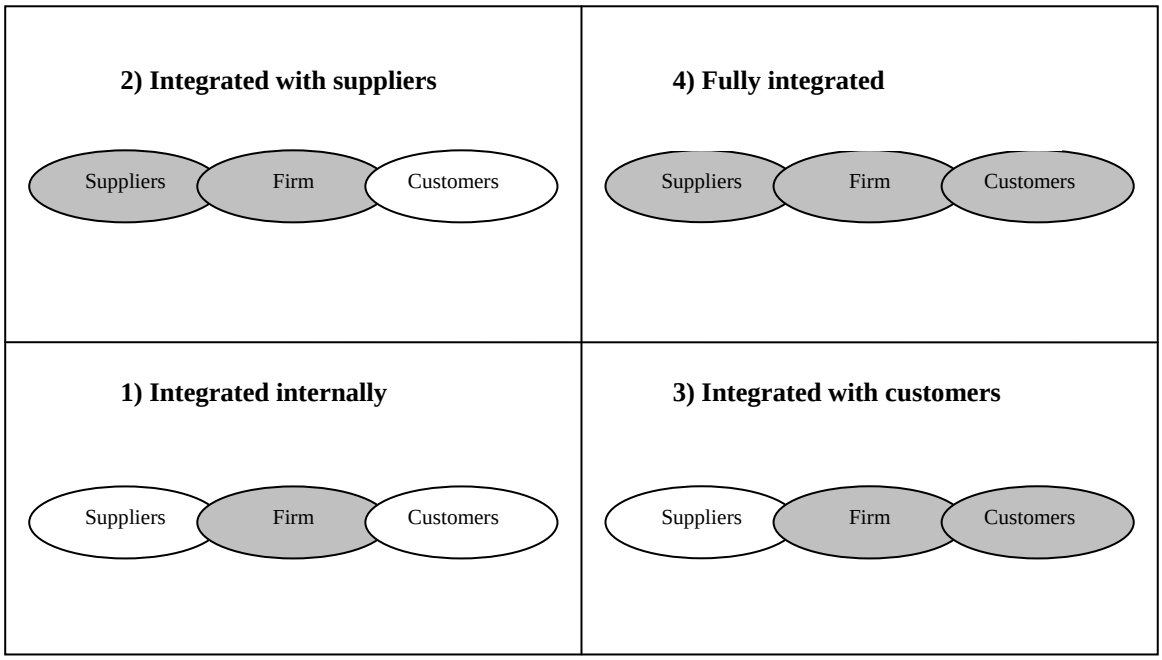


Figure 2.5 illustrates different levels of integration in a supply chain. Adopted from Frohlich (2002).

Integration with customers

Large amount of companies have customer base that are even more sizeable and intricated than the supply base. These customers provide the main source of income of money into the supply chain, and they do not hesitate to threaten to invest their money elsewhere, often to lower-cost global suppliers. Therefore, a high level of service performance is required by the customers, but they usually are not willing to pay more for these increased and improved services. In this case, it is very important to keep the customers satisfied since customers rather than suppliers usually possess the channel power (Stank et al. 2001).

In today's society, it is important for companies to integrate towards their customers by building stronger relationships. The companies should work with relationship management to build these relationships since it is the most fragile and tenuous which is most susceptible to breakdown. A poor relationship at any end of the supply chain can result in disastrous consequences for the entire supply chain. It is therefore necessary for every organization to develop a better understanding for their processes, as well as of their customer's quality and delivery performance requirements in order to discover new and improved ways to serve their customers. On the other hand, in order to build a strong relationship, communication links between the firm and its customers must be set up and maintained regularly. The result of

good communication and strong relationships with customers will provide a long term competitive advantage for the firms on the market (Handfield & Nichols 2002).

2.2.4 Supply chain performance

For every supply chain to operate efficiently, supply chain must be continuously evaluated and measured. Therefore, there is a full range of performance areas that can be measured which some of these are

Products and services offered
Sales
Market share
Costs
Quality
Inventory holdings
Delivery
Cycle time
Assets utilized
Responsiveness
Customer service

However, Hugo (2006) characterizes all supply chain performance drivers under five areas. These fives areas are production, inventory, location, transportation and information. A company's supply chain capability depends on what decision they make within these supply chain performance drivers. It is furthermore important to mention that company must have a good understanding of each driver and its operation in order to have an efficient supply chain. Each driver has the ability to directly affect the supply chain and enable certain capabilities. (Hugo 2006). The author has chosen to only describe information as a supply chain performance driver since other areas serve less relevance for this thesis.

Information

Information serves as a basis for making decisions regarding the other four supply chain drivers: production, inventory, location and transportation. The purpose is to provide a connection between all activities and these drivers in a supply chain as depicted in figure 2.6. This connection should be so strong (i.e, the data is accurate, timely and complete) so the company is able to make good decisions in a supply chain for their own operations. As a result, the company can maximize profitability of the supply chain as a whole (Hugo 2006).

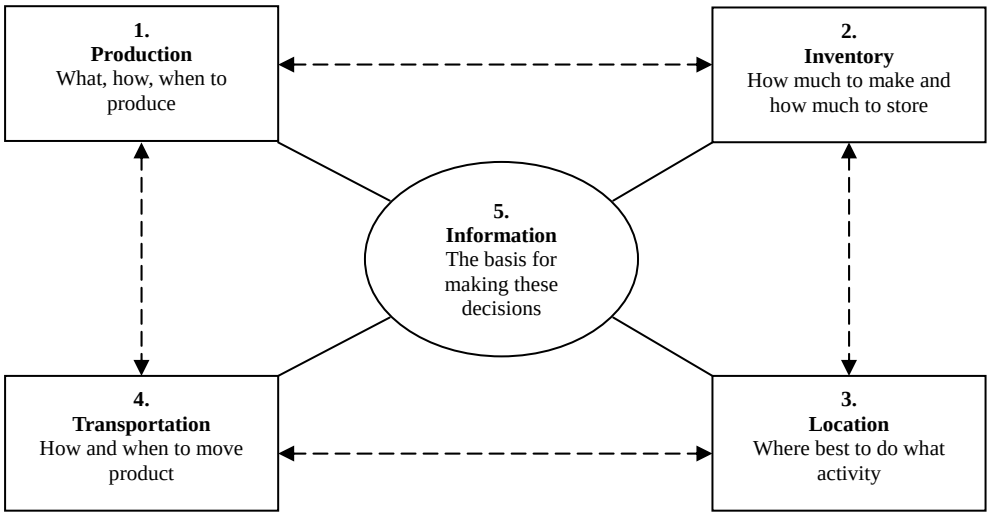


Figure 2.6 illustrates the five major supply chain drivers. Adopted from Hugo (2006).

An individual company should make certain that there exist a balance between responsiveness and efficiency. In case of information in a supply chain, this involves weighting the benefits that good information can be provided against the cost of acquiring that information. If accurate information is received, efficient operating decision and better forecast can be made. However, the cost associated with building and installing such a system for attaining accurate information is very high (Hugo 2006).

Within a supply chain as a whole, the common trade-off between responsiveness versus efficiency is about deciding how much information a company should share or keep private with their suppliers and customers (Hugo 2006). According to Handfield & Nichols (2002), all the members in the supply chain must be willing to share information and build strong relationships, if a supply chain is to be improved. It is however important for all companies to balance this openness of information since it could be used against the company by its competitors (Hugo 2006).

2.3 The outbound logistics flow

Outbound logistics is part of the supply chain that refer to physical distribution activities such as collecting, storing, and distributing products to customers. It also involves warehousing, materials handling, network planning, order processing, vehicle scheduling and routing of finished goods (Wu & Dunn 1995). The Business Dictionary (2010) defines it similarly as the "*movement of materials associated with storing, transporting, and distribution of a firm's goods to its customers*". Primary goal of outbound logistics is to manage its activities efficiently since it enhances a firm's capability to serve its customers (Coyle et al. 2003).

Wu & Dunn (1995) explain the main difference between inbound and outbound flow as what type of form a product holds within a supply chain. Inbound flow deals with maintaining the raw material until they are processed and delivered to the warehouse. On the other hand, outbound flow deals with the finish goods in the warehouse that needs to be properly maintain and managed before getting delivered to the customer.

The second flow (outbound flow) tends to be far more complicated than the inbound flow since it generally deals with higher value products that must fulfill customer delivery requirements. Therefore, managers have to chose and employ the right form of outbound strategies such as looking through options of direct shipping or hub-and-spoke, central warehouse or distributed network, intermodal or single mode, and third-party services or private fleet (ibid).

According to Coyle et al. (2003), those dealing with outbound logistics require timely and accurate information related to each individual order. This is necessary since order picking and order management are the keys to operational efficiency and customer satisfaction in a supply chain (ibid). The terms order picking and order management will therefore be discussed in the next two following sections.

2.4 Order picking

Order picking is one of the processes in outbound logistics *which deals with retrieving products from storage (or buffer areas) in response to a specific customer request* (Kostar et al. 2006, p.1). It is considered as one of the areas where most of the productivity improvements can be made. Order picking correspond to nearly 55% of the total warehouse operating expenses. It is therefore important to maintain a high level of picking service which is robustly designed and optimally controlled. (Kostar et al. 2006).

Order picking in a warehouse can be manual, power-assisted, automatic, or can possibly be a mixture of all of these methods. A manual system involves using two- or four- wheel handed trucks or cart that push through the pick line and the order picker hand picks the order. A powered system uses unguided or guided vehicles to transport the worker through the pick line. In this system the pallets, carts, or containers are manually loaded by the order picker. However, an automatic system differs from the other systems since it relies on computers to guide the picker to the pick location and indicates the proper quantity that should be picked. What interests the author the most are the two form of order picking methods that are widely known in today's industry. These order picking methods are single-order and batch picking (Ackerman 2000).

Single-Order picking

Single order picking demands the picker to assemble the total order before moving on to another one. This involves having the picker to pass through the complete order picking area for every single order that needs to be picked. There are advantages and disadvantages for applying such a method. The advantages are (Ackerman 2000):

- Maintains single-order integrity.
- Simplifies the order picker job.
- Does not require rehandling or repacking.
- Provides fast customer service.
- Allows the possibility to check for order errors so the right order quantity is picked.

However, single-order picking has these disadvantages (Ackerman 2000):

- Requires full order-picking route travel for all orders.
- Cannot perform speed picking of large quantities of an individual item.
- Requires more personnel to pick a given number of orders.

The next sub-section will first describe order batching and then discuss batch picking in detail.

2.4.1 Order batching

In order to define order batching, it becomes important to define the terms “order” and “batching” separately. According to Alarcón (2005), order deals with supporting customer request and includes the basic information that the company needs in order to adequately fulfill it. Batching involves summing together a specific amount of quantity which might wait in a process so it can be released to the next (Alarcón 2005).

According to Handfield & Nichols (2002), Order batching deals with accumulating some quantity of orders at one step in the process or organization in the supply chain before it is released to the next process step or to the other supply chain constituencies. Batching causes longer cycle time since it limits the supply chain to run optimally. Therefore, the reason behind batching should be an economic one, which should be worth the additional time required for the customer to wait (Handfield & Nichols 2002).

Batch picking

Order batch picking in a warehouse involves progressive movement, picking several orders at a time. This can save personnel time since the picking operation is more efficient due to less travel time per order and the increase in number of picked at one time (Drury & Falconer 2003). More specifically, these advantages are: (Ackerman 2000)

- Reduces picking operation time. Picking travel time can be reduced up to 50%.
- Provides the possibility to pick larger quantity which reduces the need to constantly restock the pick lines in a warehouse.
- Provides a second check of the quantity picked by comparing the batch picked against the individual quantities in each order.

This form of batch picking also has these disadvantages (Ackerman 2000):

- More space is required for the distribution and order assembly operation. Equipments that can pick and handle more order quantity may be required to batch several orders under a single shipment.
- Since there are a lot of orders involved, counting must be down twice. This will require more reconciliation time.

2.5 Order management

Order management is also part of the outbound logistics flow. Unfortunately, there are few sources in the literature discussing the details of order management explicitly. Order management is however implied in the work of a number of authors. According to Shapiro (1992), order management is one of the core processes in supply chain management which

deals with ten basic activities which are order planning, order generation, cost estimation and pricing, order receipt and entry, order selection and prioritization, scheduling, fulfillment, billing, returns and claims, and post sales service.

Hugo (2006) describes order management as *the process of passing order information from customers back into the supply chain from retailers to distributors to service providers and producers*. This process also includes passing information about order delivery dates, product substitutions, and back orders forward through the supply chain to the customers. However, Murphy & Wood (2004) describe order management as more of a phase which deals with how firm handle incoming orders. This involves the set of activities that are considered in the period between the time a firm receives an order and the time warehouse is notified to ship the goods to fulfill that order (Murphy & Wood 2004). More importantly, Coyle et al. (2003) states that those dealing with order management in outbound logistics require timely and accurate information related to each individual order. This is necessary since order management is one the key to operational efficiency and customer satisfaction in a supply chain (ibid).

To fulfill operational efficiency and customer satisfaction in a supply chain, one of the most important strategies in order management is to determine and set the right parameters for stock levels, stock points, transportation times, and transportation frequency. These parameters should be set carefully otherwise it can affect the quality of the service resulting in longer cycle and service time (Ljungberg 1994).The right form of order management and order picking is therefore crucial for supply chain efficiency, and it is not all about moving quantity of parts from point A to point B at a certain time. Inefficiency in order management can lead to longer order cycle times which will be discussed in the next section.

2.6 Order cycle

In order to define order cycle, it is important to first provide an understanding of what cycle time involves. According to Handfield & Nichols (2002, p. 53), *cycle time is the time required to complete a business process*. Here, the “real work” performed during a business process only corresponds to a small percentage (e.g., three to five percent) of the total elapsed time. The rest of time is typically employed to other counter productive, time-consuming activities and events. It is therefore possible to improve cycle time by eliminating and or minimizing these time-consuming activates that exist. However, cycle time reduction does not only depend on completing a process quickly but it is also concerned with completing the business process effectively. Supply chain member organizations can significantly improve cycle time performance by focusing on key processes which will result in a competitive advantage for the supply chain (Handfield & Nichols 2002).

This shows the importance that organizations are competing on the basis of time and performance in a supply chain. It does not only depend on superior cost, quality, delivery and technological performance. However, reducing the time needed to provide the end customer with products or services results in better customer satisfaction. Therefore companies should find ways to improve their cycle time by finding common causes that exist behind it (Handfield & Nichols 2002).

Order cycle is a form of cycle time which exists in outbound logistics. According to Murphy & Wood (2004) the order cycle process can be defined from two different perspectives

namely from a buyers and sellers perspective. From the seller's standpoint of view, order cycle is defined as the total time taken from when an order is received from a customer to when goods arrive at the customer's receiving dock. Following it from a buyer perspective, it is defined as the time an order is sent out until the goods are received (Murphy & Wood 2004). A definition that covers both perspectives, is provided by Ballou (2004, p.98), where he defines the term as "*the time between when a customer order, purchase order, or service request is placed and when the product or service is received by the customer*".

Within the spectrum of order cycle, the most time consuming activities that correspond to 50 to 70 percent of the total order cycle time in many industries are order preparation, transmittal, entry and filling (LaLonde & Zinszer 1976). It is therefore essential to manage these activities in a proper way, since a high level of customer service is provided through short and consistent total order cycle times in a supply chain. This total order cycle time consists of series of components and steps which are order transmittal, order processing and assembly, additional stock acquisition time, and delivery time (Ballou 2004).

Order transmittal is referred to two separate cycle times put together. First, it involves the length of time a salesperson or the sales office waits for retaining an order before transmitting it. Second, it also includes the length of time the order is in the transmission channel. Furthermore, this cycle time can depend on various electronic transmissions such as the transmittal time of a telephone call or electronic data interchange between companies.

Order processing and assembly involves the activities related to preparing shipping documents, updating inventory records, coordinating credit clearance, checking the orders for errors, communicating with customers. This also includes updating the customers regarding the order status, and order information that they require. It can therefore be presented as a number of activities that include order preparation, order entry, order filling and order status reporting for customers (Ballou 2004).

In more detail, the order processing deals with the following order processing activities (Murphy & Wood, 2004).

- When the order information has arrived, it is checked for completeness and accuracy;
- A credit check is made by the credit department;
- The order is entered into the system (also known as order entry);
- The marketing department credits the salesperson with the sale;
- The accounting department records the transaction;
- The inventory/outbound logistics department locates the warehouse closest to the customer and informs them to deliver the shipment. Warehouse then has the responsibility to update the firm's master inventory control system;
- Finally, the transportation department arranges the transportation from the sellers shipping dock to the buyer.

The third respective component additional stock time acquisition time is not relevant for this study and therefore will not be discussed. However, the final phase of the order cycle is order delivery. This is the time from when a carrier picks up the shipment until it is delivered to the customer's receiving dock. Carriers establish their own service standards. The shippers using the carriers have to incorporate the carrier's estimated delivery time into calculation in order to find the total order cycle time (Johnson et al. 1999).

2.7 Order fulfillment

Order fulfillment is a key process in outbound logistics which deals with "*the process of receiving an order, then shipping the order to the buyer to complete a transaction"* (Croxton et al. 2003, p.8). It is the customers' orders that set the supply chain in motion, and fulfilling them efficiently and effectively is the first step in providing customer service. However, the order fulfillment process does not only involve fulfilling customer orders. It is also about designing a network and a process that allows a firm to meet customer requests while minimizing the total delivered cost. It further involves generating, filling, delivering, and servicing customer orders (Croxton et al. 2003). In some cases, customer interacts with the firm through this process, and therefore, it is important to have an efficient order fulfillment process that over exceed customer experience and their expectations (Shapiro et al. 1992). The order fulfillment process can either potentially make or break your reputation as a customer service provider.

The primary objectives of the order fulfillment process can be categorized as delivering products to customer at the right place, right time and in good quality (Christopher 1992; Goldman, Nagel & Preiss 1995). According to Davenport (1993), the order fulfillment process is quite complex since it includes several activities that carried by different functional entities. This largely depends on tasks, resources, and agents involved in the process. This process is the coordination of activities which can include sales commitment, credit checking, manufacturing, logistics, and account receivable (Davenport 1993). But due to the purpose of this thesis, the author only focuses on logistics related areas such as order picking and order management. It also involves logistics customer service which will be discussed in the next following section.

One of the purposes of this thesis is to develop a new order fulfillment strategy ODS. According to Croxton et al. 2003, an optimized order fulfillment process or strategy should minimize total delivered cost, including outsourcing costs. Such a process will reduce the order to cash cycle and frees up capital, and at the same time reduces delivery lead-time which permits reduced inventory levels. It can furthermore, affect financial performance of the local-firm, as well as for other members of the supply chain (Croxton et al. 2003).

However, it has also come to the authors understanding that an order fulfillment strategy should be efficient and responsive in a supply chain. According to Reichart et al. (2006) Responsiveness can be defined as "*the ability of the supply chain to response purposefully and within an appropriate time-scale to customer request or changes in the market place*". On the contrast, efficiency (ex. order batching) in a supply chain focuses more on cost reduction, and that no resources are wasted on non-value added activities (Naylor 1999).

2.8 Logistics customer service

The vast majority of organizations consider customer service to be an important aspect of their business. Most companies however lack the clear perception of exactly what customer service means and are not able to provide a precise definition of customer service or its measures. In the past, service provisions have been based on very broad assumptions of what customer wants, rather than taking into account the real requirements of final customer in the

supply chain. However, the author has come across a definition that serves well for the purpose of this thesis. This definition for customer service is:

"*the collection of activities performed in filling orders and keeping customers happy, or creating in the customer's mind the perception of an organization that is easy to do business with"* (Johnson et al. 1999, p.108).

Logistics customer service is similar to this definition but can be more clearly defined as the "Seven Rs Rule". The "Seven Rs Rule" involves having the *right* product, in the *right* quantity, in the *right* condition, at the *right* place, at the *right* time, for the *right* customer, at the *right* cost. This is classified as a perfect order which occurs when all seven Rs are satisfied. A misstep in any of the given sevens areas can result in lower customer service. Consequently, competitive advantage can be achieved by creating an organization which routinely satisfies the seven Rs (Wisner et al. 2008). The sevens Rs are depicted in figure 2.7. However, the downfall of having too good of a service offering that customer does not demand can result in unrealistic high cost for the company. It is therefore necessary to have a balance between the level of service provided and the cost of that provision (Rushton et al. 2006).

Figure 2.7 Illustrates the seven rights (7 Rs) for logistics customer service.

The key objective for companies should be to have a successful customer service policy that is developed through a proper framework that includes liaison. This involves measuring, monitoring, controlling the procedures that have been set up according to customer standards (ibid). The importance of logistics customer service is emphasized by Ballou (1987) who states that "*Logistics customer service plays a critical role in maintaining customer patronage and must be carefully set and consistently provided if customers are to remain loyal to their suppliers*".

2.8.1 Logistics customer service components

The logistics components of customer service can be described in different ways. According to Rusthon et al. (2006), these components can be seen as transactional related elements where the focus is on the specific service provided. These elements can vary from providing

on-time delivery, preparing orders, completing orders to other functional attributes related to logistics (Rushton et al. 2006). Transaction elements are usually separated into three categories. The categories are divided according to the nature and timing of the particular service requirements (before, during, and after delivery of the product) (ibid):

1. Pre-transactional elements: these include those customer service factors that occur prior to the actual transaction stage. They include (Rushton et al. 2006, p.65):
    - *Written customer service policy;*
    - *Accessibility of order personnel;*
    - *Single order contact point;*
    - *Organizational structure;*
    - *Method of ordering;*
    - *Order size constraint;*
    - *System flexibility;*
    - *Transaction element;*
2. Transaction elements: these involve those elements that are directly related to the physical transaction. Such elements are most commonly concerned with distribution and logistics emphasizing on product and delivery reliability. This includes (Rushton et al. 2006, p.65):
    - *Order cycle time;*
    - *Order preparation;*
    - *Inventory availability;*
    - *Delivery alternatives;*
    - *Delivery time;*
    - *Delivery reliability;*
    - *Delivery of complete order;*
    - *Conditions of goods;*
    - *Order status information;*
3. Post-transactional elements: these are elements that arise after the transaction has taken place which occurs after product delivery (Rushton et al. 2006, p.65).
    - *Availability of spare parts;*
    - *Call-out time;*
    - *Invoicing procedures;*
    - *Invoicing accuracy;*
    - *Product tracing & warranty;*
    - *Return policy;*
    - *Customer complaints and procedures;*

All of these elements are equally important and should be carefully discussed among organizations so they hold the standards which are required by the customers.

3 Methodology

This chapter focuses on outlining the methodology and methods employed for carrying out this research. By definition, methodology can be recognized as a way of thinking about and studying reality, whilst method can be defined as "a set of procedures and techniques for gathering and analyzing data" (Strauss and Corbin 1998, p.3). Specifically, this chapter aims to first describe the research approach, research design, data sources and research strategy in the study. On the other hand, it will also consider more practical considerations and methods such as data collection, quality criteria, and data analysis.

3.1 Research approach

There exist numerous ways to carry out academic research to fulfill its overall objective (Eriksson & Wiedersheim-Paul 1997; Strauss and Corbin 1998; Sullivan 2001). Therefore, the following subsections will be provided to explain why this particular study is conducted using largely an abductive qualitative approach.

3.1.1 Inductive versus Deductive Research

A research can be conducted using two research philosophies by either applying an inductive or a deductive approach. The inductive method is based on empirical data from which the researcher introduces models and theories founded on different occurrences in reality. In contrast, if the researcher draws conclusions from pre-existing theories and investigates these by the use of different empirical data, then the researcher is applying a deductive approach (Strauss & Corbin 1998; Sullivan 2001).

In this thesis, both an inductive and deductive approach has been applied. This study holds a characteristic of a deductive approach ("top-down" shown in figure 3.1) since the author has applied preexisting knowledge from university in practical life. During this time, the author had the possibility to observe areas in logistics that can be improved. It came to the authors understanding that an ODS can be developed which would help companies to deal with part of their logistics chain.

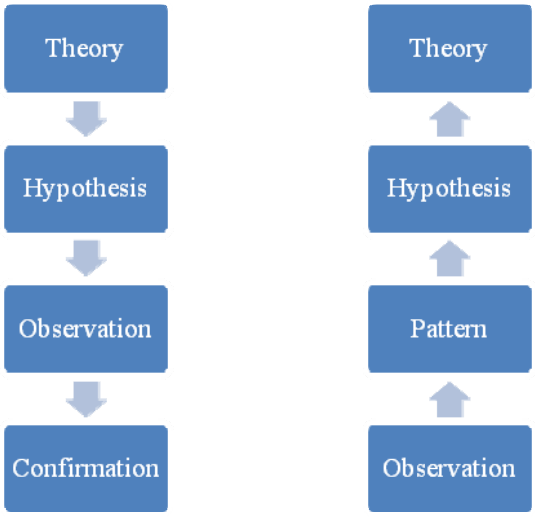


Figure 3.1 illustrates the deductive ("top-down") and inductive ("bottom up") approach in research methodology.

This research is therefore first and foremost deductive by nature but also inductive ("bottom up" approach shown in figure 3.1) since in order to develop an ODS, the author had to perform his own form of analysis (observation) which detected pattern and regularities. This form of analysis was possible since the author had one and a half year of on-hand experience in logistics. The author also took support from preexisting theories such as order theories. This study is based on the use of five specific order theories that have been used in addition to elements such as outbound logistics and the supply chain management concept. The underlying motive behind choosing these pre-existing theories are that they are used to help develop ODS into a more reliable and robust system. This form of research that is both inductive and deductive is known as an abductive approach.

3.1.2 Quantitative versus Qualitative Research

In research methodology, there are two main forms of research approaches, namely quantitative or qualitative approach. There are also however two types of research data called quantitative or qualitative data.

Quantitative Data & Quantitative Approach

The results achieved by quantitative data are presented in the form of numbers, and statistics where the aim is to make generalizations based on the processed results of the investigation. The data gathered is through structured techniques by using tools such as online questionnaires, or by measuring equipments. However, the quantitative approach deals with the research problem from a broad perspective, where the investigator has great control of the statistical method which plays a vital role. Another characteristic of a quantitative approach is that few variables are usually studied, but on a large number of entities (Neuman 2003; Sogunro 2001).

Qualitative Data & Qualitative Approach

Qualitative data is associated with words, pictures and descriptions. The research tends to explore attitudes, behavior and experiences using unstructured or semi-structured techniques such as interviews, or focus groups. Qualitative approach aims to get in-depth information from several variables, but usually from a few number of entities or units. Therefore, the qualitative researcher attempts to gain a deeper understanding of a specific phenomenon under observation in order to reach a final conclusion (Strauss & Corbin 1998; Lundahl & Skärvard 1999; Neumam 2003).

This research adopts both qualitative and quantitative data since results from the analysis will be in the form of words, numbers and statistics. The qualitative data consisted of an interview with employees at LG. The quantitative data was order data which was collected from LG's third party logistics provider DHL. More information regarding these forms of data will be discussed in detail in section 5.3.

However, only a qualitative approach have been applied in this thesis since a new phenomenon will explored called ODS. ODS is a new order fulfillment strategy in logistics which seeks to strike an appropriate balance between order batching and logistics customer service. Furthermore, this strategy will help LG set delivery days to some of their potential customers. By applying a qualitative approach, the findings will be conclusive and usually descriptive in nature. As, it has now been clarified that this dissertation will adopt an

abductive and qualitative research approach, its research design principles will be presented in the following section.

3.2 Research design

The research design for this study will be the general plan of how the researcher plans to collect and analyze the data required for achieving the objective of this research project. Therefore, it is essential to employ the right form of research design, since it will influence a large number of subsequent research activities (Churchill & Iacobucci 2006). There are three types of research designs which depend on the fundamental purpose of the study which are exploratory, descriptive and/or, casual design (Churchhill & Iacobucci 2006; Hair et al. 2003; Tull & Hawkins 1993).

Exploratory designs are conducted when the researcher lacks the basic knowledge and capability to clarify the problem area. This approach is useful when the research objective is hard to distinguish and/or the provided theories and models that exist are unclear. Furthermore, exploratory studies are appropriate when it is hard to establish important characteristics and relations in the research (Eriksson & Finn 1997; Blumberg et al. 2005). The purpose of exploratory research is to collect as much information as possible about a particular problem by utilizing several different sources (Patel & Davidson 2003). Common types of exploratory research are literature investigations, expert interviews, focus groups, and case studies (Saunders et al. 2003).

On the other hand, descriptive design is undertaken when the research problem is clearly structured. In such cases, prior knowledge is required for the phenomenon under investigation. (Churchill & Iacobucci 2006; Hair et al. 2003). Miles & Huberman (1994, p. 94) define "*describing*" as another word for "*making complicated things understandable by reducing them to their component parts*". According to Reynolds (1971), the aim of a descriptive study is to develop explicit descriptions of the co-founding patterns that were expected during the exploratory stage. Such a design is therefore recommended, if a purpose of a study is to illustrate the characteristics of a certain group, specific population with similar characteristics, or even to make certain predictions (Churchill & lacobucci 2006). Moreover, there are two kind of descriptive studies which are longitudinal or cross-sectional. Longitudinal studies are observational studies which are known to have fixed and uniform sample of elements which are measured at various points over long periods of time. In contrast, cross-sectional studies involve observations of a specific sample at a single point in time (Churchill & Iacobucci 2006; Kinnear & Taylor 1995). Descriptive studies depend on data collection through secondary sources or surveys (Tull & Hawkins 1993).

Finally casual research designs, also known as explanatory, are useful to establish casual relationships between variables. The purpose here is to study relations between causes and symptoms in order to explain the relationship between them (Saunders et al. 2003). Miles & Huberman (1994) define "*explanation*" as the activity of making complex issues easily understandable by presenting how their components parts interconnect according to some rules (i.e. theory). Casual research demands a high level of postulation and control, and this is accomplished through various experimental designs in which the researcher checks, controls and alters the independent variables and observes the outcome (Miller & Salkind 2002). If the level of control and manipulation is high, then the researcher can provide more convincing

cause-and-effect relationships compared to explanatory or descriptive designs (Churchill & Iacobucci 2006).

In order to decide which research design is most suitable for the current thesis, the nature of the study and its specific objectives were carefully discussed. Since a clear and structured problem statement was defined and the author had prior knowledge for the study under investigation, an exploratory design was out of the question. Explanatory design was not also feasible for this study since it required a great deal of time and high level of research. However, descriptive design is theoretically possible to implement for this study since co-founding patterns are supposed to be found for the data under investigation. In addition, due to the time constraints and lack of previous research in the area makes the adoption of longitudinal design impossible. On the other hand, a cross-sectional designed was feasible since quantitative data (order data) has only been collected at a defined time which was in year 2008. The author only observed data for one year whereas there was a possibility for analyzing data for a longer period of time. There were two reasons for why the author only limited himself to order data from year 2008. First, the author had a time constraint to follow. Second, the statistics and trend will not differ, if the data was retrieved for other time of the years. Moreover, the author wanted to provide a clear description of how ODS can be developed and the consequences it can have on LG's supply chain performance. Due to these reasons, a descriptive cross-sectional design was undertaken for this study.

3.3 Data sources

There are two forms of sources for data collection which are primary and secondary. Primary sources of data are collected first hand by the researcher specifically for the research problem at hand, whereas secondary sources deal with data which has been previously collected and gathered for other purposes than the current research problem. Furthermore, primary data involves compiling new information through conducting interviews, questionnaires, observations, and case-studies. If the researcher intends to use primary data, then he or she has more control over the design of the study and can freely chose the variables of the problem to be studied. This primary method is time consuming but has proven to give the researcher more freedom and better understanding of the subject given the advantage of sieving out data that is most relevant and useful for the research. However, secondary data usually can be collected and gathered at a lower cost and more rapidly than primary data. On the other hand, such data usually is collected for other research purposes which if used can result in poor reliability, accuracy and integrity (Hair et al. 2000; Tull & Hawkins 1993; Yin 1994). Moreover, there is sufficient amount of primary and secondary data available for this research. Therefore, both primary and secondary data is chosen for this study considering the complexity and the level of information required to execute this study for developing an ODS.

Primary data (qualitative data) was collected from LG by mailing them a set of 12 questions (see Appendix A). This was a form of a written interview with 3 employees at LG where a content analysis was performed. The content in the answers of the written interview provided the author with better understanding of how part of LG's logistics department operates. The questions were divided into four separate parts namely outbound logistics, delivery system, transportation cost, and order management. By the support of this primary data, the author was able to determine how their current order delivery system works and how it can be

improved. This also helped the development of ODS, since vital information was acquired describing what standards ODS should hold.

In addition, secondary data (quantitative data) was provided to the author by LG's third party logistics provider DHL. This included many rows of order data from year 2008 in excel format. Unlike primary data, this order data was analyzed through excel program providing the basic ingredients required for the development of an ODS.

3.4 Research strategy

According to Eriksson & Wiedersheim-Paul (1997), there are three major research strategies a researcher can employ: experiments, surveys, and case studies. In addition, Yin (1994) mentions two other research strategies used in the social sciences, namely history and archival analysis. The research strategy which is most applicable for the study depends on three different conditions: (1) The type of research question that are posed, (2) the level of control the researcher has over the actual behavioral events and (3) the degree of focus on up-to-date rather on past events. Table 3.2 shows the research strategies and how they relate with the given conditions.

Research strategy	Form of research question	Requires control over behavioral events	Focus on contemporary events
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how, many, how much	No	Yes
Archival analysis	Who, what, where, how, many, how much	No	Yes/No
History	How, why	No	No
Case study	How, why	No	Yes

Table 3.2 shows relevant situations for different research strategies. Source: Yin (1994)

By following these conditions and looking at the objective of this study, any of the above research strategies could be more or less applicable. However, the study deals with past order logs known to be secondary data which focuses on contemporary events and it is practically impossible to gain control of behavioral events. Therefore, the experiment and history strategies were excluded early on. Moreover, since the researcher already has present data available and does not require carrying a survey or a case study to generate and test hypotheses, the only feasible alternative left is to perform an archival analysis on the secondary data.

3.5 Data collection method

According to Saunders et al. (2003), the principal sources of data in an archival research are administrative records and documents. Such archival records include

- public related files and other statistical data made available by federal, state, and local government;
- service records, for instance the number of clients that have been served during a given time period;
- maps and chart of the geographical characteristics of a place or location; and organizational records, such as budget or employees records;
- survey data, which has been previously collected about a site's employees, residents, or participants.

As discussed before, there are numerous research strategies a researcher can employ to collect data. None of these information retrieval methods is without its flaws and advantages, and different factors must be weighted and considered against the requirements and purpose of the research project on hand (Churchill & lacobucci 2006; Hair et al. 2000). Therefore, when deciding the data collection method, all of these factors were carefully discussed depending on the time and resources available. Eventually, it was decided that archival analysis will be most suitable for this study. Archival data that is secondary quantitative data has been provided by LG in a form of past orders logs from year 2008. In this research, the records will be so important since the researcher tends to retrieve most vital information from the quantitative analysis which exists. Furthermore, archival records are produced for a specific purpose and audience other than the study under investigation. However, for this thesis the given data provided by LG is relevant, accurate and useful for this study.

3.6 Validity

Peter (1979, p.6) defines validity as "the degree to which instruments truly measure the constructs that they are intended to measure". From this definition, you can conclude that validity is essential for the credibility of a studies result.

To establish the validity in this research, the findings from the archival data have been analyzed where the results have been based on hard, rigorous, and credible facts. To maintain the validity in an ODS, the researcher scrutinized two sources of primary and secondary data which include both the archival data and the questions which were sent to LG. In addition, the researcher made sure that the data provided to him was eligible and suitable for the purpose of this study.

The author has performed his own form of analysis on archival data which is possible since he had previously worked in the field of logistics during a period of 18 months. Such an analysis was credible and valid since it was performed on Microsoft Excel, a program which the author utilized during his working period.

3.7 Reliability

Reliability depends on the consistency of the measurements which have been taken, which can be tested by measuring the same way each time under the same condition with the same

subjects. The results should therefore be more or less the same if the study is conducted again (Bryman 2001). The researcher was very conscious about the matter of reliability during the selection of theories and archival data. To develop a proper order delivery strategy, the researcher made sure that the findings from the quantitative data and the theories suggested were presented to the company during the different stages of this thesis. In this way, feedback was provided by practitioners' who helped develop ODS into a more reliable strategy.

However, such an ODS is not fully implementable for other companies. The methods for creating this ODS and the results derived from this study would differ if such a strategy was supposed to be developed for another company. For this reason, ODS holds a high level of reliability if LG wishes to implement it.

3.8 Methodology discussion

This section will describe how the author approached and solved the research questions in this study. In order to answer the first research question, the author had obtained outbound order data from LG that lists the outgoing orders from their warehouse to their customers. The data includes all relevant information such as customers name, shipment id, order number, volume and other important variables for carrying out the research. From this data, the author can analyze the customer buying behavior (e.g order pattern) in terms of the quantity and frequency of customer orders. The next step was to batch as many orders as possible according to customer buying behavior and their demands. Finally, an ODS was developed which maximized the amount of orders that can be batched depending on customer's ordering variability and their demands.

Another approach was used for research question two. When an ODS was developed, the author wanted to see the consequences that an ODS implementation can have on LG's supply chain performance. Therefore, the author examined LG's current order fulfillment strategy and examined where improvement can be made. It came to the authors understanding that supply chain areas such as order management, order picking, and logistics customer will be influenced because of ODS.

The next subsection will describe the data analysis technique which was employed to solve the research questions.

3.9 Data analysis techniques

Churchill and Iacobucci (2005) defined the objective of the analysis as obtaining meaning from data. The LG order data has been edited, coded, and compiled when received as an excel file from their third party logistics provider DHL. The first step in data analysis was to eliminate data which was not relevant for this study. Thereafter, a suitable program called Microsoft Excel was chosen which will distinguish the data into different groups. After this step the data was finally analyzed providing results for this study. However, the primary data which consist of a written interview went through a content analysis where the answers were analyzed which will be described more in detail in chapter 4 and chapter 5. This report contains confidential information that is the property of LG Electronics Nordic AB. Statistics shown in chapter 4 and 5 are therefore confidential, and other terms might have been used in italic format (e.g Sweden equals to *Country A*).

4 LG Electronics Nordic AB

The purpose of this chapter is to first provide a brief background to LG. Furthermore, this chapter will illustrate LG's outbound logistics flow, where the focal point will be on their order management, order picking, order fulfillment, and logistics customer service. With this knowledge, the author will be able to determine the factors that can be improved in their current order delivery strategy.

4.1 LG's Background

LG Electronics Nordic AB was founded in October 1999 in Sweden. This is a subsidiary that belongs entirely to the main headquarters in LG Korea which came into business in 1958. Since then, LG has been rapidly evolving in the technology market and has been introducing new great products and a broader product portfolio. Furthermore, LG Electronics Inc. is the world's largest supplier and innovator in home electronics, white goods, and mobile communications with 84,000 employees worldwide. There exist a total of 115 subsidies in LG with global revenue totaling 44.7 Million US Dollars in year 2008 (www.lge.com.)

LG consists of five business divisions which are Home Entertainment, Home Appliance, Air conditioning, Business Solutions and Mobile Communications. The company is also the biggest producer of panels for flat-screen TV's, audio/video products, mobile phones, air conditioners and washing machines (www.lge.com.). Moreover, the company has over 115 logistics departments worldwide where one of the logistics departments where this research has taken place is in Akalla, Sweden. The author has conducted a study for this department where their outbound logistics activities were analyzed which will be discussed in the next section.

4.2 LG's Outbound logistics flow

To investigate how LG handles their outbound logistics activities, the author had prepared 12 questions (see appendix A) which dealt with outbound logistics, delivery system, order management and transportation cost. The answers to these questions provided better insight of how the department worked with their outbound logistics activities. This would help develop a proper order delivery strategy which will fulfill LG's requirements.

The answers have been analyzed as discussed in the methodology section, which are divided into the following outbound logistics areas which are order picking, order management, order fulfillment and logistics customer service.

4.2.1 Outbound logistics

Due to the confidentially held with LG for this thesis, the author has excluded this subchapter for publishment.

4.2.2 Order management

Due to the confidentially held with LG for this thesis, the author has excluded this subchapter for publishment.

4.2.3 Order picking

Due to the confidentially held with LG for this thesis, the author has excluded this subchapter for publishment.

4.2.4 Order fulfillment

Due to the confidentially held with LG for this thesis, the author has excluded this subchapter for publishment.

4.2.5 Logistics customer service

Due to the confidentially held with LG for this thesis, the author has excluded this subchapter for publishment.

5 Data Analysis and Results

Chapter five displays the analysis and the results of the data under study. First, LG outbound logistics activities such as order management, order picking, order fulfillment, and logistics customer service will be examined in section 5.1. Section 5.2 will present the analysis of the order data from LG by the use of excel. Finally, results will be provided to develop a new order delivery strategy for LG from the data under investigation.

5.1 Outbound logistics flow analysis

This subchapter will follow the same layout as in chapter 4. It will start with analyzing how LG outbound logistics activities such as order management, order picking, order fulfillment, and logistics customer service function. This analysis will show what lacks in their current order delivery strategy as well as identify what improvements can be made.

5.1.1 Order management

LG's order management is a long procedure which starts from entering the order into the ERP system until it is released to the warehouse. During this whole order management procedure no form of batching is involved. Therefore, a new order batch approach should be assigned to LG's current ERP system which can assist consolidating most of their orders. This will be ideal since LG is striving towards an order batch approach. A new form of order batch approach will be introduced in the section 5.2.

5.1.2 Order picking

Single-order picking is the main strategy employed by LG. The orders are simply released from the ERP system to the warehouse when the customers require delivery. However, order batch picking has initiated at LG where they have implemented delivery days to their big customers. LG assumes that most potential savings can be made for these big customers but an analysis must take place to verify that. The author has therefore decided to analyze LG order data for big customers and all their other customers to see how to set the specific delivery days. Such an analysis will take place in section 5.2.

5.1.3 Order fulfillment

As mentioned previously, LG is striving towards an order batch approach as their new order fulfillment strategy for their big customers. To implement such a strategy, LG does apply some form of order batching since they have specific delivery days for their big customers. However, from a theoretical perspective this strategy also needs to be efficient and responsive in a supply chain. The current order fulfillment strategy is not fully efficient since no proper research has been performed which demonstrates the potential of having specific delivery days for their big customers. On the other hand, the current strategy cannot be considered as responsive since it does not fully consider the customer buying behaviour nor their complete opinion. Therefore, a way to investigate and build an order fulfillment strategy (ODS) that is both efficient and responsive is through analyzing order data for a specific period of time for LG's customers. Therefore, such a strategy will be built in section 5.2.

5.1.4 Logistics customer service

LG currently thinks that their order fulfillment strategy does not harm their logistics customer service which is based on assumptions. Most theories regarding logistics customer service suggest that the order should follow the "Seven Rs Rule". The "Seven Rs Rule" involves having the *right* product, in the *right* quantity, in the *right* condition, at the *right* place, at the *right* time, for the *right* customer, at the *right* cost (Wisner et al. 2008). Not all these terms are identified at LG since no research has taken place for their current order fulfillment strategy. Furthermore, they do not have a proper follow up with their customers of what they think of their current order fulfillment strategy. This is essential since customer opinion is very important in order to maintain a strong relationship with the customers in a supply chain. Therefore, customer buying behaviour will be analyzed in the next section. A proper follow up with their customers regarding their order fulfillment strategy will be suggested later on in this chapter.

5.2 Data examination and descriptive statistics

To consider the factors of order batching and customer buying behaviour in the new order delivery strategy, the author developed his own form of analysis which was carried in excel. This analysis was performed on LG order data for 2008. Such an analysis provided better insights of how their current order fulfillment strategy is and the ideal state such a strategy could evolve into.

The LG order data was collected from DHL which was analyzed during this study. This occurred by following a series of steps clearly shown in figure 5.1. All the steps mentioned are carried out on excel which was the main statistical and analysis program utilized for this thesis.

Figure 5.1 illustrates the different steps taken in excel to perform the data analysis.

5.2.1 Inspection & cleaning data

The first step deals with inspecting the data. During the inspection phase, a few variables were taken away since they were not required for this study. The variables not associated with this study were weight, receiver id and district. The remaining variables left convenient for this research were delivery date, shipment id, order number, volume, customer name, postal code, and country code. These variables exist in this study for the following reasons:

Delivery date: This variable is required to check the order pattern and sequence which will be described later in this study.

Shipment id: This variable will help sort out the amount of shipments to the customers.

Order number: More than one order can be sent with a single shipment. Therefore, this order number will give an idea of how many orders go under a single shipment.

Volume: This will give an idea of how much quantity is sent under each shipment.

Customer name: The identity of each customer is unique and will let the researcher know which customers to focus on.

Postal code: Transportation costs vary depending on which postal code the shipment is sent. Therefore, postal code will play a vital role from a transportation cost perspective.

Country code: This variable will help distinguish the final country of destination where the shipment will be delivered.

5.2.2 Separating data

The next step in the research was to divide the data into group and categories which will help simplify the analysis in this study. This data from DHL represents all outgoing orders to Nordic countries which include Sweden, Finland, Norway and Denmark. The research was therefore conducted by analyzing each country's data individually. The researcher started off by separating the outbound order data in Microsoft Excel according to the variable "country code" meaning into different countries. The total outbound volume from LG warehouse to their customers was *100,000* cubic meters in year 2008. The total outbound volume is illustrated in graph 5.2.

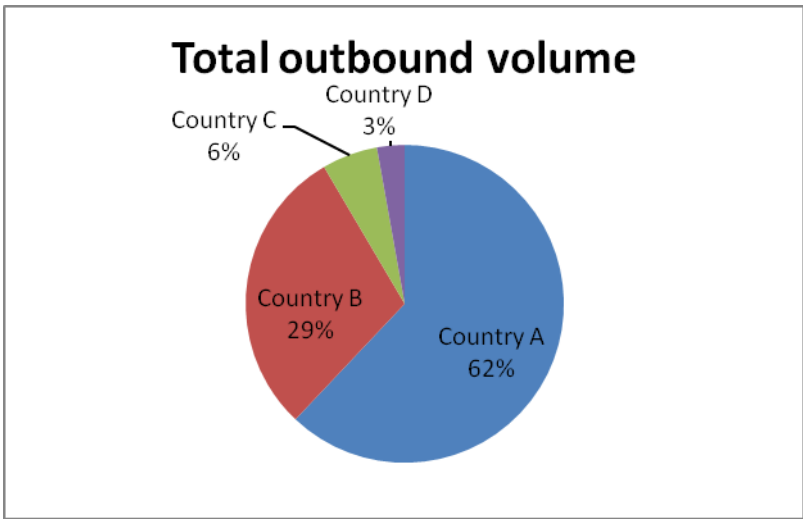


Figure 5.2 represents the amount of volume that is sent to each Nordic country in 2008.

The total outbound quantity for each Nordic country in year 2008 was *55,000* (*Country A*), *20,000* (*Country B*), *10,000* (*Country C*), and *5,000* (*Country C*) cubic meters. Country A in this example stands for Sweden. Additionally, the data from each country was distributed into each country's postal codes (region wise). This was necessary since it demonstrated where most potential customers are situated and what purchasing power they posses. In addition to this, DHL charges LG depending on which postal code the shipment is delivered to. The volume delivered to each postal code in all countries is illustrated on graph 5.3 to 5.6.

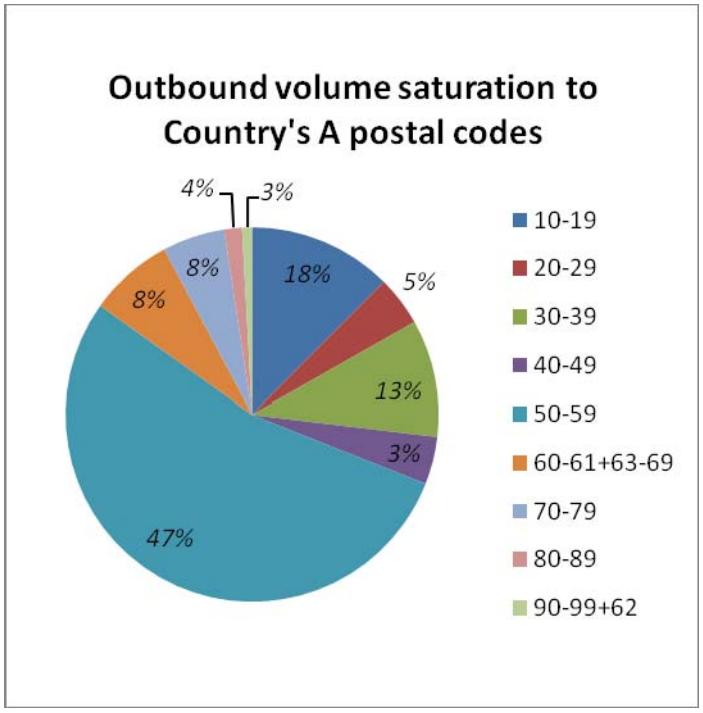


Figure 5.3 represents the volume delivered to all postal codes in country A.

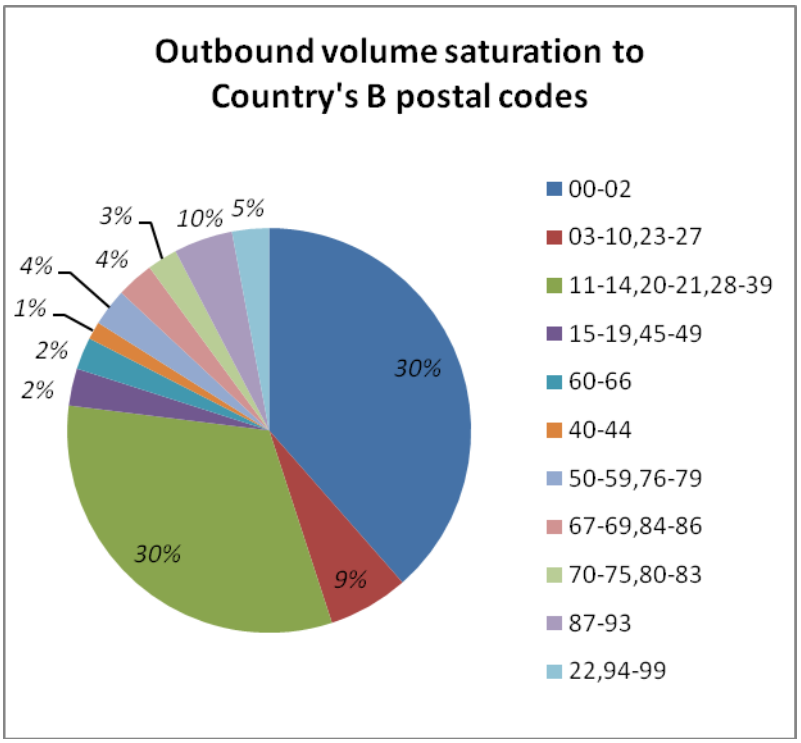


Figure 5.4 represents the volume delivered to all postal codes in country B.

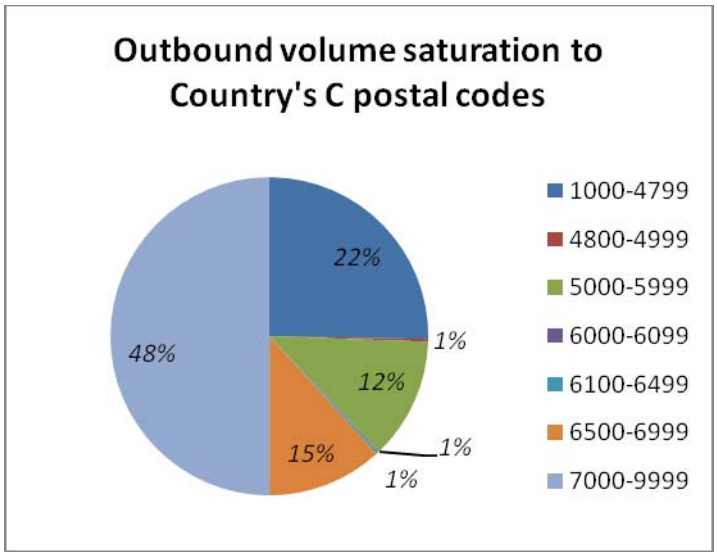


Figure 5.5 represents the volume delivered to all postal codes in country C.

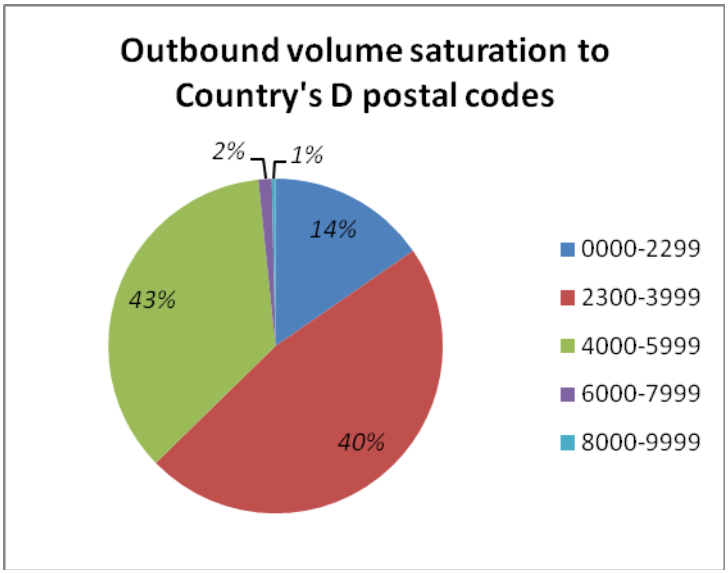


Figure 5.6 represents the volume delivered to all postal codes in country D.

In each of these graphs, there is one postal code that corresponds to at least *40%* of the outbound volume in that country. It is therefore easier to see where the biggest customers are situated and where the most potential savings can be made.

5.2.3 Modeling data

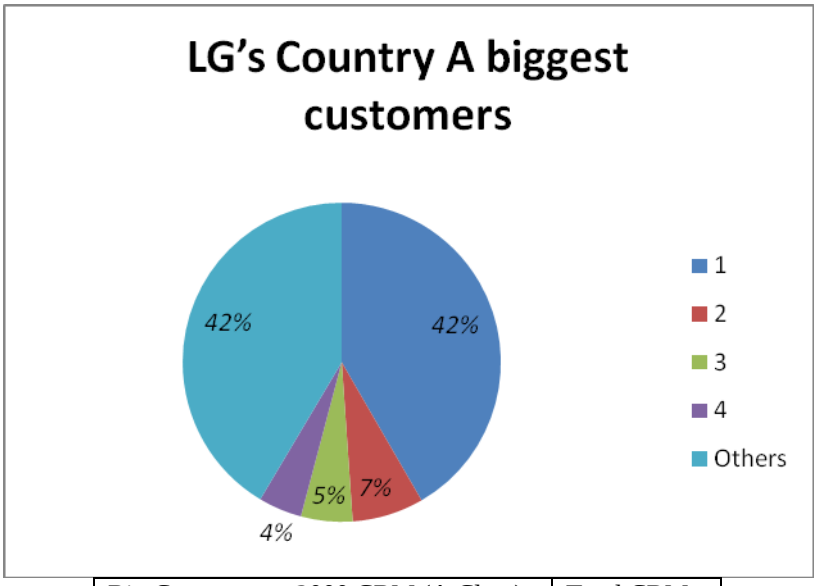
The next step involved modeling the data in various ways. After distributing the data into different countries and postal code, the author wanted to distinguish between big customers and small customers. The author decided therefore to divide customers into different customer classes.

Customer classes

The data was modeled by distributing into three specific customer categories namely small, medium and big class customers. “Big customers” are those which purchase quantity over 2000 cubic meters. “Medium customers” purchase quantity between 400 to 2000 cubic

meters. “Small customers” purchase quantity between 100 to 400 cubic meters. Other customers that purchase below 100 cubic meters were not considered for this thesis since their purchasing power is relatively low.

These customer classes have been examined for all Nordic countries. Graph 5.7 illustrates customer class “Big” in country A.



Big Customers > 2000 CBM (A Class)	Total CBM
Customer 1	*22549*
Customer 2	*3923*
Customer 3	*2823*
Customer 4	*2385*
Other customers	*22443*

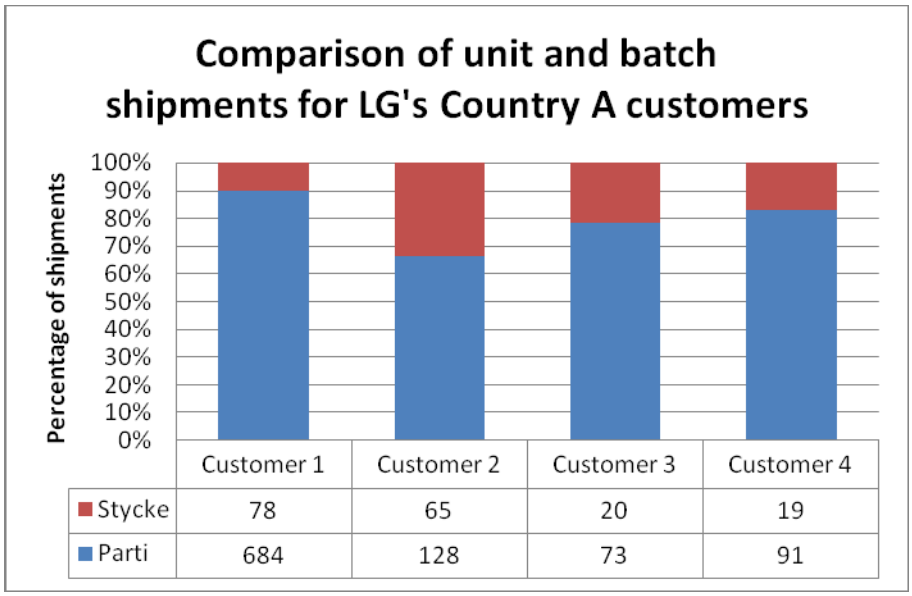
Figure 5.7 illustrates the amount of big customers for LG in country A relative to other customer classes (light blue).

All other customer classes in *Country A*, *Country B*, *Country C*, *Country D* are illustrated in appendix B. The overall pattern is the same that small, medium, and big customers together correspond to at least 75% of the outbound volume from LG’s warehouse. It is also worth mentioning that there are a total of *90* customers that correspond to this outbound volume. LG has over *500* customers registered in their system in 2008. This means that nearly 80% of the outbound volume is transported to 20% of their customers.

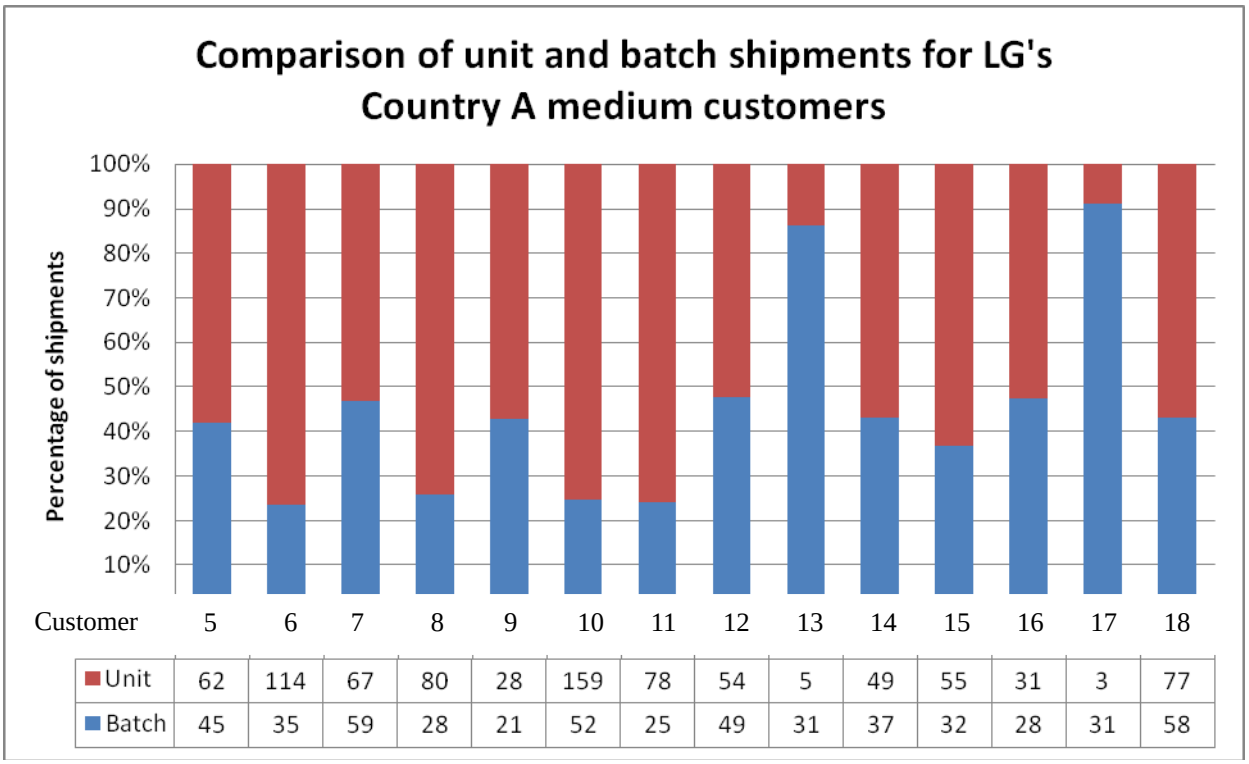
Shipment classes

The next step was to verify the different shipment classes that exist at LG. The company mainly uses two different DHL products to ship their orders to their customers. These shipping products are called unit (stycke) and batch (parti) services. Since LG is striving towards an order batch approach, more batch shipments should leave from the warehouse. This is possible by maximizing the amount of batch shipments and minimizing the amount of unit shipments. The author had therefore decided to analyze the amount of unit and batch shipments sent to each customer class in each country.

According to DHL 2011 (www.dhl.se), the unit shipments must be below 3,57 cubic meters for Sweden. The big shipments on the other hand must be above 3,57 cubic meters. For all other Nordic countries the unit shipments must be below 5 cubic meters respectively the big shipments must be above 5 CBM. The amounts of unit and batch shipments sent to each customer class are illustrated in graph 5.8 to 5.9 for LG's country's A biggest and medium class customers.



Graph 5.8 Comparison of unit and batch shipments for big customers in country A (65-90% batch shipments with an average volume of 25 cubic meters per shipment).



Graph 5.9 Comparison of unit and batch shipments for medium customers in country A (23-80% batch shipments with an average of 8 cubic meters per shipment).

The smallest customers in every country purchase up to 90% unit shipments and therefore it is nearly impossible to encourage these customers to purchase bigger orders. For this reason, small customers have been excluded from this research.

From graph 5.8 to 5.9, you can clearly see how many shipments are unit and batch for big and medium customers in country A. In addition, for each customer class the average volume per shipment is calculated to see how much quantity goes under a single shipment. The same following analysis technique is used for other Nordic countries which is shown in appendix C. The results are similar for other countries and are identical to the shipments pattern above. The analysis clearly shows that roughly *75%* of the shipments sent to big customers are already batches in 2008. Despite this, LG does have specific delivery days only to their biggest customers and this might not be the best customer class to focus on since they already purchase so big volumes in batches. More discussion regarding this matter will be taken up while developing an ODS for LG later on in this chapter.

Transportation costs

The transportation costs for delivering to customers were provided to the author by LG. For country A, these transportation costs in 2008 are illustrated in table 5.10.

CBM	0-0.299	0.3-0.999	1-4.999	5-9.999	10-19.999	20-full truck tariff
Postal Codes						
10-19	700	500	340	250	150	60
20-29	700	500	300	250	150	60
30-39	700	500	300	250	150	60
40-49	700	500	350	250	100	40
50-59	700	500	230	155	60	20
60-61 + 63-69	700	500	300	130	110	60
70-79	700	500	340	200	140	70
80-89	700	500	333	230	150	90
90-99 + 62	700	500	444	350	240	150

Table 5.10 illustrates the transportation cost per cubic meter sent to each postal code.

On table 5.10, transportation costs are shown to each postal code in Country A. You can also notice that larger shipments in terms of volume to each postal code result in lower transportation cost. It is therefore possible to apply an order batch approach which will result in transportation cost savings.

Order pattern and sequence

In able to fulfill logistic customer service demands the author had the possibility to analyze customer buying behavior. This involves checking the pattern of how customers order on a

weekly, monthly, and yearly basis. After analyzing the order pattern and their sequence the author could conclude that customers order variation is time dependant. In other words, the author could determine when the order frequency is on its maximum in a day of a week. By performing such an analysis, the author can set delivery days on the day during the week when the customer orders the most. For LG's current order fulfillment strategy the author examined their biggest customer order frequency which showed that the delivery days should be set according to table 5.11.

Customer	Set Delivery Days	Percentage of shipments minimized
Customer 3	Monday & Thursday	47%
Customer 2	Monday & Wednesday	41%
Customer 4	Monday & Wednesday	28%
Customer 17	Tuesday & Thursday	51%
Customer 37	Monday & Wednesday	49%
Customer 47	Monday & Thursday	40%
Customer 33	Tuesday & Thursday	39%
Customer 58	Tuesday & Thursday	42%
Customer 64	Monday & Thursday	45%

Table 5.11 illustrates the percentage of shipments that can be minimized by setting these delivery days for LG's biggest customers.

Some of LG's biggest customers that have specific delivery days have to be excluded from this research due to two main reasons. First, some customers are too small in year 2008 and the results will lead to statistics which might be misleading and unreliable. Second, some are new customers which do not exist in the order data that has been collected from LG. However, you can clearly see the specific delivery days generated for all other big customers on table 5.11 by excel.

If LG wishes to implement the delivery days suggested by the author, this would result in specific amount of shipments that will be minimized every year. If LG would had these delivery days in 2008, they would had have *900* (*45%*) less shipments delivered to their big customers.

5.2.4 ODS development

From the two data analyses, the author had obtained better understanding of LG current order fulfillment strategy, order pattern, order sequence, customer classes, shipment classes, transportation costs, and other relevant shipment statistics. All these factors are illustrated in figure 5.12.

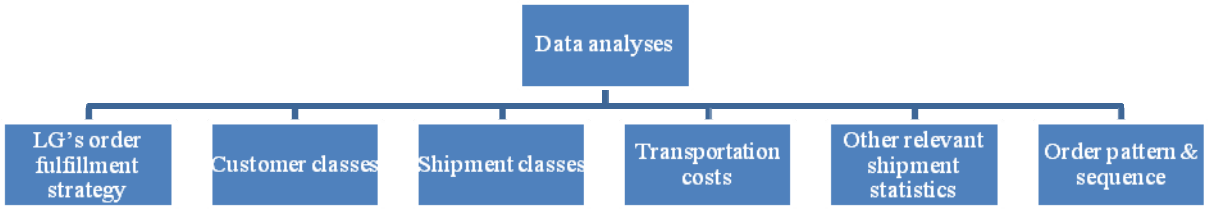


Figure 5.12 represents what has been analyzed from the data that has been collected.

From this understanding, the author was able to build a new order fulfillment strategy that is ODS. This would help answer research question one which is as follows:

RQ1: How should an ODS be modeled and managed in order to batch orders and fulfill logistics customer service requirements?

The objective of this research question was to develop an ODS which balances out logistics customer service and order batching. In order to achieve such an objective, the author followed a series of steps which should help develop an order delivery strategy. These steps are:

Step 1. Optimal order batch solution.
Step 2. Order pattern and sequence analysis.
Step 3. Customer class selection.
Step 4. Establishment of an ODS.

Step 1. Optimal order batch solution

Order management and order picking in LG are striving towards an order batch approach. To perform such an optimal order batch solution, all small shipments for all customer classes were converted to big shipments. This was possible by batching orders until they reached the big shipment limit (at least 3,57 cubic meters for Swedish customers and 5 cubic meters for other Nordic customers). By applying such a method, transportation cost savings could be calculated since more volume was sent under a single shipment. Such a method minimized the transportation costs for all customers by *800,000* kr in year 2008. This also helped determined how many shipments can be batched from the warehouse to their customers. More specifically big and medium customers in country A and country B had the most potential savings in terms of shipments and transportation costs which could be minimized. This is illustrated in table 5.13 and 5.14. Country C and Country D have not been considered to be taken up in a table since they corresponded to the least savings.

Country A	Average volume per shipment (CBM)	Amount of shipments that can be batched (Percentage)	Transportation costs minimized (KR)	Customers
Big customers	*30.0*	*26*	*40,000*	4
Medium customers	*7.2*	*65*	*150,871*	11
Small customers	*3.6*	*54*	*70,599*	19

Table 5.13 illustrates the amount of shipments that can be batched and the transportation costs that can be minimized in country A. It also includes the average amount of volume per shipment and the amount of customers in each customer class.

Country B	Average volume per shipment (CBM)	Amount of shipments that can be batched (Percentage)	Transportation costs minimized (KR)	Customers
Big customers	*30.0*	*26*	*30918*	1
Medium customers	*20.0*	*37*	*100261*	8
Small customers	*4.4*	*43*	*400161*	21

Table 5.14 illustrates the amount of shipments that can be batched and the transportation costs that can be minimized in country B. It also includes the average amount of volume per shipment and the amount of customers in each customer class.

Results from the order batch approach implicate that most savings can be made for medium customers in Sweden (*Country A*). This is because *65 %* of the shipments can be batched and a total of *150,871* kr in transportation cost savings can be made. On the other hand, small customers in every country also result in substantial amount of transportation cost savings and shipments that can be minimized. You can also clearly see that big customers correspond to the least amount of savings in both aspects of transportation and shipments.

Step 2. Order pattern and sequence analysis

The next step involves analyzing the order pattern and sequence for all these customers in table 5.14 and 5.15 since logistics customer service perspective should be considered. Such an analysis took place by first checking the order frequency for all LG's customers. The order frequency helped determine if each customer ordered heavily on a daily, weekly or monthly basis. The overall order frequency pattern for big, medium, and small customers is identical for all countries which is illustrated in table 5.15.

Customer class	Frequency
Big	3-4 shipments per week
Medium	2-3 shipments per week
Small	0-2 shipments per week

Table 5.15 illustrates the shipment frequency to each customer class.

From the order frequency analysis you can clearly see that small customers do not have the possibility to order more than twice a week. There also exists a gap between the time an order arrives until another order is placed. For instance, sometimes no orders are placed by small customers for 1 to 2 weeks. The author has therefore concluded that small customers order seldomly and assigning delivery days for those customers will not be feasible. However, both medium and big customers in all Nordic countries do order constantly throughout the year and more than two shipments are sent to these customers per week. Therefore, there is a possibility to set delivery days for these customers. For big customers, the delivery days that should be set have been discussed earlier on in this chapter. However, for medium customers the author examined which days during the week, the customer purchased most of company's order. The author came to the conclusion that medium customers in Sweden order heavily on Monday, Wednesday and Thursday as illustrated in figure 5.16. Furthermore, medium customers in Sweden resulted in the most shipments that can be minimized. Therefore, the delivery days were set on Monday and Wednesday for medium customers in Sweden which resulted in *35%* less shipments from LG's warehouse to these customers.

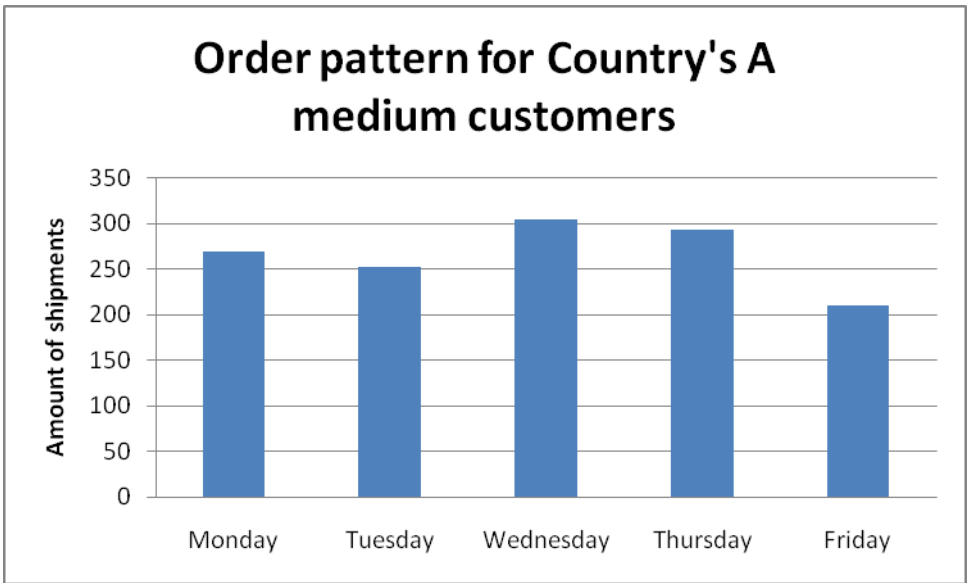


Figure 5.16 represents the order pattern for medium customers in Sweden (Country A).

Step 3. Customer class selection

The author needed to know which customer class in which country to focus on specifically. The optimal order batch method showed that the most potential savings are for medium customers in Sweden. The order pattern and sequence analysis verified the same result by showing that *35%* of the shipments can be minimized for the same customer. LG decided that they require the author to pick one customer class where ODS development can be tested. For this reason, the author picked medium customer class in Sweden where ODS could be applicable.

Step 4. Establishment of an ODS

From following the first three steps, the author was able to build a new order delivery strategy. First, the optimal order batch solution showed where the most potential savings can be made. Second, the customer's order pattern and buying behavior was analyzed which helped set delivery days and thereby calculate the shipments that can be minimized. Finally, medium customer class in Sweden was selected and the author proposed two specific

delivery days for this customer class which is Monday and Thursday. In this way, the orders were able to automatically batch until the delivery day arrives and then released. More about the specific results by following all these steps will be discussed in the next section.

5.2.5 Data results

While developing an ODS, LG's current order fulfillment strategy was analyzed. According to the author's own form of analysis which was performed, the author suggested that the delivery days should be set as illustrated in table 5.11 for LG's biggest customers. If these delivery days were followed, this would result in *900 (45%)* less shipments from their warehouse to their biggest customers. However, *75%* of the shipments that leave from the warehouse to these big customers were already batch shipments. Therefore, the author further analyzed all other customer classes in all countries. As a result of this analyses, the ODS development resulted in *500* (*35%*) less shipments and *150,871* kr in transportation cost savings for medium customer class in Sweden. If the medium customer class was selected, this could also result up to *65%* more batch shipment from their warehouse to these customers.

There are many positive implications of implementing LG's current order fulfillment strategy and the new ODS that has been suggested by the author. However, there can also be negative implications for implementing any of the order fulfillment strategies. The author assumes that there is a possibility that the order cycle time and stock levels at the warehouse can increase since the order would not be released until the specific delivery day. Therefore, the author suggests that all customers who have specific delivery days can still order on any other day. This would be possible because a discount would be provided if the customers order on the specific delivery day. This discount can be calculated by the transportation cost savings that can be made. In the case of the new ODS, medium class customers will get *150 kr* per shipment in discount if they are willing to wait until the specific delivery day. This is one of the strategies suggested by the author which can pursue customers to follow the specific delivery days and the new order delivery strategy. On the other hand there are more positive and negative implications which will be discussed in the next chapter.

6 Conclusions and Implications

In this chapter, conclusions will be provided illustrating what consequences ODS can have on LG's supply chain performance. Furthermore, LG's current order fulfillment strategy will be compared to the new ODS that has been developed in this thesis. Finally implications will be extrapolated from findings to practitioners and academic researchers as well as for LG in relation to implementing an ODS. This will also include study limitations and future research avenues.

6.1 Consequences of an ODS

ODS was fully developed in the last chapter. However, it is more interesting to see what are the consequences of an ODS on LG's supply chain performance areas in outbound logistics such as order management, order picking and logistics customer service. This will help provide the answer to research question two which is:

RQ2: What are the consequences of an ODS implementation on LG's supply chain performance?

Order management

Maintaining orders is hard and time-consuming process. This process will be more efficient since the orders will not be released to the warehouse on a daily basis. Instead, by setting delivery days for medium customers in country A, the orders will automatically batch up. The staff at LG will clearly know when to release each order's request. As a result, the author assumes that all work related to order management should decrease and coordination among their orders should improve. Such an improvement is already noticeable at LG with their current order fulfillment strategy. The order team, outbound team, DHL and LG's customer are able to plan ahead and coordinate their orders better.

Order picking

Order preparation in an order picking process will improve since the employees know which day to release the order to the warehouse. As stated by Koster (2006), order picking is a costly procedure which is estimated to be as much as 55% of the total warehouse cost. Since orders have been batched up, less number of shipments will go from the warehouse to the customers. In this way, the warehouse will be able to plan their man power better, pick several orders at a time and thereby increase their order picking efficiency.

Logistics customer service

For logistics customer service to improve, one must follow the 7 Rs rule which involves having the *right* product, in the *right* quantity, in the *right* condition, at the *right* place, at the *right* time, for the *right* customer, at the *right* cost. The ODS will affect these service areas which are having the right quantity, at the right place, at the right time, for the right customer, at the right cost. Through this development of a new order delivery strategy the author believes that most of these service requirements should be fulfilled. However, a more thorough research can be performed in the future which can analyze these parameters for an ODS.

Similar to their current order fulfillment strategy, customer will know exactly when to expect their delivery from the company. However, LG should have a proper follow up with their customers of their order fulfillment strategy and ODS. If LG follows this strategy up successfully, they will be able to build stronger relationships with the customers in the supply chain. Therefore, the author recommends LG to follow their order delivery strategy up every 6 months so they can receive a proper feedback from their customers.

Logistics costs

LG will be able to decrease its overall logistics cost especially in transportation. In addition, the author does assume that cost savings will be made in the areas of order management and order picking.

Best case & worst case scenario

Two scenarios were examined in order to see the consequences of an ODS on LG's supply chain performance. In the best case scenario, the author concluded from the data analysis that ODS could improve order management, order picking, logistics customer service and thereby reduce its overall logistics costs for LG. This is illustrated in table 6.1.

Supply chain performance areas	Overall impact
Order management	Positive
Order picking	Positive
Logistics customer service	Positive
Logistics costs	Positive

Table 6.1 This table Illustrates the best case scenario for implementing an ODS

On the other hand there can be a worst case scenario if ODS is not implemented correctly. In this case, the customers are only limited to receiving deliveries on the specific delivery days. Such a scenario is illustrated in table 6.2. However, the author has already found a solution to this problem by encouraging the customers to follow the delivery days by providing them a discount. The customer has the possibility to order on any other day during the week while not receiving the discount. It is therefore more likely that a best scenario will occur.

Supply chain performance areas	Overall impact
Order management	Positive
Order picking	Positive
Logistics costs	Positive
Logistics customer service	Negative
Order cycle time	Negative
Inventory holdings	Negative

Table 6.2 This table Illustrates the worst case scenario for implementing an ODS

From the worst case scenario in table 6.2, the most important factor to realize is that the customer will not be satisfied because of the longer delivery days. The order cycle time will increase and thereby also the inventory holdings at the warehouse.

6.2 Old & new order fulfillment strategy

Old order fulfillment strategy

The traditional order fulfillment strategy at LG has not been analyzed before. Through this ODS development the author was able to set delivery days most suitable for their big customers. LG saves *900* (*45%*) shipments however *75%* of these shipments are already batches. Furthermore, the logistics team at LG, LG's customers and DHL can plan and coordinate their orders better. For this reason, the author suggests that LG keeps their current order fulfillment strategy since it is the most beneficial. However, this strategy can be complemented by the new order fulfillment strategy (ODS) which will be now discussed.

New order fulfillment strategy

The objective of this research according to research question one was to build a new order fulfillment strategy that strikes an appropriate balance between order batching and logistics customer service. By conducting this research, the author has developed such a strategy based on the steps carried out in Chapter 5.2.4. The first step was to obtain an optimal order batch solution. Thereafter, customer order pattern and sequences was analysed explaining to the author where most shipments and transportation costs can be minimized. As a result, this strategy suggested that LG should set specific delivery days for their Swedish medium customers on Monday and Wednesday since it resulted in *500* (*35%*) less shipments and *150,871* kr in transportation cost savings. Furthermore, this could also result in *65%* more batch shipments for medium customers if they chose to agree upon the given delivery days. Moreover, similar to the traditional LG's order fulfillment strategy it will help improve order management, order picking and logistics customer service at LG.

An ODS has been developed which is both efficient and responsive in a supply chain for LG. ODS is efficient because an order batch approach has been applied. On the contrast, the strategy is also responsive since it does take into concern the customer order buying behavior and therefore customer service requirements. Due to these reasons, a proper ODS has been

developed which strikes an appropriate balance between order batching and logistics customer service for LG. Furthermore, such an ODS can be applied if companies need to come up with specific delivery days for their customers. With such a strategy, most constituencies involved in an order delivery strategy will be able to benefit from the right type of information in the supply chain.

6.3 ODS implementation

From the worst and best case scenario in section 6.1, the author is able to determine the significance of applicability of an ODS. The two major reasons for implementing an ODS depend on the fact that it does minimize transportation costs and the ability to batch orders together according to customer demands. Furthermore, ODS helps companies to come up with specific delivery days if they wish to improve their order management, order picking and logistics customer service. There are, however, negative implications if ODS is not implemented correctly. It is therefore very hard to say if ODS is implementable for all companies since performing an ODS analysis on different companies can either result in more positive or negative results.

In LG's case, however, there is a possibility for them to implement such a strategy. With their current order fulfillment strategy, the author suggest that the new ODS development should be fully tested on medium customers in Sweden. This can be accomplished by following these steps

1) The company should integrate towards medium customers in Sweden by providing them with delivery days on Monday and Wednesday.
2) Check the logistics costs that have been affected in areas of transportation, order picking, and order management.
3) Check with the customer if they are satisfied with the delivery days and with the overall logistics customer service.
4) Permanently implement ODS, if the customer is satisfied and the potential logistics cost savings are positive.

The order team or the outbound team can take the responsibility to implement ODS. Furthermore, LG's ERP system can be utilized to automatically set delivery days for their customers which can hold the orders until the specific delivery day arrives and then release them.

The author suggests that LG should implement ODS since there is a higher probability that a best case scenario will occur. For such a scenario, an ODS implementation will provide logistics cost savings, less frequent deliveries and improve order picking, order management and logistics customer service. Due to these reasons, the overall supply chain performance at LG should improve.

6.4 Future research

Future research can deal with further developing ODS. This can involve testing ODS on different companies and measure its output. This thesis was limited to company's perspective but in order to really understand ODS, future research should include conducting interviews with company's customers. ODS is a new concept and therefore this research is limited to logistics related areas that can affect an ODS.

Finally, according to the author the new order delivery strategy which has been developed will serve importance in logistics for three fundamental reasons:

- Global competition is exerting pressure to reduce costs, which contributes to the growing importance of an ODS.
- Firms that wish to implement order delivery days for their customers have the possibility to do so through ODS.
- A top priority in firms is to improve supply chain performance areas which is possible through implementing an ODS.

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Appendix A. Interview Questions

The questions below investigate how part of the outbound logistics & order department in LG Electronics Nordic AB functions and operates in Akalla, Sweden. These questions are divided into four separate parts namely outbound logistics, delivery system, transportation cost, and order management. In this interview, there are a total of 12 questions. Please answer each question in each section at the interview as descriptive as possible.

Outbound logistics
Q1. What are some of the main tasks an outbound logistics coordinator deals with on a daily basis?

Q2. Describe the steps from when an order is entered into the GERP system until it is released to the warehouse?

Q3. Which type of order release strategy does LG apply to release orders to their warehouse?

Q4. Are the orders set for pick every day? If so, what is the last order entry time?

Delivery system
Q5. Does LG have specific delivery days to any customers? If so, please provide their customer name and their details.

Q6. How did LG decide specific delivery days to these customers? What is this delivery system technique based on?

Q7. What form of impact has these delivery days resulted in for LG? Please mention all logistics and other related aspects (such as customer service, lead time etc) that have been influenced because of this implementation.

Q8. Does LG Electronics Nordic AB follow up with their customers on what they think of their delivery day's strategy?

Transportation cost
Q9. How does LG Electronics Nordic AB charge their customers for transportation costs? What is the general concept behind it?

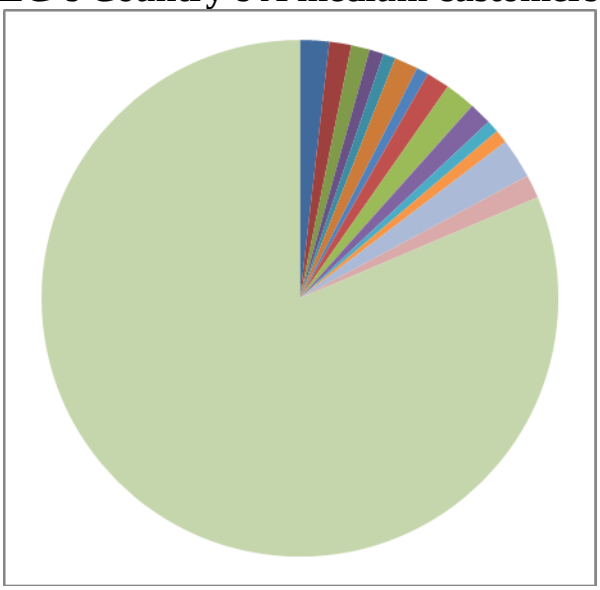
Order management
Q10. How does LG Electronics Nordic AB handle and deal with incoming orders? In which way does the company plan, prepare, prioritize, and select their orders.

Q11. Does LG Electronics Nordic AB have any form of written logistics customer service policy?

Q12. Does the company deal with any order size constraints for any customers? What do you think about the idea of implementing order size constraints to LG Electronics Nordic AB customers?

Appendix B. Customer classes in Nordic countries

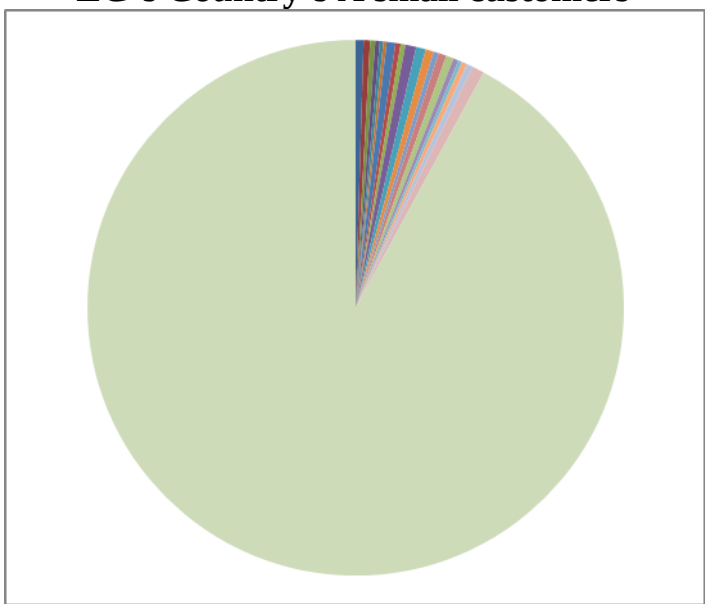
LG's Country's A medium customers



This figure shows the amount of medium class customers in different colors relative to other classes (light green) in country A (10,000 CBM = 22% of country's A total outbound volume).

Midsize Customers 400 < x < 2000 cubic meters	Volume
Customer 5	980
Customer 6	745
Customer 7	629
Customer 8	481
Customer 9	417
Customer 10	803
Customer 11	408
Customer 12	761
Customer 13	420
Customer 14	453
Customer 15	1353
Others	44055

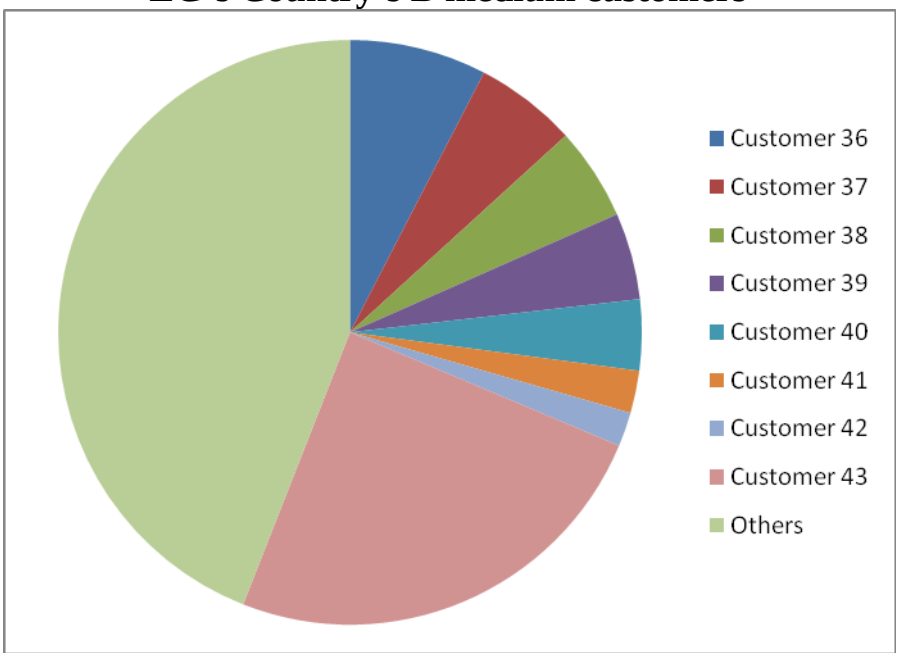
LG's Country's A small customers



This figure shows the amount of small class customers relative to other classes (light green) in country A (5000 CBM= 10% of country's A total outbound volume).

Small Customers 100 < x < 400 cubic meters	Volume
Customer 16	253
Customer 17	213
Customer 18	165
Customer 19	146
Customer 20	117
Customer 21	105
Customer 22	288
Customer 23	166
Customer 24	154
Customer 25	356
Customer 26	314
Customer 27	263
Customer 28	171
Customer 29	259
Customer 30	245
Customer 31	171
Customer 32	127
Customer 33	176
Customer 34	204
Customer 35	393
Others	49836

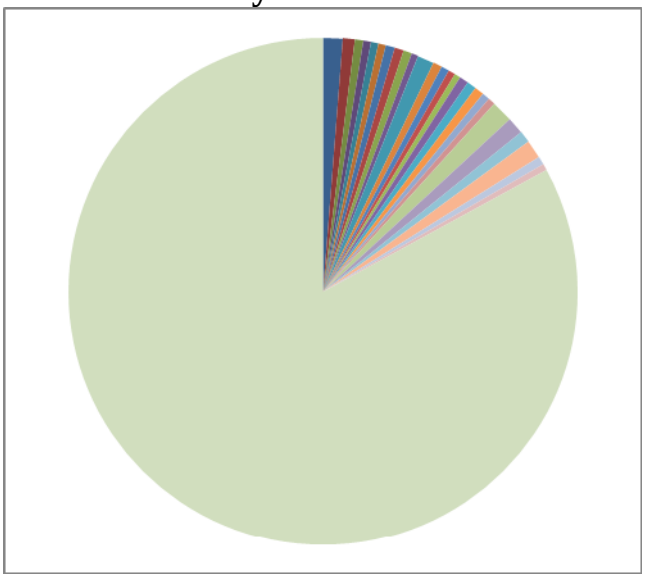
LG's Country's B medium customers



This figure shows the amount of medium class customers in country B.

Midsize Customers 400 < x < 2000 cubic meters	Volume
Customer 36	1949
Customer 37	1453
Customer 38	1323
Customer 39	1236
Customer 40	1012
Customer 41	603
Customer 42	487
Customer 43	6329
Others	11328

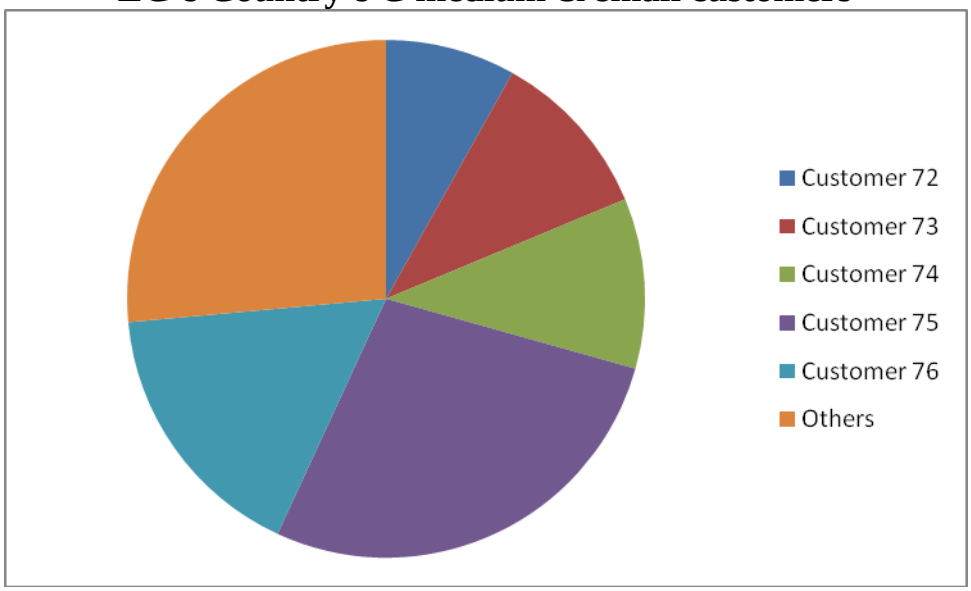
LG's Country's B small customers



This figure shows the amount of small class customers relative to other classes (light green) in country B.

Small Customers 100 < x < 400 cubic meters	Volume
Customer 44	319
Customer 45	195
Customer 46	137
Customer 47	127
Customer 48	122
Customer 49	121
Customer 50	150
Customer 51	149
Customer 52	140
Customer 53	109
Customer 54	270
Customer 55	148
Customer 56	128
Customer 57	114
Customer 58	100
Customer 59	148
Customer 60	153
Customer 61	152
Customer 62	125
Customer 63	117
Customer 64	354
Customer 65	276
Customer 66	192
Customer 67	301
Customer 68	134
Customer 69	106

LG's Country's C medium & small customers

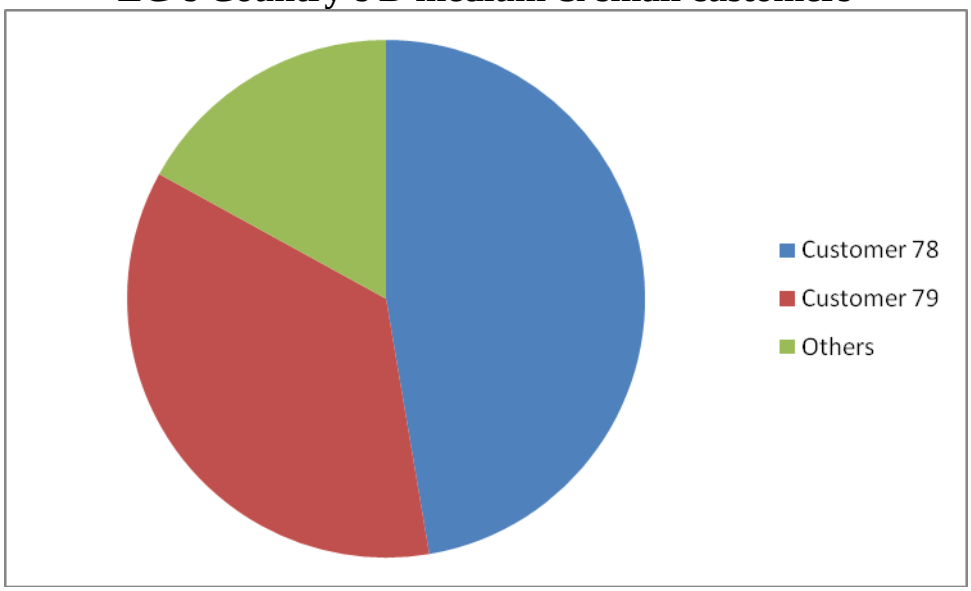


This figure shows the amount of medium class customers in country C.

Medium Customers 400 < x < 2000 cubic meters	Volume
Customer 70	400
Customer 71	523
Customer 72	525
Customer 73	1 359
Customer 74	823
Others	1 305

Small Customers 100 < x < 400	Volume
Customer 75	238

LG's Country's D medium & small customers



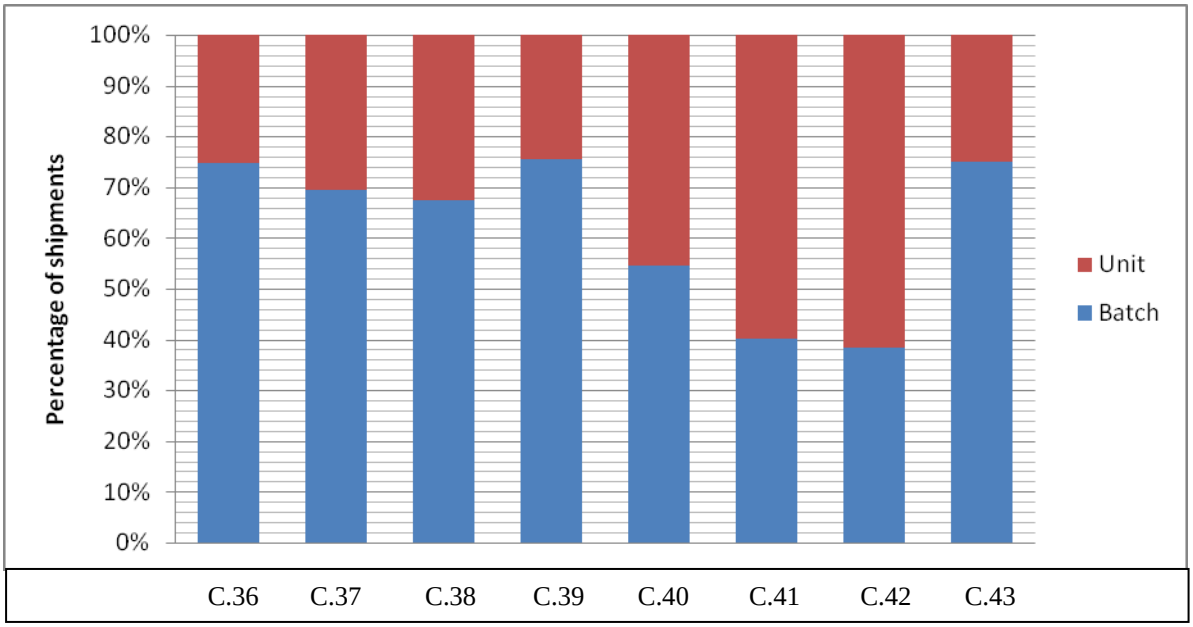
This figure shows the amount of medium class customers in country D.

Medium Customers 400 < x < 2000	Volume
Customer 76	735
Customer 77	554
Others	264

Small Customers 100 < x < 400	Volume
Customer 78	160
Customer 79	119
Customer 80	115
Customer 81	86
Customer 82	124
Customer 83	118

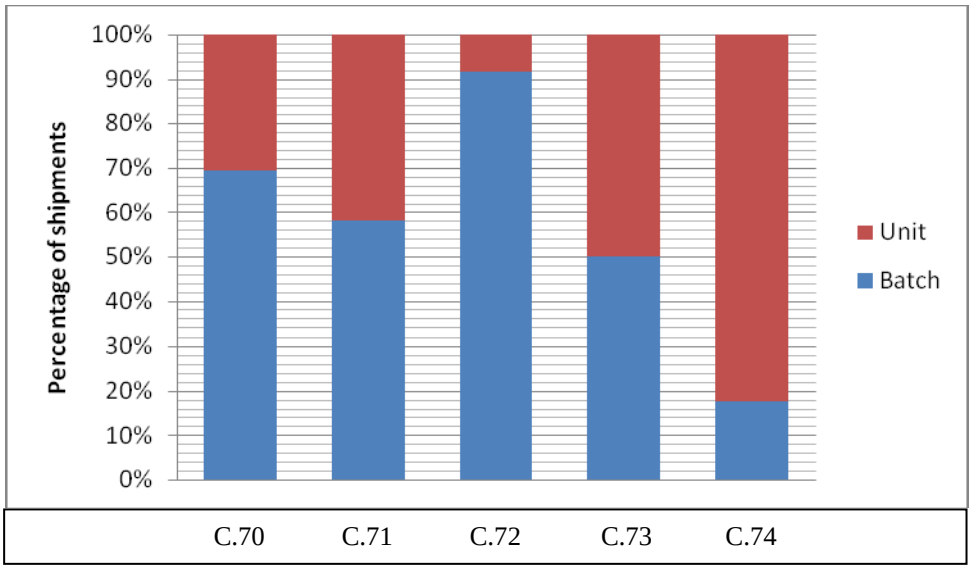
Appendix C. Shipment classes in Nordic countries

Comparison of unit and batch shipments for Country's B medium customers



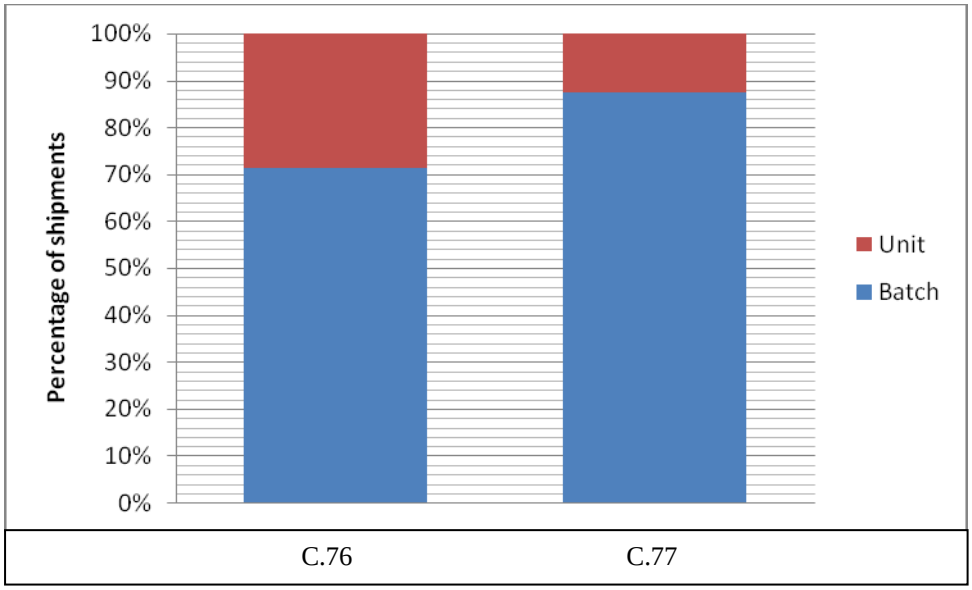
The graph shows the comparison of unit and batch shipments for medium customers in country B (C= Customer number).

Comparison of unit and batch shipments for Country's C medium customers



The graph shows the comparison of unit and batch shipments for medium customers in country C (C=Customer number).

Comparison of unit and batch shipments for Country's D medium customers



The graph shows the comparison of unit and batch shipments for medium customers in country D (C=Customer number).