UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

MASTER'S THESIS

DESIGN OF AN APPROPRIATE MODEL FOR LOGISTICS AND INVENTORY MANAGEMENT IN A DISTRIBUTION COMPANY

Ljubljana, September 2016 STAŠA LACKOVIĆ

AUTHORSHIP STATEMENT

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INTRODUCTION

In the environment of constant changes in all areas of life and human endeavour, from political, economic, demographic, technological and the like, all business models (hereinafter: BMs) must be flexible and innovative enough in order to provide a competitive advantage as a key factor of further development and growth. Enterprises must be very innovative in the adoption of strategic decisions and use the best BMs, frameworks and concepts in order to focus on their core activity, and combinations of concepts are needed to achieve an improvement in their performance.

Currently, the small and medium-sized enterprises (hereinafter: SMEs) are passing through a very challenging period in their evolution, especially in traditional industries like distribution. Small enterprises must consider and implement BMs which were in past exclusively part of strategies of large enterprises (hereinafter: LEs). They must be fast and flexible and implement some of the innovative concepts and market solutions, in order to reach a competitive advantage.

A start-up distribution enterprise for instance must make some strategic decisions which include the design of a supply chain (hereinafter: SC) strategy. A good SC design, planning and operation is an issue of strategic importance for every enterprise, and in this paper I shall focus on the design and planning of a SC from the perspective of SMEs in a fast-moving consumer good (hereinafter: FMCG) distribution environment. Products which have a high turnover, and relatively low cost are known as FMCG.

In order to remain competitive, small enterprises must provide superior quality goods at the lowest prices possible. This imperative to minimize product costs makes effective supply chain management (hereinafter: SCM) vital, and this represents an exclusive area of responsibility of the owners-managers. A SC includes all the parties involved, directly or indirectly, in fulfilling a customer request. It is a dynamic activity which involves a constant flow of information, products and funds between the different players, among other the distributor/wholesaler. The objective of every SCM is to maximize the overall value generated by the business activity. It implies identifying processes that increase costs without increasing the value of the final product. Such processes should be eliminated wherever possible.

There has been a massive surge of interest in SCM in the business community, due to its innovative approach and the competitive advantage which it offers. Until now, LEs have recognized the benefits of SCM, but SMEs, however, are lagging behind in appreciating the benefits of an integrated SCM for better quality services, cost reduction and efficiency. A successful SCM depends on a number of distinct managerial decisions, which, according to are split up into 3 different phases SC design, planning and operation.

Distribution, in its classical meaning, includes all activities responsible for the transfer of material and/or economic power over tangible and/or intangible goods from one enterprise to another. Distribution systems can be divided into an acquisition distribution system, and a logistic system. The acquisition distribution system management includes the management of distribution routes or channels. On the other hand, the logistic distribution system implies a bridging of space and time by transportation and storage, as well as order processing and shipment.

Logistics is a cross-functional activity that extends beyond the boundaries of the enterprise into the SC. Here, it assumes the complexities of synchronizing the movement of materials and information between many business entities. The surfacing of logistics depended, therefore, on the development of a cross-functional organization model, and on the perception of the need to integrate business processes within the supply network. As a major economic development, the tools and concepts that enable the integration of the SC are starting to work well for the enterprises. A competitive advantage is gained from responding to end-customers better than the competition. In this response, logistics plays a vital role.

SC technology has remained static, outsourcing has caused SC business processes to undergo a dramatic transformation. Nearly everything in a SC can be outsourced - from sales, contract suppliers, co-packers, to logistics, and etc. In its very nature, this increased specialization is a good thing, and up till now has resulted, by and large, in lower prices and more favourable conditions for the end consumer.

What SCs need is a technology that allows them to capture the lower risk and costs of outsourcing without sacrificing visibility and control; where 20th century SCs were vertically integrated, 21st century SCs should become virtually integrated. Virtual integration requires a technology that coordinates and connects all the different SC functions in real time. The only technology that can support virtual integration is a many-to-many network platform.

The main motive for choosing and researching the subject of this paper has grown from the personal drive to connect latest research on SC design, with special focus on logistics and distribution models with practice, and designing and improving the model of observed enterprise, which is at the moment a micro enterprise start-up.

The goal is to create a paper which could be easily applicable for other start-ups in distribution industry, which are of the similar size. Based on this paper it should be understandable that a goods SC design is of the strategic importance for the enterprise, that SCM could be a great competitive advantage but also an important foundation for a long term success of the same.

The purpose of this master's thesis is to design an appropriate logistic model for a distribution enterprise with a focus on logistics and inventory management based on available theory and best practice models applied by SMEs in the area of distribution, with the implementation of the SCM.

The main objectives of this research are proposals and decisions about the most appropriate logistics model for a distribution SME which includes decisions on:

- configuration of a SC (location of warehousing, transportation models, enterprise resource planning (hereinafter: ERP);
- logistics management (logistics outsourcing or insourcing, advantages and risks, third party logistics providers (hereinafter: 3PL), optimising logistics costs);
- inventory management (inventory policies, challenges, inventory models and costs);
- research and development of all mentioned models that are applicable for micro-enterprises and SMEs;
- analysis of the current situation and quantitative and qualitative research to develop a most appropriate logistics and inventory model.

The challenge of managing in a modern enterprise is to achieve and sustain the right mix of employees, technology and know-how within the enterprise. To do this, owners-managers must first be sure that they have determined their business goals and set out workable strategies to achieve them. The next step is to develop the appropriate organizational structure with the best mix of real and virtual elements for meeting that goal. Finally, they must invest into the right technology to enable the creation of the tangible and/or virtual space as a focus of integration of all of the enterprise's activities.

The first, theoretical part of this work will be based on analyses and syntheses of definitions and interpretations of the terms associated with SCM, SMEs, logistics and inventory management as they appear in domestic and international literature. Secondary data will be used.

In the second part, which is practical, qualitative and quantitative analyses of a current system will be done in order to make proposals for the enterprise and conclusions for the master's thesis. Descriptive methods will be used to describe the logistics model employed and to make a cross-section of the enterprise based on author's experience and available enterprise data. Deductive analyses of the case will be given in order to associate practical examples with theoretical concepts. Primary and secondary data will be used.

In the practical part of the work comparative techniques will be used, such as benchmarking, and finally, in combination with inductive analyses I will make conclusions and give proposals to the analysed enterprise.

1 SUPPLY CHAIN MANAGEMENT IN SMALL AND MEDIUM-SIZED ENTERPRISES

1.1 Definition of Small and Medium-Sized Enterprises

The importance of the SMEs in Croatian economy can be seen in the fact that they contributed 99.7% of the 101,191 industrial, commercial and service provider enterprises, numbered 49.9% of enterprise employees and had 33.8% of total national income (CEPOR, 2014). Since they represent most of the enterprises within the Croatian economy and employ a significant part of the workforce, SMEs represent a frequently researched area. The concept of SMEs defined by various enterprise size indicators (turnover/sales revenue, investment, capitalisation) is frequently used in economy.

The European Union generally applies the definition of SMEs provided by the Commission's Recommendation concerning the definition of micro enterprises and SMEs (notified under document No. 1422, 2003). Criteria for classification of entities in the SMEs sector in Croatia are defined by the Accounting Act (Official Gazette, NN 109/2007, 54/2013) and the Small Business Development Promotion Act (Official Gazette, NN 29/2002, 63/2007, 53/2012, 56/2013).

According to the Small Business Development Promotion Act, the SMEs sector consists of physical and legal entities that independently and permanently perform allowed activities with the purpose of making profit. Physical and legal entities that are part of the SMEs sector must satisfy the following three conditions:

- average annual number of employees less than 250;
- independence in business (meaning that other physical or legal entities individually or jointly possess no more than 25% of share in ownership or decision rights in the SME entity);
- total annual revenue of up to 50,000,000.00 EUR or balance sum if they are profit tax payers, i.e. long-term assets equivalent of up to 43,000,000.00 EUR if they are income tax payers.

According to the recommendation of EU, and in accordance with the Croatian Accounting Act the enterprises presented in Table 1 shall be regarded as SMEs.

Table 1. Classification of Small and Medium-Sized Enterprises in Croatia

	Average Number of Employees	**Annual Revenue (HRK)**	**Total Assets (HRK)**
Small enterprise	50	65,000,000.00	32,500,000.00
Medium enterprise	250	260,000,000.00	130,000,000.00
Large enterprise	satisfy two conditions from the definition of medium entrepreneurs		

Source: Zakon o računovodstvu [*Accounting Act*]. no. 109/2007, article 3.

According to Wymenga, Spanikova, Barker, Konings and Canton (2012) it could be noticed that SMEs make 99.79% of all enterprises in EU, and employ majority of the workforce. The numbers are similar also in Croatian economy, though Croatia still still offers a lot of space for development. With the further development of micro- and SMEs, they are bound to make an impact on a general growth of economy and employ a higher share of the workforce, thus reaching the EU levels. There are many EU projects which promote the development of SMEs, which Croatian economy should exploit. In Table 2 below number of all enterprises and their ratio in EU is shown.

Table 2. Number and Ratio of EU-27 Enterprises, Respectively (2010)

Enterprise size	**EU-27 Enterprises**	
	Number (in thousands)	% of All Enterprises
Micro	19,198.50	92.13
Small	1,378.40	6.61
Medium	219.30	1.05
Large	43.00	0.21

Source: G. Gecse, *Logistics practice of small and medium-sized enterprises*, 2012, p. 16.

1.2 Definition of the Supply Chain Management

SCM has been interpreted by various researchers. Potočan and Nedelko (2008) define SCM as a broader and strategically significant concept which includes the entire SC from the supply of raw material, through manufacture, assembly and distribution to the end customer. It includes the strategic and long-term consideration of SCM issues as well as the shorter term control of flow throughout the SC. Basic objectives of SCM are mainly: to focus on satisfying end customers, to formulate and implement strategies based on capturing and retaining end-customer business and to manage the chain effectively and efficiently.

Chow et al. (2008) on the other hand define SCM as a holistic approach to demand, sourcing and procurement, production and logistics process management. Mentzer, Dewitt, and Keebler (2001) state that SCM is a strategic and systematic coordination of the traditional business functions and tactics across these business functions within a particular enterprise and across businesses within a SC, for the purposes of improving the long-term performance of the individual enterprises and the SC as a whole. While the separation of SC activities among different enterprises enables specialization and economies of scale, there are many important issues and problems that need to be resolved for a successful SC operation – this is the main purpose of SCM (Trkman, Stemberger, & Jakelic, 2005).

D. Simchi-Levi, Kaminski and E. Simchi-Levi (2008) define the term SCM as a set of approaches utilized to efficiently integrate manufacturers, suppliers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right

locations, and at a certain time, in order to minimize the system-wide costs while satisfying service level requirements.

A SC consists of all parties involved, directly or indirectly, in fulfilling a customer demand. It includes manufacturers, suppliers, transporters, warehouses, retailers and customers themselves. Most SCs are actually networks, which is a more accurate to describe their structure. A typical SC brings together in the same network customers, retailers, distributors, manufacturers and suppliers (Chopra & Meindl, 2001).

According to Rushton, Croucker and Baker (2010) SC includes the provision of raw materials and components as well as the delivery of products to the final customer, which is shown in equation 1 hereunder:

$$SC = Suppliers + Logistics + Buyers \quad (1)$$

The most complete definition of SCM is the one by Stock and Boyer (2009). Their definition is based on a synthesis of a wide range of proposals given by a variety of sources - practitioners, academic and other. In a most genial way, they blended together all the given proposals and suggestions in order to develop a synthetic view of SCM which says that SCM is the management of a system of interactions within an enterprise and between enterprises and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, research and promotional activities all of which facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer. In the process, the benefit of added value is accrued, maximizing profitability through efficiency, and providing customer satisfaction (Stock & Boyer, 2009).

To some extent, SCM definitions represent a move away from the chain analogy to a system analogy. Hertz (2001) also discusses SC systems as the system that supplies a specific product or product group following the chain from raw material from its origin to the final consumer. A most insightful approach is taken by Lambert, Cooper and Pagh (1998) who state that a SC is a system of enterprises, or independent business units, in a range from the original supplier to the end-customers, and the operation of this system is a broad and challenging managerial task. Thus, the supply systems consist of both upstream systems of suppliers and downstream systems of distributors and customers. According to this concept, the distributors are part of the downstream system. Similarly to SCs, network systems encompass various dimensions of physical, payment and information flows and also other aspects such as social, technological, legal and administrative ones.

1.2.1 Competitive Advantages of the Supply Chain Management

Myerson (2015) says that historically, SC and logistics functions were perceived primarily as cost centres necessitating control. It is only in the past 20 years or so that another view

prevailed implying that it can be used for a competitive advantage as well. To accomplish this, an enterprise should order its competitive priorities and provide a set-up so that its SC satisfies internal and external customers.

The business world currently lives in an era of SC competition, where an enterprise no longer acts in isolation as an independent entity, but as a SC to create value delivery systems that are more responsive to fast changing markets and more specific demands, and are at the same time more stable and reliable (Christopher, 2005; Pandey & Garg, 2009). The core competences of an enterprise lie in its ability to visualize, develop and implement its SC in order to gain maximum advantage in the market with fast changing competitive forces. New managerial practices are introduced and unique BMs emerge and disappear all the time as managers strive to help their enterprises succeed in an unpredictable business environment (Fawcett, Ellram, & Ogden, 2007).

Enterprises must develop specific strategies in order to effectively respond to increasing levels of instability in demand (Vinodh, Sundaraj, & Devadasan, 2009). However, it is crucial for an enterprise to steadfastly hang on its position in the SC in order to create the best possible competitive position. As stated by Rosenzweig, Roth and Dean (2003), enterprises can achieve two main competitive advantages. First, a high integration among partners in a SC can lead more responsive enterprises to efficiently face unstable demands due to increased information visibility and operational knowledge (K.K. Kim, Umanath, & B.H. Kim, 2006). Secondly, highly integrated SC partners have the potential to offset net costs of doing business and thus reduce the total delivered cost to the customers (Swink & Song, 2007). This will be a benefit for each member in the SC.

SCM can be perceived as efficient means to achieve successful international competitiveness (Evans, Naim, & Towill, 1996). This is because recently, the focus on massive production yield has waned for many manufacturing enterprises (Christopher, 2005). Instead, there is a huge potential for upgrading in order to reduce inefficiencies caused by poor performance of the suppliers, volatile customer demands and a vague business environment (Koh, Demirbag, Bayraktar, Tatoglu, & Zaim, 2007).

Successful enterprises realized that shifting costs upstream and/or downstream does not make an enterprise more competitive, because ultimately all costs will be reflected in the price paid by the end consumer. Therefore, the traditional arm's length, even adversarial approach between the buyers and the sellers of the past is gradually being replaced by cooperation, trust, recognition and competent management (Christopher, 2005).

Important competitive edge defined by Pociask (2010) as one of the most recent developments is building partner trust by better information flow and general business transparency. Competitive edge can be reached by those SCs that can activate coexisting business processes and core competencies in order to merge infrastructures, share risks and costs, influence the shortness of contemporary product lifecycle, reduce time-to-market,

and gain and anticipate new visions of corporate leadership (Ross, 2004). In the competitive environment, the enterprises that turned successful either have a productivity advantage (or cost advantage) or value advantage. Ideally, they have a combination of both (Christopher, 2005).

A SC is the foundation of an enterprise's competitive edge. Every enterprise works in teams or SCs. So, if any part of the chain is weak then the whole BM becomes weak. Wastes and inefficiencies that cannot be passed on to the customer result in costs and low profits for the producer creating an uncompetitive position and a risk to the enterprises' operations as a whole.

Mentzer (2007) states that the two most important principles for gaining a competitive edge in a SCM for enterprises of any size are the following:

- to stick to core competencies and outsource non-core competencies;
- coordinate these functions across SC partners.

Customer value and satisfaction is acknowledged to be a necessary factor to achieve the competitive edge and profitability for both individual enterprises in the SC as well as the SC as a whole (Mentzer et al., 2001).

1.2.2 The Role of the Supply Chain Management in Small and Medium-Sized Enterprises

SMEs are now playing an increasing major role in the global business systems and participating in many intertwined SCs (Hvolby & Trienekens, 2002). Defining SC in SMEs might be a little bit difficult because most of definitions are custom-made for LEs. Beside this, SMEs often lack organized structure and are mostly managed intuitively by their owners. However, quite a sizeable literature has accumulated to date on SCs of SMEs. In its greater part, this literature addresses the fact that the SCs of SMEs are controlled and governed mostly by their big customers instead of themselves.

Thakkar, Kanda and Deshmukh (2009) stated that the present focus of SCM research is focused on LEs where small businesses act as an supplementary, first and second tier suppliers in their SCs. According to these authors, specifically the FMCG sector traditionally relied on SMEs where they constitute first-tier suppliers. By actively participating in SCs of LEs, the SMEs acquire an increasing share of impact on SC performance and can serve in all the key roles of the SC – as suppliers, distributors, producers and customers (Hong & Jeong, 2006).

Desiring to minimize the system-wide costs, LEs often expect various adaptations to be made at the end of their SMEs SC partners. On the other hand, according to Levy, Powell, and Yetton (2001) it is a normal behaviour for SMEs to focus their activities on specific

niche markets due to their unique competencies in the SC. They can compete within the SC for competitive positions in terms of either low cost or value added operations.

A succinct view of SCM for SMEs was suggested by Thakkar et al. (2009) who imply that SCM in SMEs is a set of business undertakings including purchase from an open or spot market, manufacturing or processing of subcomponents and delivery of the same to LEs using rented transportation to enhance the value of the end-product and in turn to ensure long-term purchase orders from the same LEs.

SCM has both positive and negative effects on the performance of SMEs. The potential benefits include increased customer service and awareness, improved SC communication, risk mitigation, reduced product development cycle, inventory reduction and improvements in electronic trading (Meehan & Muir, 2008). Another study involving SME manufacturing enterprises in Turkey found that the implementation of SCM practices could result in benefits to SMEs in terms of reduced inventory level, reduced LT, increased adaptability, accuracy of prediction, cost saving and accurate resource planning (Koh et al., 2007).

The responsiveness for changes in the business environment (Westhead & Storey, 1996), adaptability to respond to the customers ‘ demand (Carson, 1995) and rapid decision-making (Tidd, Bessant & Pavitt, 2005) have made SMEs good candidates to meet fluctuating customer needs and adapt to fast-growing information technologies. Due to the restrictions in their size and resources, SMEs will probably turn to have less leverage in negotiations and will have to accept a degree of control by the LEs.

Compared with LEs in the SC, SMEs have traditionally been modelled with some significant shortcomings such as having a small range of products or services, few customers, low volume of production, lacking know-how and learning capacity, having higher capital costs, being reactive in nature, commanding only weak marketing skills, having less competitive edges and generally being more vulnerable in the volatile world business environment (Coviello & McAuley, 1999; O’Gorman, 2001).

1.3 Participants in the Supply Chain

The participant system varies in size and scope, depending on the products offered, geographic dispersion of supply and demand and customer service requirements. We are free to say that no two SCs are completely the same, and a participant’s role may vary in each of the systems. In its simplest outline a SC includes a corporation, the contributors and clients of that particular enterprise (Hugos, 2006). Comprehensive SC includes three further kinds of contributors. In the first line there is the supplier's provider or the final provider at the beginning of a protracted SC. Then there is the customer's customer or ultimate customer at the end of a protracted SC. Finally, there are the enterprises that provide marketing and advertising services, IT, logistics, and finance (Hugos, 2006).

Gibson, Hanna, Defee, and Chen (2013) state that a logical breakdown of SC participants is their ownership in the end-product. Enterprises that own the goods at various stages of the SC are direct stakeholders. This group includes the final consumers or end-users of the goods, retailers, distributors, manufacturers, and suppliers. As our main goal is a definition of an appropriate model for logistics and inventory management in a distribution enterprise, we have to define distributors more specifically, and we have done so below.

Distributors are enterprises that catch inventory in large quantities from the producers and distribute connected product lines to customers. A distributor can also be an enterprise that only acts as broker between the producer and the consumer and on no account obtains possession of the brokered goods. This type of distributor carries out mostly the activities of marketing and sales (Hugos, 2006). In both of these instances, as the demands of customers develop and the variety of the available product range is modified, the distributor is the representative that closely follows customer's demands and provides him with goods that are desired (Hugos, 2006).

The distributors are entities providing value-added services to both producers and buyers. They buy products in bulk from the producers and sell the products in smaller quantities to retailers, providing in the process storage distributor facilities to and thus reducing the need for distributor producers and retailers to hold large inventories. This allows the producer to focus on the production and larger deliveries to distributors rather than managing small-time orders from a broad, often even global customer base (Gibson et al., 2013). SCM Globe (2014) defines distributors as enterprises that take inventory in bulk from producers and deliver related product lines to customers. They also offer delivery services to both sides of the chain. Similarly, distributors assure efficiency of the process between producers and buyers.

1.4 Key Elements of Defining the Business Model in the Supply Chain Management

The term BM is well established in the theory, but it became widely used only in the 1990s during the information and communications technology (hereinafter: ICT) revolution. By that term we usually refer to a description, representation, conceptual tool, structural template or a framework. This may be confusing as there is no general definition, but in this section we will present the main definitions and questions, that such an enterprise must answer at the moment when a BM is designed. The capabilities introduced by ICT brought to the business environment new ways of doing business which were impossible before (Brynjolfsson & Hitt, 2000).

A SC can help shape innovative customer value propositions and ensure the BM as a whole to become more resource-efficient. Enterprises that have taken a long view on

sustainability, and integrating this into their BM, are already demonstrating the benefits (Smith Gillespie, 2014).

The definition of a BM differs with various authors, and such a lack of common ground makes the matter rather confusing. Mahadevan (2000) utilised a basic concept of flows that exist across the SC. He defines BM as a blend of three elements:

- the value stream for business partners and buyers;
- the revenue stream, and;
- the logistical stream.

Morris, Schindehutte and Allen (2005) state that a BM is a concise representation of how decision variables relating to venture strategy, architecture and economics are addressed to create sustainable competitive advantage in defined markets. They present a definition of BMs derived from the entrepreneur's perspective, and distinguish BMs from business plans, strategy, and activity sets.

The BM is like a blueprint for a strategy to be implemented through organizational structures, processes, and systems. Most of the academic research on BM was done in the context of e-business, i.e. new ways of doing business enabled by information technology. According to Osterwalder & Pigneur (2010) there are nine elements that have to be defined in order to make a complete design of the BM. These elements are customer segments, value propositions, channels value propositions, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure. Similar to this is the concept of Morris et.al (2005) who state that the key questions that must be answered in developing the value-creating logic of the enterprise are as follows:

(1) how do we create value?
(2) who do we create value for?
(3) what is our source of competence?
(4) how do we competitively position ourselves?
(5) how do we make money?
(6) what are our time, scale, and scope ambitions?

Timmers (1998) says that a BM is an architecture for the flow of products, service, and information that includes descriptions of the business participants plus their roles, the incentives for each participant, and the sources of revenue. It can be concluded based on all literature that the BM is a subset of a top model that exists at the overarching marketing model on multi-enterprise level. The BM model has to be in line with the enterprise strategy, in order to make an overall synergic effect. From the research of literature it can be concluded that BM plays important role in the overall enterprise performance, and companies must take time to design an efficient BM.

2 LOGISTICS MANAGEMENT

2.1 Definition of Logistics Management

Logistics is the term widely used in business for the range of activities associated with the movement, storage and handling of materials. The management of logistics has been revolutionized over the past 30 years and has come to be regarded as a key determinant of business competitiveness. Many people use two terms, logistics and SCM, interchangeably, but there is a difference between the two. According to Harrison and van Hoek (2014) logistics is a vital enabler for SCM.

They define logistics as the task of coordinating material flow and information flow across the SC. Logistics has both strategic (long-term planning) and managerial (short- and medium-term planning and control) aspects. Logistics supports competitiveness of the SC as a whole by meeting end-customer demand through supplying what is needed in the form in which it is needed, when it is needed, all at a competitive cost. They distinguish three hard objectives for creating logistics advantage: quality, time and cost. There are two important ways of creating logistics advantage: controlling variability in logistics processes, and dealing with uncertainty.

Hugos (2006) says that logistics refers to activities within a single enterprise while the SC refers to networks of enterprises that work together. Traditional logistics focuses on activities such as procurement, distribution and inventory management. SCM also includes marketing, new product development, finance, and customer service. In other words, SCM includes the managing of supplies, information and finance in a network containing providers, producers, wholesalers and customers (Stanfield, 2002). Basically, all these activities are intended to deliver the optimal result to the end-user via procurement of raw materials, manufacturing, distribution, and customer services (Symeonidis, Nikolaidou, & Mitkas, 2006). Johnson and Wood (1996) stated that SCM is somewhat larger than logistics. Lambert et al. (1998) mentioned that a contemporary understanding of SCM is not appreciably different from the understanding of integrated logistics management.

Logistics is defined as the planning, organization, and control of all activities in the material flow, from raw materials until the final consumption and reverse flows of the manufactured product, with the aim of satisfying the customer's and other interest parties' needs and wishes i.e., to provide a good customer service, low cost, low tied-up capital and small environmental consequences (Jonsson & Mattson, 2009).

Logistics management is that part of SCM that plans, implements, and controls the efficient, effective forward and reverse flow and storage of products, services, and related information between the point of origin and the point of consumption in order to meet the customer's requirements. Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling,

order fulfilment, logistics network design, inventory management, supply/demand planning, and management of 3PL.

To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved in all levels of planning and execution – strategic, operational, and tactical. Logistics management is an integrating function which coordinates and optimizes all logistics activities and also integrates logistics activities with other functions, including marketing, sales, manufacturing, finance, and information technology (Council of Supply Chain Management Professionals, 2004).

Logistics is the portion of SCM that encompasses distribution, transportation and inventory management. To put it in context with the simplified description given above regarding the SCM functions of planning, buying, making, storing, moving, selling and returning, logistics represents the store and move functions.

Ballou (2004) states that the logistics activities can be classified into core and supporting ones. The core activities take place in every supply channel and they contribute the most to the total cost of logistics or they are essential to the effective coordination and completion of the logistics task. These activities include customer service, transportation, inventory management, information flows and order processing. Support activities vary from enterprise to enterprise and include: warehousing, materials handling, purchasing, protective packaging, cooperation with production/operations and information maintenance.

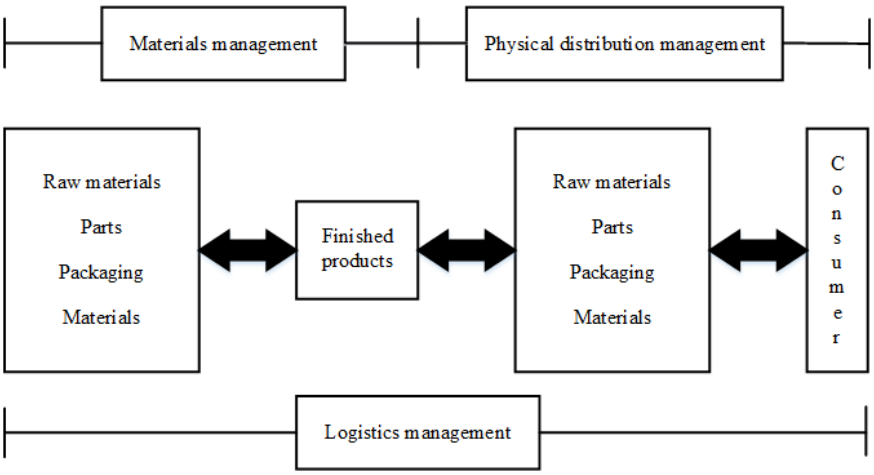
According to Rushton et al. (2010) one quite widely accepted definition of key relationships between logistics and distribution is as follows in equation 2:

$$Logistics = Materials\ management + Distribution \tag{2}$$

The same authors state that logistics and the SC are concerned with physical and information flows and storage from raw material through to the final distribution of the finished product. Thus, supply and materials management represents the storage and flows into and through the production process, while distribution represents the storage and flows from the final production point through to the customer or end user (Rushton et al., 2010).

Traditionally, logistics management has been divided into materials management and physical distribution management, as noted in Figure 1 below (Fernie & Sparks, 2014). The focus of this thesis is on the physical distribution management. Managing the physical distribution means managing inventories, storage facilities, unitisation, transportation and communication, as seen in the Figure 1 below.

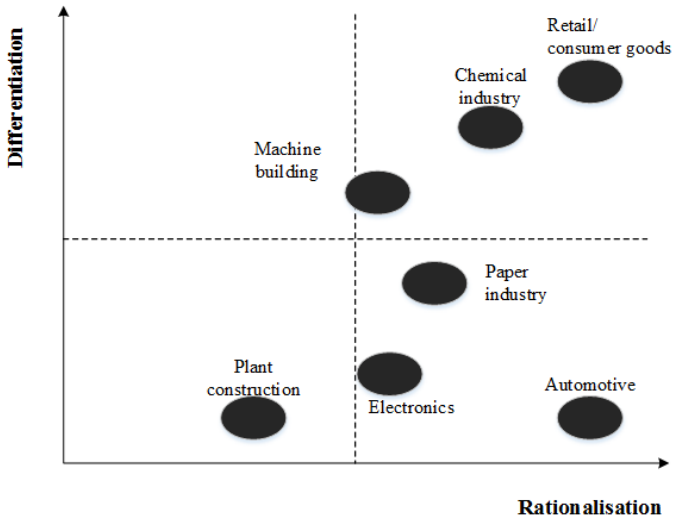
Figure 1. Constituents of Logistics Management



Source: J. Fernie & L. Sparks, *Logistics & Retail Management; emerging issues and challenges in the retail supply chain*, 2014, p. 322.

Efficient logistics is fundamental for the successful distribution. Figure 2 shows the great importance of logistics for retail and various industry sectors under the aspects of differentiation and rationalisation.

Figure 2. The Importance of Logistics for Different Industries

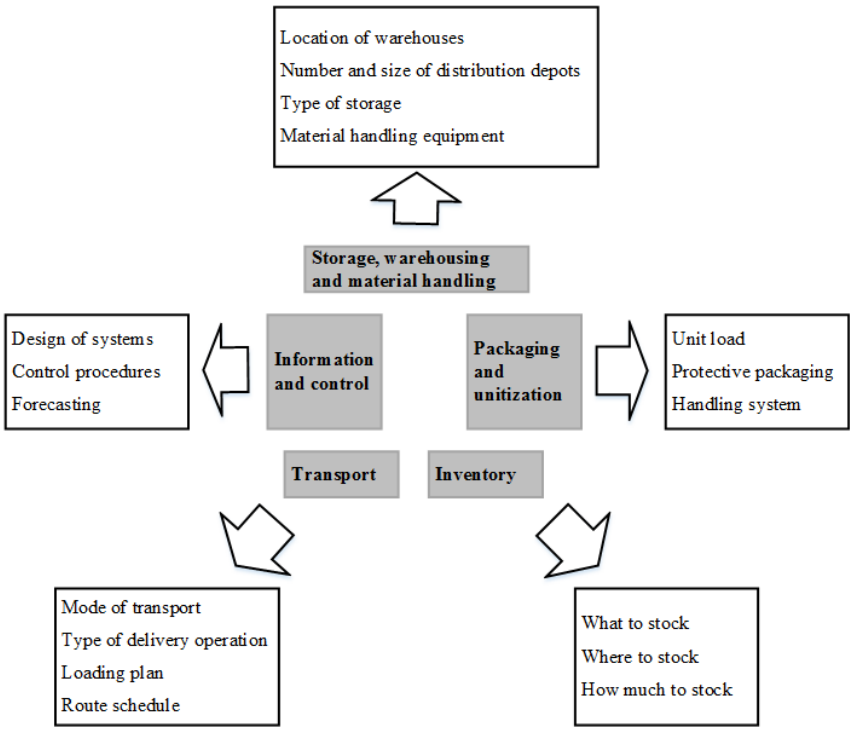


Source: M. Kowalski, *Qualität in der Logistik,* 1992, p. 54.

The importance of logistics for the retail sector is based on the nature of the products sold. Most consumer products, for example daily food items, are relatively cheap and the consumer generally buys them without quality or price comparisons. Nevertheless, the importance of logistics in other sectors is increasing as well, as stressed by Pfohl (2004).

According to previously described elements of logistics management, a model that includes all mentioned elements is presented in Figure 3 below and was developed by Rushton et al. (2010). In order to develop the most appropriate logistics model, I am going to define all the mentioned elements of this model in the empirical part of my thesis.

Figure 3. The Key Components of Distribution and Logistics



Source: A. Rushton et al., *The Handbook of logistics & distribution management,* 2010, p. 6.

All of these functions and sub-functions need to be planned in a systematic way, in terms both of their own local environment and of the wider scope of the distribution system as a whole. A number of questions need to be asked and decisions made.

2.2 Importance of the Reverse Logistics within the Supply Chain

Thirty years ago, SCs were focused on optimising the flow of products to the end customer. Nowadays, an increasing flow of products is going back in the opposite direction of chain. Thus, we are now speaking also about reverse logistics, with which the enterprises are faced. Importance of reverse logistics is increasing with importance of post sales services. It is an important element of creating and maintaining competitive advantage that the enterprises might use.

The efficiency of reverse logistics has an important impact on customer satisfaction and evaluation of enterprises service level. The enterprise needs to develop a visible reverse logistics chain to the customer, which will result in the increase of customer satisfaction. (Pollock, 2007). rReverse logistics is more reactive than the forward logistics process (Haas, Murphy, & Lancioni, 2003; Tibben-Lembke & Rogers, 2002).

Tibben-Lembke and Rogers (2002) portrayed reverse logistics by stressing the goal and the intrinsic (logistics) processes as the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished products, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal.

According to Lambert et al. (1998) reverse logistics is ranging from as simple as processing of returns, to as complex as the logistics process of removing new or used products from their initial point in a SC and returning them upstream in the SC with main objective to minimise costs. Dekker (2003) defines reverse logistics as the process of planning, implementing and controlling backward flows of raw materials, in-process inventory, packaging and finished products, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal.

For the purpose of this thesis we will further explain distribution returns. According to Smith, Thomas and Quelchi (1996) distribution returns refers to all those returns that are initiated during the distribution phase, and includes (Tsay, Nahmias, & Agrawal, 1998):

- product recalls - products recollected because of safety or health problems with the products;
- commercial returns -returns for which a buyer has a contractual option to return products to the seller and it includes quantitative or qualitative discrepancies of products, expired or products with low turnover ratio;
- stock adjustments - occur within an enterprise;
- functional returns – pallets and similar items which move backward and forward in a SC.

The decision on insourcing or outsourcing reverse logistics has to be in accordance with the global enterprise strategy and logistics strategy. According to some studies as this is an important element of customer relationship management and enterprises should keep this function in-house (Morton, 2007; Tibben-Lembke & Rogers, 2002).

2.3 Definition of Logistics Outsourcing

2.3.1 Logistics Outsourcing in Small and Medium-Size Enterprises

Corbett (2004) describes outsourcing as a phenomenon that has skyrocketed in recent years. However, it is not a new phenomenon; outsourcing as a practice originated in the 1950s and in the 1980s it was first adopted in organisations as a strategy (Hätönen & Eriksson, 2009). Outsourcing has become a megatrend in many industries, most particularly in logistics and SCM (Feeney, Lacity, & Wilcox, 2005).

The overall scope of outsourcing is continuing to grow, as enterprises focus on their core competencies and tasks perceived as non-core (Lindner, 2004). Rushton and Walker (2007) define outsourcing as the strategic use of external specialized service providers to execute and manage activities or functions that are normally seen as non-core to the business. Outsourcing happens when enterprises decide to buy products or services from external vendors, as opposed to making them in-house. This is referred to as the

enterprise's make or buy decision (Sako, 2006; Contractor, Vikas, Sumit, & Pedersen, 2010).

In logistics this was mostly confined to outsourcing dedicated distribution and transportation activities, but gradually other logistics services were outsourced, including stock control, order processing and returns operations. Outsourcing in general and outsourcing logistics in particular is a strategy enterprises use in order to reduce their costs and to gain competitive advantage (Bardi & Tracey, 1991; Tian, Lai, & Daniel, 2008; Qureshi, D. Kumar, & P. Kumar, 2007).

According to the Capgemini (2015) and Langley (2014) European and Latin American businesses are more likely to outsource logistics and SC activity. Western European businesses spend 61 percent of their logistics payment on 3PL services. The same figure is 65 percent in Latin America, against 44 percent in North America and 49 percent in Asia Pacific.

A study on top 500 Fortune enterprises in the US showed that 60% of the respondents reported having at least one big 3PL contract, and that the market for logistics outsourcing continued to grow (Lieb & Bentz, 2005). Another more recent source mentioned that in Australia about $26 billion (or about 46%) worth of logistics functions are being outsourced to 3PL providers, and that the market was growing (Relph & Parker, 2014). Most recent research done by Capgemini (2015) shows that the size of global 3PL market in 2013 was 703.8 billion $.

There are many potential benefits from logistics outsourcing, but over the years it has become obvious that outsourcing is accompanied by some disadvantages and risks as well. Most commonly cited advantages of logistic outsourcing are logistics and inventory cost reduction, optimized asset use, service improvement, increased flexibility and focus on core businesses (Bardi & Tracey, 1991; LaLonde & Cooper, 1989; Bradley, 1994; Wilding & Juriado, 2004; Capgemini, 2015).

According to Schoenherr (2010) outsourcing is a key determinant for success, improved performance and competitive advantage. It also brings improvements in logistics performance that could not be achieved in-house, by eliminating inefficiencies which have not become apparent as long as the service was provided in-house (Wallenburg, 2004). According to Ernst & Young (2013) enterprises report that by outsourcing logistics activities they cut costs by 11% on average, hold 6% less stock and save an average of 23% on fixed logistics costs.

Multiple authors go into further detail, such as Richardson (1990) who mentions next service improvements with logistics outsourcing: faster transit times, less damage, and improved on-time delivery. The increased flexibility allows the enterprises to become more responsive as the needs of the market or customers change, contributing its know-how and

existing resources. Logistics outsourcing reduces both the strategic and the operative risk of the enterprise. The strategic risk in the form of investment decisions in assets, as well as operative risks, e.g. missed deadlines, unexpectedly surging costs or quality problems in the logistics processes. Beyond that, logistics outsourcing also allows for a decrease of the workforce and the associated investments (Sheffi, 1990; Lynch, 2000).

On the other hand most commonly cited risks of logistics outsourcing is the loss of control paired with the dependence on an 3LP (Razzaque & Sheng, 1998; D.Simchi Levi et al., 2008; Langley, 2010). The loss of control can be seen in terms of quality, service, efficiency and price.

Bradley (1994) points out that logistics service provider can be more efficient than a supplier, because logistics is their core business. Hence, specialization effects and the proper utilization of core competencies lead to lower costs. Lower costs can also be achieved through economy of scale and economy of scope.

Aas, Buvik, and Cakić (2008) argue that the evolution of gradually more complex SC makes decisions about logistics outsourcing more difficult. Their empirical analysis showed that it is not always beneficial to outsource some of the activities. According to McIvor (2000), the strategic dimension of outsourcing projects is often neglected, leading to sub-optimal results based on short-term reasons of cost reduction and capacity issues. He concludes that problems frequently occur because complex issues, such as a formal outsourcing process, inadequate cost analysis and a thorough definition of one's own core business have not been given sufficient attention.

Li-Jun (2012) describes a control model of logistics outsourcing risks which includes the following five basic categories:

(1) contract risk – the risk that a 3PL cannot fulfil all requirements according to required quality or in required time;
(2) management risk – this type of risk can be caused by the difference between the management methods and the company culture characterizing the provider and client;
(3) information risk – the risk of poor quality information sharing which can result in serious problems and dramatic losses;
(4) market risk – this type of risk refers to market fluctuations such as labour price, raw materials price, changes in customer demand, etc.;
(5) financial risk – financial risk means that the real return on investment of logistic outsourcing is lower than the expectation.

Despite of abundant literature on the topics of outsourcing and logistics outsourcing process, it is surprising that there is only very limited literature focusing on SMEs. Arbaugh (2003) proposes a very interesting reason of this lack of research, namely too much emphasis on studying the behaviour of LEs in the process of logistics outsourcing.

He also reveals that in SMEs outsourcing decision is based very much upon the preference of owner/CEO of company, whether they wish to do outsourcing or not (Arbaugh, 2003).

According to research of Zborowski (2013) almost 50% of Hungarian SMEs have used outsourcing for more than three years. The most popular are 3PLs that offer transportation services, which are used by nearly 60% of respondents. The most important selection criteria for SMEs are attractive prices, location and range of offered services. Most enterprises use the services of one outsourcing company, which performs only one type of logistics function. Some parts of the logistics functions the enterprises execute by themselves.

Vaaland and Heide (2007) show that different implementation in the SC causes a lack of performance in SMEs. Financial shortage and lack of experience in management lead to failures in logistics adoption. Usually, SMEs want to concentrate on their core business; therefore, they expect to see operational assistance in their day to day business. The implementation of logistics in the whole SC requires a lot of time but due to the lack of resources, SMEs prefer simple methods and concepts which need less specialized knowledge (Wang, Kovacs, Wozny, & Fang, 2006).

Van den Berg (2009) provides some insight into the past trends and changing patterns in the overall outsourcing practices for SMEs. According to him, in the past suppliers of outsourced services were looking for large contracts to achieve economies of scale and so they could keep their services cost as low as possible. But the old model of large traditional outsourcing companies did not allow them to serve SMEs cost effectively, even though they did have the scale and capacity. While using smaller service providers, SMEs were not getting the scale and high enough quality which was a big obstacle for fast growing sophisticated SMEs. For average SMEs outsourcing meant pursuing a complicated outsourcing strategy without enough gain and they also held a wrong impression that the cost would be prohibitive (van den Berg, 2009).

Holter, Grant, Ritchie, and Shaw (2008) also identify a lack of competence on the part of SMEs that reduces the quality of logistics outsourcing process. He suggests that, due to lack of subsequent purchasing power, in many cases, SMEs are treated as “order takers” rather than “order makers” by 3PLs. That is an obstacle in obtaining good service at a competitive price. Although LEs also face these problems related to transport cost, reliability and service from 3PLs they usually have more leverage than SMEs to rectify this situation with their 3PL. Furthermore he suggests that depending on intensity, SMEs can be attractive for large 3PLs but usually they acquire low volume contracts.

The use of outdated procedures and infrastructure, especially ERP, is another problem that makes it difficult for high-class 3PLs to focus on SMEs. Furthermore, this is often compounded by the lack of capital to implement the needed changes. Foster (1994) advices SMEs to be more careful in logistics outsourcing and points out the importance of good

preparation for this step. He also suggests to SMEs to adopt a more strategic view on logistics outsourcing as a potential source for competitive advantage (Foster, 1994).

Logistics decisions of a company are driven and justified by various factors including, among others, the need to achieve operational flexibility, customer service, risk mitigation, cost reduction, operational efficiency and access to resources and markets. It is argued that out of these many factors, cost reduction and expectation to improve services are the most frequently quoted factors for outsourcing (Mello, Stank, & Esper, 2008). The level of outsourced logistics varies from simple capacities and asset outsourcing, such as transport or warehousing, to bundled activities, where we have a mediator who coordinates integrated value-added logistics in the SC (Stefansson, 2006).

Agreements with 3PLs vary from spot contracts to long-term agreements and strategic alliances. However, practical experience has shown that it is very important to keep in-house expertise and control of outsourced activities; at least enough to be able to make appropriate contracts with 3PLs and properly monitor the execution of the activities (Aas et al., 2008). Wilding and Juriado (2004) support the idea that outsourcing in logistics should not be treated as an "all or nothing" kind of decision and that mixed solutions may often give the best results. In practice, companies usually outsource their fleet, facilities and activities which tend to be transactional, operational, and repetitive, but keep in-house control over strategic decisions and activities (Langley, 2014).

2.3.2 Scope of Logistics Outsourcing to the Third Party Logistics Providers

3PL outsourcing is defined in many different ways by different authors. The variations in definitions are mainly in terms of degree of formalization, scope of outsourced activities, financial arrangements and length of the resulting relationships between an enterprise and its 3PL. On the whole, they provide parameters by which 3PL outsourcing practices can be assessed and variations between various approaches, if any, can be identified.

In their legalistic perspective, LaLonde and Cooper (1989) provide some illumination on what the formal relationship has to be like. Referring to it as contract logistics, they define 3PL outsourcing as a process whereby a shipper and 3PL enter into an agreement for specific services at specific costs over a defined time horizon. Sink and Langley (1997) define 3PL outsourcing as the use of external service providers to perform some or all logistics functions that were traditionally performed internally by an enterprise.

This is further elucidated by Murphy and Poist (2000) who, after going over a number of literature items, defined the 3PL as a relationship between a shipper and third party which, compared with basic services, has more customized offerings, encompasses a broader number of service functions and is characterized by a long term, mutually beneficial relationship. D. Simchi-Levi et al. (2008) define 3PL simply as the use of an outside

enterprise to perform all or part of the enterprise's materials management and product distribution function.

The Council of Supply Chain Management Professionals' defines 3PL as follows: An enterprise that provides multiple logistics services for use by customers. Preferably, these services are integrated, or bundled together, by the provider. Among the services 3PLs provide are transportation, warehousing, cross-docking, inventory management, packaging, and freight forwarding. 3PL providers are: freight forwarders, courier enterprises, other enterprises integrating and offering subcontracted logistics and transportation services.

Enterprises outsource to solve a specific problem, improve performance, or achieve any other goal fitting their needs. From the 3PL definitions in the previous sections we get at least 4 important features of a logistics outsourcing design: nature or type of outsourced logistics function; number of outsourced functions; proportion of budget outsourced; and length of outsourcing relationships.

Referring to the scope of activities, 3PL outsourcing does not necessarily mean overhauling the whole logistic system. Millen, Sohal, Dapiran, Lieb, and Van Wassenhove (1997) advise that outsourcing should not be taken as an "all or nothing" decision. These explanations indicate that most enterprises would settle with a design entailing outsourcing of only those logistics functions critical to addressing their specific or custom needs. As we have seen, the nature, types and number of outsourced functions are presented in the definitions as important elements of 3PL outsourcing.

After reviewing a number of academic literature items, Wilding and Juriado (2004) identified transport and shipment, warehousing and inventory control, ERP-related and value added services as the most outsourced logistics areas. They surveyed the consumer goods industry to understand customer perceptions on key outsourcing decisions and summarised their findings in a tabular form as shown in Table 3.

Table 3. Logistics Functions Most Likely to be Outsourced, Kept In-House or Managed with a Mixed System (% of Enterprises)

Logistics Functions Most Commonly Fully Outsourced	Logistics Functions Most Commonly Managed as a Mixed System	Logistics Functions Most Commonly Kept Fully In-House
Primary transport – 68%	Additional storage during peak periods – 38%	Carrier selection –82%
Secondary transport – 52%	Storage during off peak periods – 34%	Storage during off peak periods – 44%
Additional storage during peak periods – 36%	Secondary transport – 30%	Logistics information systems – 78%
Fleet management – 36%	Primary transport – 22%	Returns and reverse logistics – 56%
Re-labelling and repackaging – 26%	Returns and reverse logistics – 20%	Final product customization – 42%

Source: R. Wilding & R. Juriado, *Customer perceptions on logistics outsourcing in the European consumer goods industry*, 2004, p. 633.

2.4 Classification of the Logistics Costs in Supply Chain

For the enterprises it is very clear what the costs are, but the problem arises when we come to logistics costs. Von Thünen (1826) was the first author who investigated transport costs as an element of logistics costs. Logistics costs can be used as a measure of efficiency of logistics performance but there is no general definition. Christopher (2005) states the following deficiencies of accounting costs related to logistics:

- the realistic costs of servicing different customer are poorly understood;
- costs are captured at too high level of a aggregation;
- costing is functionally oriented;
- the emphasis of total cost allocation to products ignores customer costs.

Further precaution regarding logistics costs and their level in SMEs must be taken into account since logistics costs are usually treated as overheads, there is a shortage of data of the same, a data relating to costs are in most cases estimates, their reference bases are either sales revenues or total costs, usually there are no defined cost centres in SMEs and ERP system does not support their collection (Kummer, 1995; Tempel & Meißner, 2002).

According to a study conducted in Germany and Mexico within SMEs, 42.4% rendered no accounts of their logistics costs, and according to a similar study none of the observed SMEs have knowledge of all components of logistics costs. It is a positive development that SMEs, according to recent studies conducted in Finland, have better knowledge about logistics costs. It could be noticed that SMEs which outsource the logistics are more aware of their logistics costs (Berr, Borchert, & Feldhahn, 1990; Campos-Garcia, Garcia-Vidales, & Gonzales-Gomez, 2011).

It is important to understand that logistics costs level are influenced and vary by different industries, enterprise strategies, markets, environment and efficiency of observed enterprise. In most cases, non-representative studies were usually conducted in LEs or SMEs of similar sizes, and contain findings just for that size of enterprises. But, as will be presented in this section, the number of studies on SMEs is increasing, and nowadays it is easier for SMEs to find a valid benchmark for logistics costs.

According to Chopra and Miendl (2001) total logistics costs is a sum of the inventory, transportation, and facility costs. According to the same authors inventory and facility costs increases as the number of facilities in SC increases. At the same time, transport costs decrease as the number of facilities is increased. Rushton et al. (2010) divided logistics costs into transport cost, warehouse costs, inventory investment and administrative costs. Classification of logistics costs according to Solakivi et al. (2009) is shown in Figure 4.

Figure 4. Classification of the Logistics Costs

	Direct logistics costs	Indirect logistics costs
Alternative or overhead costs	Warehousing cost Time value Operation costs	Costs of lost sales Cost of consumer service level Costs of non-marketable goods IT purchasing and maintenance costs
Cost related to activities	Transport (freight) Cargo handling Inventory costs Shipping route, toll fees Documentation costs Direct IT	Packaging materials Packaging costs Costs of logistics equipment, premises and capital Administration costs

Source: T. Solakivi et al., *Finland - State of Logistics 2009,* 2009, p. 21.

As stated earlier, logistics costs can vary between different enterprises and industries from roughly from 10 to 22%. In a study conducted in Hungary in 2004, the logistics costs levels of SMEs were estimated at around 12.1% of the sales revenue, and in 2005 their share in total costs was 19.18%.

Within the costs of logistics, the carrier (46.6%), and warehousing and inventory costs (37.1%) were the decisive components (Szabó, 2005; Vízhányó, 2006). According to a study performed in Finland in 2009, the total logistics costs level of was 11.9% on average, and within this number, the corresponding figure for micro-enterprises was lower than in 2005 and 2008, whereas the one for SMEs was higher (Solakivi, Töyli, Engblom, & Ojala, 2011).

Listed in Table 4 are logistics costs classified according Rushton et al. (2010) from different enterprises in UK, collected from an industry cost audit by Dialog Consultants Ltd. This will be used later in this thesis to benchmark obtained results in observed enterprise.

Table 4. Logistics Costs as a Percentage of Sales Turnover (cost as % of turnover)

Main Enterprise Business	Transp-ort Costs	Warehouse/ Depot Costs	Inventory Investment/ Holding Costs	Admini-stration Costs	Overall Logistics Costs
	%	%	%	%	%
Office equipment	3.20	10.70	0.87		14.77
Health supplies	1.36	9.77	0.66	0.19	11.98
Soft drinks	2.53	2.71	0.44		5.68
Beer (food and drink)	8.16	2.82	0.56	2.19	13.73
Spirits distribution	0.37	0.27	0.07	0.10	0.81
Cement	25.20	9.10	7.10	4.60	46.00
Computer services	0.45	0.10	0.29	0.05	0.89
Computer supply	0.65	0.78	0.09		1.52
Healthcare	0.96	1.08	1.32		3.36
Fashion	0.38	1.31	0.33		2.02
Food packaging	3.14	3.73	0.85		7.72

Source: A. Rushton et al., *The Handbook of logistics & distribution management,* 2010, p. 11-12.

Important benefits can be gained by reducing logistics costs. According to some authors it is very easy to optimize logistics and consequently logistics costs. Different studies have shown that total logistics costs in SMEs increase proportionally with their sales revenue, decrease with the growth of enterprise size, and that economies of scale are an important factor in the overall performance (Hovi and Hansen, 2010).

One of the interesting researches shows that logistics costs are lower in SMEs with a longer export history. In the research from 2005, the logistics costs level of exporter SMEs were significantly lower (Naula, Ojala, & Solakivi, 2006). Logistics outsourcing might be a possible option for reducing the logistics costs. A U-shaped relationship was found between logistics outsourcing and costs.

The reduction of logistics costs is often set as an objective. As a part of this thesis, I will calculate an enterprise's logistics costs as a percentage of enterprise sales revenue/turnover and benchmark it with the results above.

3 INVENTORY MANAGEMENT IN THE SUPPLY CHAIN

3.1 The Role of Inventory Management in the Supply Chain

The inventories are usually kept in almost all the enterprises within a SC. In order to match the gap between the supply and the demand the enterprises hold the inventories. The most frequently quoted reason for the enterprises to hold the inventories are uncertainties and variability. Inventory and stock are often used as synonyms, and for the purpose of this

paper we will use the term inventory. This section will elaborate main motives for enterprises to hold inventories and their classification.

According to Azadivar, and Rangarajan (2008) the main reasons to hold inventory are:

(1) economies of scale: order and transport costs are usually fixed, and they don't change with ordered quantity. Therefore, order costs increase with a higher frequency of orders;
(2) uncertainties: as products are moved within the SC, variability exists between the actual demand and the level of inventories being produced and distributed. Therefore, inventories help mitigate the impact of not holding sufficient inventory where and when this is needed;
(3) customer service levels: inventories function as a buffer between demanded and supply.

There are many classifications of the inventories by different authors. Basically, it could be noticed that the authors classify the inventories based on the above quoted main reasons to hold them. Rusjan (2013) classifies inventories as cycle, safety, seasonal, buffering, transit and speculative. Further similar breakdown of inventories was done by Rushton et al. (2010) who defines them as working, cycle, safety, speculative and seasonal inventories.

Minner (2000) divides the inventories into five basic types. These are:

(1) cycle inventories. The cycle inventory induced by batching alternates between an upper level when a batch has just arrived and a lower level just before the arrival of the next batch. Cycle inventories mostly attribute to economies of scale of purchasing and transportation and technological restrictions in production (Minner, 2000);
(2) pipeline inventories. Order processing times, production and transportation rates contribute to pipeline inventories, also called process inventories. Materials that are in process, in transport, and in transit to another processing unit belong to pipeline inventories (Minner, 2000);
(3) safety inventories. The safety inventories are interpreted as the expected inventory just before the next replenishment arrives. It is caused by the uncertainty of demand, processing time, yield and other factors. Its major function is to protect business performance in the lack of forecasting errors (Minner, 2000);
(4) speculative inventories. Expected price increase may result in earlier supply than would have been experienced under constant price, which means that there are more inventories on hand than actual demand at certain period of time and the redundant inventory is speculative inventory. Additionally, stimulated by the possible higher selling price, speculative inventory may also appear (Minner, 2000);
(5) anticipation inventories. Some products are characterized with seasonal demand. In case of seasonality enterprises find it more efficient to produce products prior to demand, which causes accumulation of inventory (Coyle, Bardi, & Langley, 2003).

3.2 The Goals of Inventory Management in the Supply Chain

The inventory management is a very important part of the SCM. It is a critical issue for most enterprises – LEs and SMEs. Together with the logistics they are tied up very closely. Successful inventory management is a foundation of effective logistics. The American Production and Inventory Control Society (hereinafter: APICS) define inventory management as the branch of business management concerned with planning and controlling inventories (Toomey, 2000).

The scope of inventory management is broader than the stock. Primarily, inventory management is about specifying time and size of orders. It is necessary to protect different parts of a SC from running out of products. In fact, inventory management is a set of techniques that are used to manage the inventory levels within different enterprises in a SC according to Hugos (2006). It can be also defined as the management of materials in motion and at rest (Coyle et al., 2003). According to the same author the aim is to reduce the cost of inventory as much as possible while still maintaining the service levels that customers require. Buxey (2006) says that the inventory management content refers to the ongoing provision of standard items with independent demand, where some speculative quantity should always be on hand.

Enterprises keep inventories for diverse causes, including protection from a broad lack of products or possible difficulties with providers; also, since unit price increases may be coming up. Ali (2011) defines inventory management as the continuing process of planning, organizing and controlling inventory that aims at minimizing the investment in inventory while balancing supply and demand. Inventory management basically serves two main goals: to provide highest service level at the lowest costs (Routroy & Kodali, 2005; Reid & Sanders, 2007). By high service level it is meant that the inventory management is responsible for the availability of the products that should be in the right quantities, at the right time and quality in order to deliver a selected service level.

Inventory management aims to control the inventories and related costs and finance. Inventories are one of the biggest costs responsible for a large part of the working capital costs - up to about one third, and they represent a significant component of total logistics costs (Harrington, 1996; Goor & Weijers, 1998, Coyle et al., 2003). Therefore, to be competitive, enterprises must reduce costs, and inventory management is one of effective tools to achieve this goal.

Enterprises must balance supply and demand while reducing inventories by developing inventory reduction strategies. Gordon (2006) identified that a key driver in the 50 percent reduction of logistics costs as a percentage of gross domestic product (from 16.2 percent in 1981 to 8.5 percent in 2003) is the reduction in inventory levels. Inventory carrying costs decreased by 60 percent over the same time period.

3.2.1 The Challenge of Inventory Management in the Supply Chain

When demand occurs, warehouse should deliver some products to fulfil the market's requirement, and thus demand is reflected in the inventory system. Demand is stochastic and therefore it is difficult to forecast (Cachon & Terwiesch, 2006). The wholesalers and retailers that are major actors involved in downstream distribution channels face a special challenge in keeping inventory at reasonable levels due to the difficulty of forecasting demand and expectations of customers about product availability (Coyle et al., 2003). The challenge increases with the diversity of the products.

Cachon and Terwiesch (2006) state that in the short period inventories are determined by managers according to historical records or research and analysis based on sales on the market. According to related studies, demand is classified into several types. The most common type is cyclic demand, which means that the demand for certain products is a response to a season, or shows peak over time (Warkentin & Bajaj, 2003). On the other hand, there are a deterministic demand and a random demand which are influenced by the demand quantity, demand rate and demand mode. Warkentin and Bajaj (2003) explain that a deterministic demand is based on historical data for a specific area. By contrast, the quantity of random demand is difficult to ensure since it is more easily affected by some factors outside the system.

The challenge of forecasting demands results in two opposite problems, stock-out and overstock of inventory. As enterprises strive to avoid lost sales from stock-out of inventory, there is a tendency to overstock. Nevertheless, because keeping inventory is costly which definitely reduces the profit margin, enterprises try to reduce the inventory level, thus creating the tendency towards the stock-out of inventory.

We can get an overview of inventory management dilemma, where two opposing powers keep pulling the inventory in their own direction. It is hard to balance the two powers all the time and station the inventory at the right level constantly. For the purpose of this thesis I will base my analyses on the stochastic demand, which is based on historical data of sales on the market.

Supply can also determine an enterprise's inventory (Scully & Stanley, 1994). In this case distributors help buyers/retailers to determine inventory. They monitor the buyers' inventory status and get ready for resupply in advance, even before the buyers placed their orders. Thus, inventory replenishment can be controlled by vendors, since they determine order quantity, shipping and timing (Waller, Johnson, & Davis, 1999). This approach is known as vendor managed inventory (hereinafter: VMI) and it is described in chapter 3.4.3.

3.2.2 Definition of the Inventory Policy

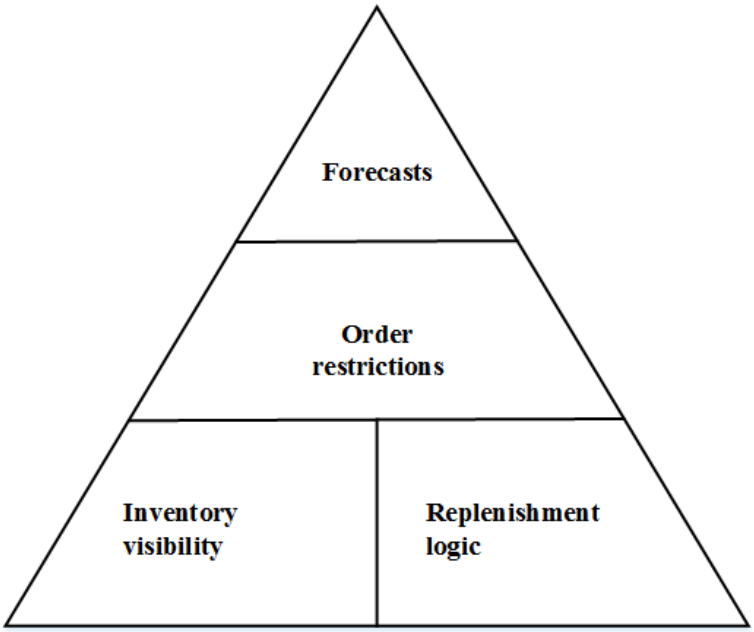
Chopra and Meindl (2001) and Wagner (2002) state that a replenishment policy consists of decisions when to order and how much to order. Most commonly, we can find two types of inventory policies such as:

(1) continuous review policy – inventory is continuously tracked and order for a lot size Q is placed when inventory declines to ROP. This policy is also known as "perpetual inventory system" (Heizer & Render, 2004). In theory, this policy is also recognized as (Q, R) policy by D. Simchi-Levi et al. (2008), where Q represents the quantity delivered with each new order, and R corresponds to the level of inventory reached when the new order is placed, which is also known as ROP. According to Setyaningsih and Basri (2013) a continuous review is more suitable for situations of high demand, but it has a disadvantage in the high costs of implementation;
(2) periodic review policy – inventory is checked at regular periodic intervals and an order is placed to raise the inventory level to a specified threshold. By periodic review, the inventory level is reviewed at regular periodic intervals and after each review, an appropriate quantity is ordered, so that the predefined target inventory is reached. In theory, the target inventory is also known as base-stock level (D. Simchi-Levi et al., 2008).

For enterprises that have implemented computerized inventory the policy of continuous review is more convenient. The advantage of periodic review policy lies in relatively lower implementation costs compared to continuous review systems. On the other hand, the disadvantage of periodic review policy is that there is no correct information on inventory levels during the review period, which may result in stock-out during this time. Accordingly, compared to continuous review, by implementation of periodic review policy a need is created for higher level of safety stock to be maintained, in order to protect the enterprise from stock-out during both the review period and the lead time (Heizer & Render, 2004).

Four elements of the replenishment systems are shown in Figure 5. The first part of this system is inventory visibility, the ability to track the status of inventory in a SC tier or even across the entire SC. In order to be able to decide which quantity to order, it is necessary to know how many items are on stock. The replenishment logic defines the business rules that are followed in order to decide when to order (Silver, Pyke, & Peterson, 1998). Some systems take into account order restrictions as well. The last element is the forecasting part. Some systems try to anticipate future consumer demand by computing forecasts (Angerer, 2005).

Figure 5. Descriptive Model of Replenishment Systems



Source: A. Angerer, *The Impact of Automatic Store Replenishment Systems on Retail*, 2005, p. 54.

Inventory visibility. As stated above, inventory visibility is the ability to track the status of inventory across the SC. The physical stock level in a warehouse is called the stock on-hand. The inventory on the way to the warehouse is called net stock. Both quantities have to be taken into account before reordering (Angerer, 2005). For the purposes of this thesis, only the inventory in the warehouse and quantity ordered but not yet arrived to the warehouse, has been taken into account.

Replenishment Logic. The store has to have a stock on-hand at the beginning of the period that is bigger than the demand, otherwise an out-of-stock (OOS) occurs and the demand cannot be fulfilled. An inventory system is deciding for every item whether it is time to place an order or not. The decision rules determine when T (order frequency, or Reorder point (hereinafter: ROP) and in which quantity (Q) a replenishment order is made (Angerer, 2005). The four basic decision rules are therefore following (Silver et al., 1998):

- (T,Q) order every T period, order Q;
- (T,S) order every T period, fill up to level S;
- (ROP,Q) whenever inventory drops below ROP, order Q;
- (ROP, S) whenever inventory drops below ROP, fill up to level S.

Order Restrictions. Inventory replenishment systems are forced by many restrictions to deviate from an optimal calculated order quantity and replenishment time. These order restrictions are necessary as enterprises face certain business and logistics limitations. Many of these aspects were not taken into account in the optimization equation, and so the result has to be adapted (Angerer, 2005). Restrictions that may need to be taken into account are according to Rushton et al. (2010), the following:

- minimum order quantities – is an minimum order quantity, below which it is uneconomic to place an order;
- layer or pallet quantities – this is usually requirement or restriction set up by supplier. The main reason is lower costs of manipulation, which is more economic;
- seasonality - many products have a peak demand at certain times of the year. The most common peak occurs just prior to Christmas (toys, games, wines and spirits, etc.).

The importance of accurate forecasting has been stressed by several authors (Ritzman & King, 1993; Moon & Mentzer, 1998). In theory, forecasts are not necessary if the probability distributions are already available. According to Chopra and Meindl (2001) forecast forms the basis for all strategic and planning decisions. The same authors define the following forecasting methods:

- qualitative – they are subjective and based on human judgement. They may include estimates by sales teams, experts or Delphi method;
- time series – based on historical demand, and assumption that demand history is a good indicator of future demand;
- causal – based on assumption that the demand forecast is highly correlated with factors in the environment;
- simulations – which is combination of time series and causal methods.

In this thesis, a forecast is regarded as a statement about the expected future demand.

3.2.3 Measuring the Inventory Turnover Rate

The inventory turnover rate is a measure that expresses how many times, on average, an inventory is replaced over a period of time (Coyle et al., 2003; Muller, 2011). To maximize sales with the least amount of inventory, the enterprise should try to meet demands by ordering smaller quantities more frequently from the suppliers, thus achieving more inventory turns, which reflect on the annual number of times an average inventory is being sold (Goldsby & Martichenko, 2005). As the inventory turnover has big implications for an enterprise's liquidity it is an important measure. It is a relative measure that can be used for comparability within the enterprise or with other enterprises (Fredriksson, Jonsson, & Karlsson, 2015). The inventory turnover rate is calculated using equation 3.

$$Inventory\ turnover\ rate\ = \frac{Cost\ of\ goods\ sold}{Average\ inventory} \tag{3}$$

According to Dias (2012) most of the private enterprises would expect an inventory turnover rate of twelve or higher. Although it looks conceptually simple, there are many aspects to consider when calculating the inventory turnover rate (Muller, 2011). When calculating inventory turnover in the retailing industry, average inventory can either be measured in retail prices or in purchasing prices. For the sake of the argument just made, it

is then important that these values are put in relation to net yearly sales and cost of goods sold, respectively. One way for enterprises to increase the inventory turnover is to reduce the inventories of slow moving items (Zentes, Morschett, & Schramm-Klein, 2011).

Consistency is a key item also when determining the value of cost of goods sold in situations of dynamic purchasing prices. Two methods for valuing the cost of inventory are first-in, first-out (FIFO) and last-in, first-out (LIFO). FIFO is based on valuing the inventory from the purchasing price of the oldest item, i.e. the one that was first put in stock (Muller, 2011).

LIFO inventory valuation on the other hand, relies on inventory value based on the most recent item put in stock (Toomey, 2000). Another method for evaluation of the cost of inventory is the specific cost method. This method relies on the fact that the enterprise can track the cost of an item in the SC. Consequently, using this method allows the enterprise to charge the actual cost of an item on the point of consumption (Muller 2011).

3.2.4 Determining the Appropriate Service Level

The main function of inventory is to accommodate the customer needs. It is the responsibility of the enterprise to hold a stock level that ensures a sufficient service level for the end customer.

All SC parties have similar responsibilities towards their customers. If the inventory level is not sufficient to cover the customer demand, stock-outs can be the result. In turn, a stock-out may result in a backorder if the customer is supplied, but at another time or in another quantity than expressed. This can cause customer dissatisfaction or loss of future business. However, if a product substitution is possible, the negative consequences of stock outs can be diminished (Toomey, 2000).

Enterprises want to avoid the negative consequences of inventory shortages to the best of their abilities. The most common solution to avoid stock outs is often to carry more inventory. However, it is important to determine the cause of the stock-out before suggesting a solution. For instance, the problem may be related to the demand, or more precisely, the forecast accuracy, the customer's replenishment system, unreliable lead times or quality problems. Depending on the cause, the solution has to take different forms. The ability to correct the problem is also strongly related to the willingness to pay for it (Toomey, 2000).

The aim of the distributor is to identify methods for minimising the inventory carrying costs while improving customer service levels (Ross, 2004). Managers should consider how to achieve the balance between good customer service and reasonable cost, which is the purpose of inventory management, involving the time and volume of replenishment (Borowiec & Liedberg, 2009).

Service level can be defined in a number of ways. It can be defined as:

(1) the cycle service, which is the probability of no stock out per order cycle. This definition expresses the probability that an order arrives before the stock on hand is finished. The major drawback of the definition is that it does not consider the batch size;
(2) demand fill rate - fraction of demand that can be satisfied immediately from stock on hand;
(3) ready rate - fraction of time with positive stock on hand;
(4) percentage of individual items ordered from a supplier that is issued from stock on hand. It is measured by counting the total number of items issued and dividing it by the total number of items requested.

Last three definitions are more complex and they give a better indication of the customer service. However, from a practical point of view it is more important that the service level is consistently defined and measured throughout the enterprise, than to make sure that it is perfectly defined (Axsäter, 2006; Fredriksson et al., 2015). In general, it is not suitable to have the same service level for all articles. On the other hand, to employ individual service levels for all articles may be unpractical. A common way of handling articles is to group them in some way and subsequently assign service levels for each group (Axsäter, 2006).

For the purpose of this master's thesis I will use the equation which is most appropriate and in theory is called 'the perfect order'. The obtained result of perfect order will be compared to the average service level, which is a part of enterprise's contracts with clients. According to Rushton et al. (2010) this is a measure which attempts to take into account all of the main attributes that go towards the completion of an order that absolutely satisfies customer requirements. This is sometimes known as 'on time in full' (OTIF). The key components of the equation are:

- delivered complete to the quantities ordered;
- delivered exactly to the customer's requested date and time;
- no delivery problems (damage, shortage, refusal);
- accurate and complete delivery documentation.

Whatever is included, the perfect order fulfilment is displayed in equation 4:

$$Perfect\ order\ fulfilment = \frac{number\ of\ perfect\ orders}{total\ number\ of\ orders}\ x\ 100 \qquad (4)$$

3.3 Classification of the Inventory Costs in the Supply Chain

Total inventory costs consist of inventory carrying cost (hereinafter: ICC) and the cost of personnel, space used for offices and systems that are employed to manage inventory

(Frazelle, 2002). Christopher (2005) states that it could be more than 50 percent of the current assets of an enterprise that are tied up in inventory. However, it is important to notice that many authors refer to ICC while illustrating total inventory costs. An overview of the literature shows that most authors include all the costs related to inventory e.g. costs of personnel to ICC, while Bowersox, Closs, and Cooper (2010) and Frazelle (2002) are excluding those costs from ICC.

There are costs associated with holding all inventories, and the costs go beyond the expenditure in the inventory investment. ICC forms an interesting concept, representing both accounting costs and economic costs (Goldsby & Martichenko, 2005). Accounting costs are explicit, and economic costs are implicit, not necessarily involving an outlay but rather an opportunity cost. Bowersox et al. (2010) explain ICC as the expense cost of maintaining inventory. Further, they define inventory expense as annual ICC percentage multiplied by average inventory value. It is important to notice that some authors define ICC as holding costs According to Chopra and Meindl (2001) there are two major inventory related costs, order and holding costs.

Holding costs are usually estimated as a percentage of the cost of product. They are estimated as the sum of following major components (Chopra & Meindl, 2001; Goldsby & Martichenko, 2005; Rushton et al., 2010):

(1) cost of capital: this is most important component of holding cost. The appropriate approach is to evaluate weighted average cost of capital (hereinafter: WACC). This cost takes in account the return demanded on enterprise's equity and the amount an enterprise must pay on its debt;
(2) obsolescence cost: this is an estimation at which the value of the product you are storing drops either because market value of that product drops or because the product deteriorates;
(3) handling cost should only include receiving and storage costs that vary with the quantity of product received. However, if incremental handling cost incurred, then the handling cost associated with this additional inventory should be included in the handling costs. Quantity-independent handling cost that vary with number of orders should be included in ordering costs;
(4) occupancy cost: it should reflect the incremental change in space cost due to changing quantity;
(5) miscellaneous costs: theft, security, damage, tax, and additional insurance charges that may be incurred.

The order cost is the sum of all the incremental costs associated with placing or receiving an extra order that are incurred regardless of the size of the order. Generally, ordering costs do not depend on the procured quantities. These costs are primarily focused on personnel costs, data processing costs and transportation and handling costs. All these costs do not apply to every purchase item. For example, in the case of call-off based procurement, the

costs for request for quotation, supplier negotiations and selection of supplier should not be included (Jonsson & Mattson, 2009). The ordering cost should be re-evaluated once a year (Piasecki, 2001).

In this thesis I will use the definition of ordering costs according to Chopra and Meindl (2001), who differentiate the following order costs:

(1) buyer time;
(2) transportation costs;
(3) receiving costs;
(4) other costs.

The average ordering cost can be calculated by using equation 5 shown hereunder.

$$Average\ ordering\ cost = \frac{Total\ ordering\ cost\ per\ time\ period}{Number\ of\ orders\ per\ time\ period} \quad (5)$$

In all calculations and equations, inventory is valued at the purchase or manufacturing cost, not the price of selling the inventory. Bloomberg, LeMay and Hanna (2002) state that usually the total inventory cost for a product is between 14 to more than 50 percent of the value of the product. According to Bowersox et al. (2010) and Monczka, Handfield, Giunipero, Patterson, and Waters (2010) overall inventory costs are between 9 and 50%. A non-industry specific rule-of-thumb state 25%, and textbooks on inventory management usually use values ranging from 20% to 30% (REM Associates). Table 5 displays the classification of inventory costs, their average level and range.

Table 5. Inventory Carrying Costs (ICC)

Element	Average (%)	Ranges (%)
Capital costs	15.00	4.00 – 40.00
Taxes on inventory	1.00	0.50 – 2.00
Insurance costs	0.05	0.00 – 2.00
Obsolescence of inventory	1.20	0.50 – 2.00
Storage costs	2.00	0.00 – 4.00
Total	19.25	9.00 – 50.00

Source: R.M. Monczka et al., *Purchasing and supply chain management*, 2010, p. 52.

Carrying costs per unit are, on the whole, rather fixed and difficult to decrease when holding the actual level of inventory constant. Some of these costs, such as insurance, tax and capital costs are correlated fairly linearly with inventory level, while storage costs (a component of which is defined in terms of the unit's share of total, fixed storage costs) represent a marginal decrease and costs of obsolescence a marginal increase in the inventory level.

The inventory carrying factor provides the basis for calculating the ICC. More precisely, the ICC for a product is determined as the inventory carrying factor multiplied by the inventory value for the product at the time of calculation (Mattson, 2003). Mattson (2003) divides the inventory carrying factor into three categories - capital costs, ICC and risk costs. Within each category, there are different associated costs. Table 6 shows all costs divided into a specific category.

Table 6. Cost components of the inventory carrying factor divided into capital costs, inventory carrying costs and risk costs

Capital costs	**Inventory carrying costs**	**Risk costs**
Capital cost	Cost for premises	Costs for depreciation
	Costs for shelves, racks	Wastage costs
	Handling equipment costs	Scrapping costs
	Handling costs	
	Insurance costs	
	Administrative costs	
	Data processing costs	
	Costs for physical inventory	

Source: S.A. Mattson (in C. Fredriksson et al., *Improving retail store replenishment,* 2015, p. 24.)

According to Mattson (2003) it is possible to disregard the majority of the ICC when calculating the inventory carrying factor. This is because it is only the avoidable costs that are relevant here, i.e. the ones that are dependent on the inventory levels. All ICC except the insurance costs have a marginal effect on the inventory carrying factor and can consequently be excluded from the calculations.

Different costs can be relevant in different situations and it is always important to consider which ones are relevant in the specific case. Mattson (2003) even states that it can be recommended to differentiate the ICC for different types of items within the same enterprise. Subsequently, all relevant costs will be summed together and then expressed as an inventory carrying factor, which is a percentage related to the capital tied up in inventory.

As mentioned by Jonsson and Mattson (2009), the relationship between ICC and size of stock is assumed to be linear and the inventory carrying factor can be regarded as an interest. Piasecki (2001) underlines the importance of re-evaluating the inventory carrying factor at least once a year, considering changes in interest rates, storage costs as well as operational costs.

3.4 Types of Inventory Models

3.4.1 The Role of ABC Classification in Inventory Management

The traditional ABC classification approach is based on a single criterion, usually the annual sales value. The sorting of items into categories is done by putting the relative weight of each item's annual sales value in relation to the accumulated annual sales value of all items (Fuerst, 1981; Hadad & Karen, 2013; Fredriksson et al., 2015). Bloomberg et al. (2001) noted that ABC categorises products based on importance. Product importance may came from cash flow, lead time, sales volume, availability on the market place, profitability, stock out, or stock cost. Rudberg (2007) and Fredriksson et al. (2015) state that the aim of the classification determines which criteria should be considered. Once the classification is done, the classes are chosen. Coyle et al. (2003) and Yu (2011) argue that ABC classification is based on Pareto's Law.

According to this model, group A contains about 20 percent of the articles, which make up 80 percent of the enterprise's annual sales value and group B items contains about 50 percent of the articles, which make up 15 percent of the annual sales value. Group C contains the remaining 30 percent of the items, which comprise approximately 5 percent of an enterprise's annual sales value (Ng, 2007; Hadad, & Keren, 2013). According to Rushton et al. (2010) by using Pareto analysis products can be categorized as:

- A items = fast movers (20 per cent);
- B items = medium movers (30 per cent);
- C items = slow movers;
- D items = obsolete/dead stock (C+D representing 50 per cent).

Onwubolu and Dube (2006), state that when ABC analysis is applied to an inventory situation, it determines the importance of items and the level of control placed on the items. Based on conducted analysis, policy decisions can be made, for example: A items should have 98 percent availability; B items should have 90 percent availability; C items should have 85 percent availability; and D items should be discontinued (Buxey, 2006).

Carenzo and Turolla (2010), and Hughes (2005) suggest that the SMEs' adoption of the ABC classification is slow. Hall (2011) noted that challenges to LEs are as follows:

- the cost of implementing and maintaining the system;
- estimating the benefits associated with ABC classification (improved pricing and product planning), and;
- integrating the system into the overall management structure.

This approach might be insufficient and other criteria are important and should be considered (Ng, 2007; Hadad & Karen, 2013). ABC classification has its main advantage in its simplicity. This is the primary reason for ABC classification to become the leading technique for inventory control for a majority of enterprises (Hadad & Keren, 2013).

3.4.2 The Definition of Economic Order Quantity

The economic order quantity (EOQ) or the Wilson equation is the most widespread method for determining a fixed order quantity (Jonsson & Mattson, 2009; Dias, 2012). Order quantities are calculated based on the trade-off between holding and ordering costs, by minimization of the total costs an order generates (Berry, Jacobs, Vollman, & Whybark, 2005; Jonsson, 2008).

Bowersox et al. (2010) postulate that the EOQ is concerned with answering the question, 'how much should be ordered?' Since 1915, Management Scientists have been applying quantitative methods to help inventory managers make two critical decisions; how much to order, and when to order. EOQ is quantity-based, time-invariant and non-discrete. Time-invariant means that the order quantity is fixed over time. As a result, the EOQ must be revised occasionally.

EOQ is a basic inventory model based on several assumptions: the demand is constant and known, the cost of ordering is constant, the lead time is zero, the unit price is not dependent on the order quantity, there are no shortages, only one product is considered and the entire quantity is delivered at the same time. As a result of these assumptions, there is no optimization in a strict sense with respect to prevailing conditions in normal planning situations (Jonsson & Mattson, 2009; Ross, 2004; Rusjan, 2013).

The EOQ model with all the assumptions may not be representative of most inventory environments, but works well to bring good intuitions and understanding of more complex, realistic models. There are several articles and review papers about EOQ and its several variations (Wu, Ouyang, & Yang, 2006; Maddah & Jaber, 2008; Kiesmüller, de Kok, & Dabia, 2011; Jaber, Bonney, & Moualek, 2009). However, when used in association with other methods, such as the fixed point reorder system, and with safety stock provision, the EOQ is very valid and can be applied to many different products (Rushton et al., 2010).

Notations outlined below will be used in next sections:

Q = economic order quantity
D = annual demand of the product
H = holding cost per unit per year (often expressed as percentage of the unit price per year (h))
S = fixed order cost incurred per period
C = cost per unit
LT= lead time
ROP = reorder point
avrD (LT) = average demand during LT
SS = safety stock
z = standard deviation for selected service level
σ (LT) = standard deviation of demand during lead time

The equation for calculating the economic order quantity is illustrated in equation 6 shown below (Berry et al., 2005; Jonsson & Mattson, 2009; Rusjan, 2013).

$$Q = \sqrt{\frac{(2\ x\ D\ x\ S)}{H}} \tag{6}$$

Total costs connected with size of order in observed year are calculated according to equation 7 and are sum of annual ordering and annual holding costs of inventory:

$$TC = \left(\frac{Q}{2}\ x\ H\right) + \left(\frac{D}{Q}\ x\ S\right) \tag{7}$$

ROP in this case of stochastic demand is equal to average demand during lead time (avr (LT)) increased for safety stock (SS).

$$ROP = avrD\ (LT) + SS \tag{8}$$

Safety stock is the level of inventory that the enterprise needs to have in order to protect itself from deviation of average demand during the lead time (avrD (*LT)).* Standard deviation for different service levels are quoted in Appendix 2 of this thesis. The value of safety stock is calculated according to following equation:

$$SS = z\ \times\ \sigma(LT) \tag{9}$$

Dubelaar, Chow, and Larson (2001) state that retail inventory management is often based on EOQ principles. Another author, Piasecki (2001) stresses that whenever there are repetitive purchases of an item, EOQ should be considered. It is important however to keep in mind that the model works most satisfactorily in environments where the demand is stable.

In practice, the application of the EOQ equation for the SMEs is very difficult for several reasons. Since records of various costs in SMEs could be rather moderate or even inappropriate it is difficult to calculate order and holding cost. Moreover, EOQ have to be recalculated with each change in interest rate, price, or demand, which increases the order cost (Lin, 1980). It is very important for the SMEs that the inventory models are simple and easy to use, as it will be described in empirical part of this paper.

3.4.3 Retailer and Vendor Managed Inventory in the Supply Chain

Retailer-Managed Inventory (hereinafter: RMI) is a traditional approach in managing inventory in SC and it is the SC structure with the lowest level of integration (Sari, 2008; Lee & Ren, 2011). By using this approach each member optimizes his own part of the SC, and limited amount of information is shared between the members of SC.

In the RMI approach, an enterprise places orders to the supplier, to meet his demand. After an enterprise receives the products, the supplier sends an invoice to the enterprise. This

means that suppliers in the upstream SC develop forecasts based on orders from their direct downstream customers. The supplier does not receive information about the customer's needs in advance, and he is forced to keep safety stock in order to meet all the customers' demand. They are often faced with an unexpected demand, which leads to frequent changes in production and distribution, and creates additional costs (Gumus, Jewkes, & Bookbinder, 2008; Sari, 2008; Lee & Ren, 2011).

The costs associated with this model, which an enterprise bears, include the fixed ordering cost, holding costs and penalty costs. The supplier on the other hand incurs fixed and variable costs of production and delivery (Lee & Ren, 2011). Thereby, RMI could be used to describe the enterprise with a simple SC network, and is not founded as an appropriate model in the future. (Danielsson & Nilsson, 2013).

VMI is a SC strategy where the supplier is given the responsibility of managing the customer's stock. VMI is one of the most widely accepted partnering initiatives for improving multi-enterprise SC efficiency, also known as continuous replenishment or supplier-managed inventory. It was launched as a pilot programme in the retail industry in the late 1980s between Wal-Mart and Procter and Gamble (hereinafter: P&G) and has been adopted by many SCs such as Dell, Barilla, Costco and Campbell's Soup (Sohel, Osman, & Islam, 2015).

In the SC, the supplier assumes responsibility for the management of inventory at the customer's premises, and takes decisions regarding replenishment (Waller et al., 1999). Yao, Dong, and Dresner (2012) state that VMI's model enables an upstream enterprise to control inventories for its downstream partner. In the VMI model, enterprises can save costs and increase profit, while vendors can maximize scale economies and flexible deliveries when realizing the integration of production and supply (Guan & Zhao, 2010).

Within the usual procurement BM, when an enterprise or distributor requires a product, they place an order with the supplier. An enterprise has total control of the size and delivery times of the order. Under the VMI process the supplier and an enterprise are linked via Electronic Data Interchange (hereinafter: EDI) or a secure internet connection. The supplier is aware of the enterprises' stock levels and point of sale figures. This is usually done by linking the enterprises' ERP systems together. The supplier creates the orders and maintains the enterprise's inventories on agreed levels.

Different studies showed that SC members can have substantial benefits from VMI implementation. Some of the benefits are a decrease of lead-times and stockouts, improved control of the bullwhip effect, increased service levels and costs savings (Angulo, Nachtmann, & Waller, 2004; Cheung & Lee, 2002; Kulp, Lee, & Ofek, 2004; Kaipia, Holstrom, & Transkanen, 2002; Waller et al., 1999). The bullwhip effect means that demand variability increases as one moves up the SC, and it leads to raised costs in the SC (Hohmann & Zelewski, 2011).

Further benefit for supplier comes from economies of scale. VMI increases the efficiency of production in order to increase product margins. Due to the collaboration and integration of the supplier and the enterprise, the costs of the total SC always decrease (Kulp et al. 2004; Lee & Ren, 2011). VMI brings more profits for the enterprises because it leads to higher product availability and service level, with less concentration on inventory monitoring and lower ordering costs, especially compared to RMI (Kuk, 2004; Lee & Ren, 2011).

Five most important factors that lead to the successful implementation of VMI are (Classen, Weele, & Raaij, 2008; Gumus et al., 2008; Singh, 2013):

- top management support;
- employee involvement;
- investment in ERPs and infrastructure;
- vendor development;
- production planning and control.

3.5 Use of the ERP Systems for Inventory Management in the Supply Chain

In this last section of the theoretical part of the paper, the ERP system is defined and it's role is examined. ERP systems are creating a homogeneous environment for the employees, in which tasks are efficiently executed. They are a very important factor, which can be described as one of strategic importance for the competitiveness and long-term success of the enterprises. For the all enterprises, in order to remain competitive, implementation of an ERP system has become mandatory. ERP systems are a structured rendering of the operations; moreover, they create a manageable organizational reality (Kallinikos, 2004).

Watson and Schneider (1999) describe ERP as a generic term for an integrated enterprise informatics system. Gronau (2004) and Monczka et al. (2010) state that ERP is characterized as large, integrated transaction processing and reporting system, which integrates the different functions of an enterprise. According to Bernroider and Tang (2003) ERP allows the enterprises to integrate at all levels and to utilise important ERP applications. These applications may vary by different ERP system, but in general include modules such as: accounting and financial management, inventory management, human resources management (hereinafter: HRM), customer relationship management (hereinafter: CRM) and etc.

The implementation of ERP systems is a challenging task. For an efficient implementation of such system a comprehensive re-engineering is almost mandatory. There are different barriers which enterprises have to overcome for a successful implementation. According to

Chircu and Kaufmann (2000) these are the two types of barriers: valuation barriers and conversion barriers. According to same authors, the technical barriers are rather low, and the organizational barriers are much more difficult to overcome.

ERPs offer for the SMEs is either custom made, or package branded for SMEs (mySAP, Oracle Small Business Suite, Navision, Pantheon) also known as Commercial Off the Shelf (hereinafter: COTS). In the case of SMEs, most often the decision to purchase a COTS product is motivated by a reduction in cost and finishing the implementation as quickly as possible. A Study on Austrian SMEs in 2005 shows that the penetration of ERPs in SMEs compared to LEs is still rather low: 22.5% of SMEs have ERP, as opposed to 71.1% of LEs (Bernroider & Leseure, 2008).

Many studies were conducted on the influence of ERP systems on enterprises' performance. Research done in Austria by Bernroider and Tang (2003) shows that, on average, only 80% of planned functionality is obtained after ERP implementation, 90% ERP implementation projects are late or over budget, 40% end up with only a partial implementation, and 20% of all projects in 1999 were discarded as total failures. SMEs prefer slow-phased implementation.

Negative experience for enterprises while implementing ERP are the following: ERP does not work as expected in 65% of cases, while 70% experience a short decline in performance. According to literature, SMEs have a more opportunistic approach to ERP implementation and poorer project management, which results in more unsatisfying outcomes (Sarpola & Scott, 2003). On the positive side, SMEs are more simple and flexible, so even a really poor ERP implementation does not cause permanent damage.

4 ANALYSIS OF THE CURRENT SITUATION

4.1 Enterprise Profile

A1 Ltd. is an enterprise established in 1996 as a printing and marketing enterprise. In 2007 it was taken over by Pretti Ltd. At the same time, the enterprise changed the industry and became a wholesaler and import-export enterprise for healthy, organic and gluten-free foods. From 2008 until 2013 A1 Ltd. imported products from the EU, and exported them to Serbia, where it developed organic and gluten-free market with a partner. The change of ownership occurred again in 2011, and since then the enterprise has had just one owner, a status which remains to this date. The enterprise withdrew from the Serbian market at the end of 2013 and for the next two years remained inactive.

From 2007 to 2016 there were no activities on domestic, Croatian market. A1 conducted its activities from 2007 until 2016 as additional / complementary activities, without a business plan, without employees, organizational structure, etc. It was only in 2016 that the owner decided to focus exclusively on the A1 enterprise and define strategy, establish an

organization, employ a workforce, shape an adequate logistics model and all other essential elements for a long-term success of the enterprise. For this reason I treat A1 as a start-up enterprise in the remainder of this paper.

At the beginning of 2016, the owner decided to activate the enterprise in its core business of distribution of healthy, organic, gluten-free, fine foods, all of premium quality on the Croatian market. The owner has 13 years' experience in this field, and is responsible for the development of gluten-free market in Croatia and Serbia, having introduced innovative organic categories like coconut water and raw bars, possesses relevant know-how, and has a broad network of contacts with tradespersons (retail, pharma, HORECA), professionals and societies.

In the portfolio of the enterprise there are 4 brands at the moment, with a tendency to increase that number over time, and develop a new BM of distribution, which would be sustainable for the long term, innovative in the segment of logistics, competitive and cost-effective. This means that the enterprise will not only be the distributor but also an agent in the organic market specializing in the following:

- representation and distribution of premium gluten-free brands;
- representation and distribution of premium organic brands;
- agent for private label (PL) of organic, gluten-free products, premium products for Croatia and the region;
- agent for branded organic, gluten-free products, premium products for Croatia and the region.

The enterprise represents and distributes innovative and high-quality products from the world of organic food and natural cosmetics. The products can be found in more than 400 points of sale in Croatia: drugstores, supermarkets, specialized shops, pharmacies, herbal pharmacies in cities across Croatia. The portfolio consists of innovative organic categories: coco-water, raw energy bars, jams, hazelnut spread, sun care cosmetic products, all products being of premium quality and organic.

The turnover in 2016 is expected to be around 2 million HRK, 4.5 million HRK in 2017, and until 2020 it should reach 20 million HRK. The main tools for enterprise growth are the following: a further development of current brands, introduction of new products and brands, entering into new markets and introducing new ways of distribution. The enterprise would like to implement innovative, new business linkages and alliances with customers, suppliers, competitors and other enterprises with the implementation of virtual organization, with ERP in cloud, focusing on core competences such as know-how, trade, marketing and strategy and outsourcing all functions that can be outsourced.

4.2 Description of the Organizational Structure

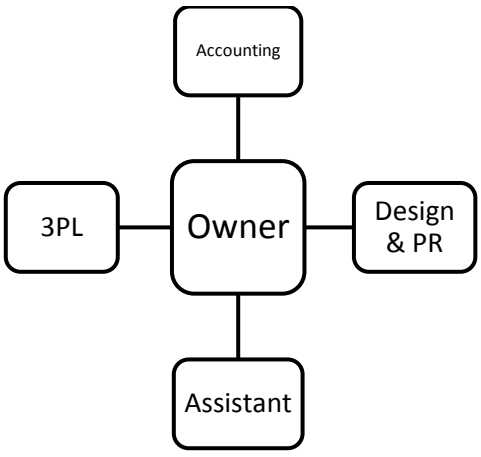
A1 has a simple organisation structure as shown in Figure 6. On the top is the owner, who also acts as the top manager of the enterprise, with an assistant below. Currently there are 2 employees in the enterprise, along with the outsourcing of logistics (to 3PL), accounting, marketing and PR (to a professional agency).

The owner/top manager is engaged in negotiations, purchasing, collaborating with the suppliers to develop a most appropriate market model, and making principal decisions regarding the inventory level for each product item. She often makes business trips to the supplier's plant to negotiate and communicate with the supplier on matters such as product portfolio, product quality, prices, promotional activities, delivery time, and so on. Her function is the overall management of the business of the enterprise.

The owner has one assistant, who works in the back office, and whose main responsibility is administration and customer service, which includes order receipt, customer order processing, communication regarding order processing with customers, production of dispatch information to 3PL, preparation and delivery of associated documentation, processing of all shipments, everyday communication to 3PL operators, etc. She also provides assistance to the owner/ manager regarding purchase issues.

3PL is responsible for warehousing, labelling of products, domestic and international transport. Outsourced accounting is responsible for all accounting functions, design studio for the design of all promotional materials, paper and digital, and PR agency for the entire communications segment. In the future, the enterprise plans to employ a representative responsible for visiting, informing, educating and taking orders from clients for the whole country, and with the time a representative for the most important regions, North Croatia, and South Croatia.

Figure 6. Organizational Structure of A1



4.3 Description of Current Situation in A1

4.3.1 Description of the Suppliers

A1 is a wholesaling and distribution enterprise whose collaboration with suppliers is based on exclusivity. It collaborates with 4 suppliers from Denmark, Germany, Italy and Belgium, respectively. Within the distribution function the enterprise is involved, among other, in procurement, logistics and inventory management. These are the most important functions and tools to reach a competitive advantage for A1.

At the moment the owner is completely involved in procurement. The top priority for procurement in the analysed enterprise is to establish, maintain and develop long-term relationships with current suppliers by negotiating optimal contract terms, as well as finding new suppliers. It includes identifying and selecting suppliers, negotiating, agreeing terms, expediting, monitoring supplier performance and analysing orders.

Each supplier is specific and has its own terms of collaboration. With all of them annual meetings are usually held. A1 and suppliers mutually set up sales targets for the next year, analyse sales results for the current year, analyse logistic and inventory costs and possibilities for some cost saving, analyse orders and possible improvements in the ordering process. A1 aims to standardise collaboration terms with each supplier. General requirements from suppliers are that A1 orders minimum 1 mix pallet, and orders each product in full layer.

A1 usually pays transport costs, as most of the contracts have the term “ex works” included. Suppliers prepare shipments according to the order, and inform A1 on the number of pallets, gross weight and possible day for loading. Al transport arrangements are done by the A1 assistant, who instantly sends orders to the transport enterprise. It is possible that transport is arranged by suppliers, but this option would be an exception. Based on suppliers’ experience, transport prices in western EU countries are usually higher. The delivery time for European countries are anywhere between 2 and 5 working days.

The next important element of negotiations with suppliers are labels, which must be in Croatian language. The common practice is that labels on the products are international until a certain level of volume of sales is reached. When this occurs, it is usual in the FMCG area that the supplier makes labels in national language without any additional cost. A1 has to provide translation and it is responsible that labels are obeying all national laws and regulations. In more competitive categories, and in cases of simple packaging (e.g. jar or bottle in juice or jam industries), labels are made in national language from the start.

Payment terms differ depending on supplier. They range from advanced payment to 30 days or 60 days after the invoice date. Enterprise pays in advance in cases where suppliers apply additional discounts for advanced payment.

A1 has 4 suppliers, with characteristics given in the following paragraphs.

Supplier 1 is from Denmark. It produces product for stock only for their domestic market. They do not hold any stock for export. Orders have to be placed during a certain period of the month. At the beginning of the year A1 gets their production plan, with information on production numbers, estimated day of delivery of ordered items, and a date span in which the orders have to be placed. This is the reason why A1 has implemented a periodic review policy for this particular supplier. Orders are made on the 15^{th} day of the month.

There are no restrictions regarding order quantity by supplier. Supplier organizes the transport of products, and delivers the products via their partner logistics enterprise once per month. Transport cost is paid by A1. LT for this supplier is 6 weeks, and procurement period is 4 weeks. Procurement period is time until next order will be placed. Products are delivered with international labels, so A1 must print and label all the items. Shelf life of the product is 9 months, which is an important factor. It determines the size of the order, since A1 wants to minimise the risk of obsolescence costs. Demand can vary between months. The lowest demand is at the beginning of the year. Higher demand is during spring and autumn, since wellness, fit and sport active people are one of the main target groups for these products.

Supplier 2 is a German supplier. It holds products on stock, and has a LT of 2 weeks from the day of receiving an order. Continuous review policy is conducted for this supplier. Supplier's minimal order quantity requirement is one mix pallet. Transport is organised and paid by A1. Products are delivered with international labels, so A1 has to print and label all the items. Shelf life of the product is 12 months. This minimises risk of obsolescence cost because of expiry of the product. Demand can vary between months. Since these are drinks, the lowest demand is at the beginning of the year, and the highest demand is during summer time.

Supplier 3 is an Italian enterprise. They hold product on stock, and according to the contract lead time is 4 weeks, but in practice it is usually 2 weeks from the moment of order confirmation. Continuous review policy is conducted for this supplier. Supplier's minimal order requirement is one mix pallet, and a full layer per product has to be ordered. Transport is organised and paid by A1. Products are delivered with international labels, so A1 has to print and label all the items. From the next business year the supplier will make and label the best-selling items with Croatian labels. Shelf life of the products is 24 months, which means that risk of obsolescence cost because of expiry of the product is almost nil. Demand varies in the course of the year. During summer month it is the highest because of the impact of the tourist season.

Supplier 4 is from Belgium. It produces natural cosmetics and sun care products. The products have a seasonal character. The supplier holds its products on stock, and lead time is 2 weeks after the order confirmation. The first order for this supplier is made in March, and last order is made at the end of June. Inventory is reviewed continuously. It is important that the last order is well planned, so that minimal or no inventories are left at the end of season. Minimal order requirement is one mix pallet. Transport is organised and paid by A1. Products are delivered with international labels, so A1 has to print and label all the items. Shelf life of the product is 24 months, which means that risk of obsolescence cost because of expiry of the product is almost nil. Besides high product seasonality, with season starting in May and lasting until end of August, demand also depends on weather conditions.

4.3.2 Description of the Buyers

A1 implemented indirect distribution, according to which the product goes to the intermediate / retailer which is a buyer for A1, and finally to the end customer. Enterprise's main buyers are:

- drug stores chains;
- retail chains;
- specialized shops/chains;
- pharmacies wholesalers/pharmacies and;
- HORECA wholesalers.

Since A1 deals with premium products, selective distribution strategy is carried out. At the moment, the products can be found in more than 400 points of sale in Croatia. As a standard, A1 has the following minimal requirements of sales and logistics for its buyers:

- minimal value of order of 1,000.00 HRK;
- ordered products must be in original transport boxes;

Minimal order value is based on the average transport costs per parcel of 40 kg and 0,3 m^3, which are 75.00 HRK, or 7.5% of the sales value. When we add to these costs the transport costs that the enterprise has to pay for transport of shipments from the supplier, we reach the upper limit of the level of transport costs as percentage of enterprise sales turnover. This limit was mentioned in theoretical part in Chapter 2.4. of this work and it equals 8.16% for food and drinks.

At the same time A1 is committed to have a service level of 97%. This limit was set up according to the contract with one of the larger clients, based on professional experience. As we could see in the theoretical part there are different definitions for service level, and in A1 the service level is defined as the percentage of individual items ordered by the customer that is issued from stock on hand. Service level in A1 is measured for each

product, counting the total number of items delivered and dividing it by the total number of items ordered.

Delivery time for a customer order is 48 h from the moment of the receipt of the order or payment in case of new customers. Islands are the exception where delivery is according to 3PL timetable. Deliveries are Monday to Friday, during normal business hours. Orders are mostly received by e-mail or fax. EDI is implemented with two clients. Whenever possible, the enterprise tries to get sales forecasts from their most important clients, in order to avoid possible stock-out. Usually it is not possible to get the formal forecast for regular sales. For the introduction of new items and promotional activities customers provide sales forecasts based on their experience and number of points of sale.

Buyer one is a Croatian retailer with network with 700 points of sale. A1 products are positioned only in largest points of sale. They are positioned on healthy food or organic food shelf within the shops. Products are delivered to their two distribution centres, which work as cross docks. They collect orders from all points of sale and make a central order. Order is delivered within 24 h to the central warehouse, and in 72 h hours to the each point of sale for which products have been ordered. Products are ordered just for the shelf, which means that the level of the inventory for A1 products is defined by shelf capacity in their system. They place orders daily over EDI, and A1 sends back delivery notes also via EDI. VMI is possible for additional payment by the supplier, but it is intended only for the largest distributors.

Buyer two is a drug store chain with over 150 points of sale. They have a central warehouse, and place orders once per week on a fixed day. Delivery is 48 h from the moment of order receipt, also on the predefined day of the week. Order day and delivery day change only in case of a public holiday. Otherwise, the change of the day of delivery is possible, but additional fee is than paid. They hold a stock of monthly demand in their central warehouse for each A1 product, and this is part of their inventory policy. They service their points of sale from the central warehouse daily. Points of sale have stock on the level of shelf capacity.

Buyer three is an organic food chain with 18 points of sale. Shortly after the beginning of collaboration with them A1 established delivery to their central warehouse. The main reason for this decision was that some points of sale could not reach a minimal level of order value, and this decision was jointly reached in order to have product within the whole chain. As they are still developing the central warehouse system for its domestic suppliers they have the flexibility to place orders according to their needs, any day of the week. A delivery time of 72 hours from the moment of order receipt is defined. They keep products on stock in their central warehouse. According to orders of each of their points of sale they send them the ordered articles daily. Points of sale have stock on the level of shelf capacity.

Minimal order value is one of the problems from the perspective of inventory management. Therefore the enterprise should reconsider a possibility to lower the required value level. This might increase sales and inventory turnover. On the other hand, lower values increase transport costs. The next problem are forecasts of sales that buyers are not willing or obliged to give, this being a matter of their good will, because they are avoiding possible responsibility. Buyers' forecasts would make the whole process of inventory management much easier, lead to higher sales during promotional activities, and potentially help the enterprise to lower inventory cost in the end. A better communication and reliable relationships must be reached as a part of win-win situation.

4.3.3 Description of the Inventory Policy

The whole process in A1 starts by placing order from A1 to the supplier. The owner is making orders on a regular basis, based on the analysis of monthly demand which is done in spreadsheet. The quantity to order (*Q)* for the each item is calculated automatically by the spreadsheet formulas. The periodic inventory policy is conducted for Supplier 1, for which the order is placed at 15th day of the month. Continuous review policy is conducted for the Suppliers 2, 3 and 4.

When preparing an order for each item, the following parameters are taken in account:

- stock on hand (equals ROP);
- average demand per month;
- sales of previous month;
- lead time in weeks (LT), and;
- procurement period in weeks (PP).

For Supplier 1, orders are placed every four weeks (PP), with the LT of six weeks. Q for each item is an average monthly demand. The SS equals two weeks' average demand for each item.

In cases of other suppliers, where the continuous review policy is conducted, the enterprise orders each item with the stock level at/or near ROP. All the items near ROP from the same supplier are ordered. Currently, ROP is based on subjective opinion, i.e. experience of the owner, and it is set at a level of two weeks' average demand. Q for each item is the average monthly demand. Since LT for those suppliers is two weeks, the enterprise does not hold any SS for those suppliers.

Restrictions that are taken into account when placing an order for each supplier are minimum quantities required by supplier, which are specified in Chapter 4.3 for each supplier, and restrictions set up by A1. A1 order restrictions are:

- minimum quantity of one pallet, single or multiple products;

- order in full case packs;
- minimum order value for which transport cost are maximum 10-15% of the value;
- preferably bundling of products from the same supplier.

The demand forecast is based on historical monthly sales data. A1 assistant makes reports available extracting them from ERP. Reports contain monthly sales data. They are being exported to excel sheet for each product, and saved for each supplier. To make forecast as accurate as possible, A1 takes into account additional variables like price, season and promotional activities. They are based on a subjective estimate done by buyers' traders in case of promotional activities, or subjective estimate of the enterprise owner who is responsible for the final demand forecast.

A1 finances the entire inventory from its own capital at the moment, which is important in the calculation of the cost of capital. As already mentioned, A1 is committed to provide a service level of 97%; which was set up according to the contract with one of the biggest clients.

4.3.4 Description of the Logistics, Purchasing and Distribution

A1 outsourced logistics to a 3PL partner. As A1 is a start-up, 3PL was chosen as a support of a startup operation, with minimal capital requirements and without any investment in resources to deploy this operation. Further reasons for outsourcing include cost reductions, flexibility, reduction of risk, operational efficiency, higher service level, customer satisfaction and access to all required resources without any investment. A one-year contract with the 3PL partner was signed, with automatic extension for another year. Contract termination is possible during first year without prior notice, which was a requirement on the part of A1.

According to current needs of A1, the following logistics services are outsourced to 3PL:

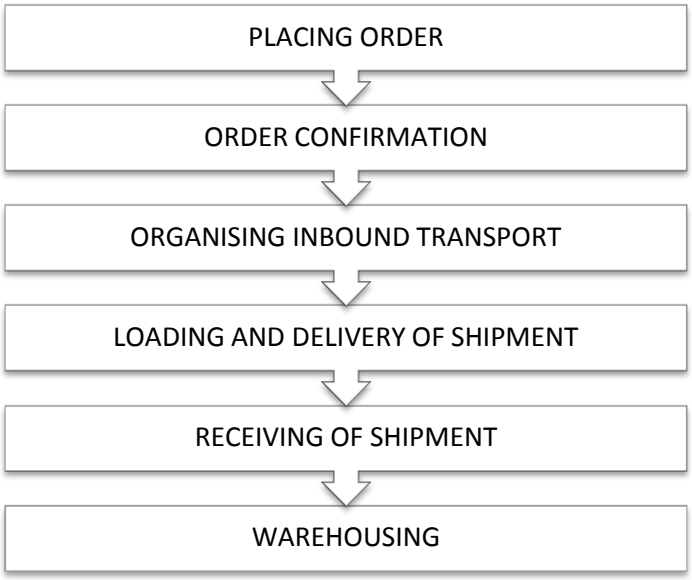
- transport (inbound and outbound);
- warehousing;
- returns and reverse logistics;
- standard value added services: labelling and foil wrapping;
- complementary value added services: packaging and other services based on request.

All supplier orders are delivered to the 3PLs warehouse, there the products are stocked, labelled and delivered to A1 customers according to their orders. Agreed logistics standard process includes:

- entry of products/purchasing process (inbound);
- picking and delivery of products/ ordering process (outbound), and;
- reversed logistics.

A1 purchasing process is shown in Figure 7.

Figure 7. A1 Purchasing Process

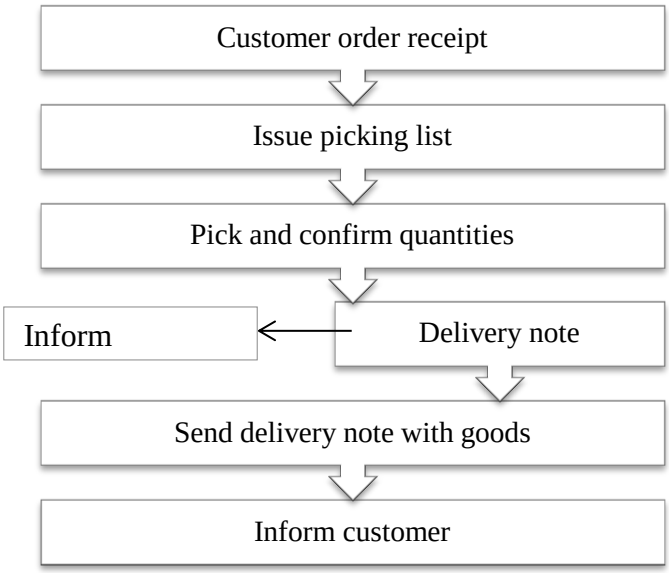


The purchasing process starts by placing an order to the supplier, which is sent by e-mail. After the order is confirmed, the supplier sends details about the shipment. A1 uses this information to organise transport to the 3PL partner, resulting in loading and delivery to the 3PL's warehouse. Most of information flow is done by the e-mail, and the shipment is delivered by truck. A1 announces one day in advance to the 3PL which items are coming, by e-mail in spreadsheet format. At the receipt of the shipment the warehouse operator unloads the truck, makes sure that the delivery matches the order/announcement, inspects products for damage, sorts them and sends to A1 for confirmation of receipt. The receipt contains quantity, batch number and shelf life. It is being sent in pdf format by e-mail.

Received items are then moved into storage. Agreed unit of storage is pallet space, and one item is stored per pallet. Items are stored in controlled conditions until needed. At this stage the 3PL staff has to label all items. The printing of the labels and applying labels on the products is performed by the 3PL according to the order from A1 staff. All the labels are printed just in time. Labels ordering, printing and delivery is organised during lead time of the shipment from the supplier. Lead time for printing labels is 3-4 days. 3PL has its own partners who print the labels.

A1 order processing is presented in Figure 8, and all elements of this process are described below.

Figure 8. A1 Order Processing



Order processing is next part of the logistics. It deals with the orders submitted by the customers and ensures that their deliveries are properly organized. After receiving the customer order, A1 assistant enters the order into the system and prepares a picking list, which is sent by e-mail in spreadsheet format to the warehouse operator. The customer places orders to A1 in different ways, by EDI, by sending e-mail orders, telephone or fax. The orders should be complete, specific and accurate, have to include order number, place and date of delivery, customer code per item, order quantity and they could be in spreadsheet, text or similar format. Based on the picking list, the warehouse operator starts with order picking, finds and removes products from shelves and gets them ready for delivery to the customers. Ordered items are located, identified, checked, consolidated into a single load, wrapped and moved to a departure area for loading onto delivery vehicles.

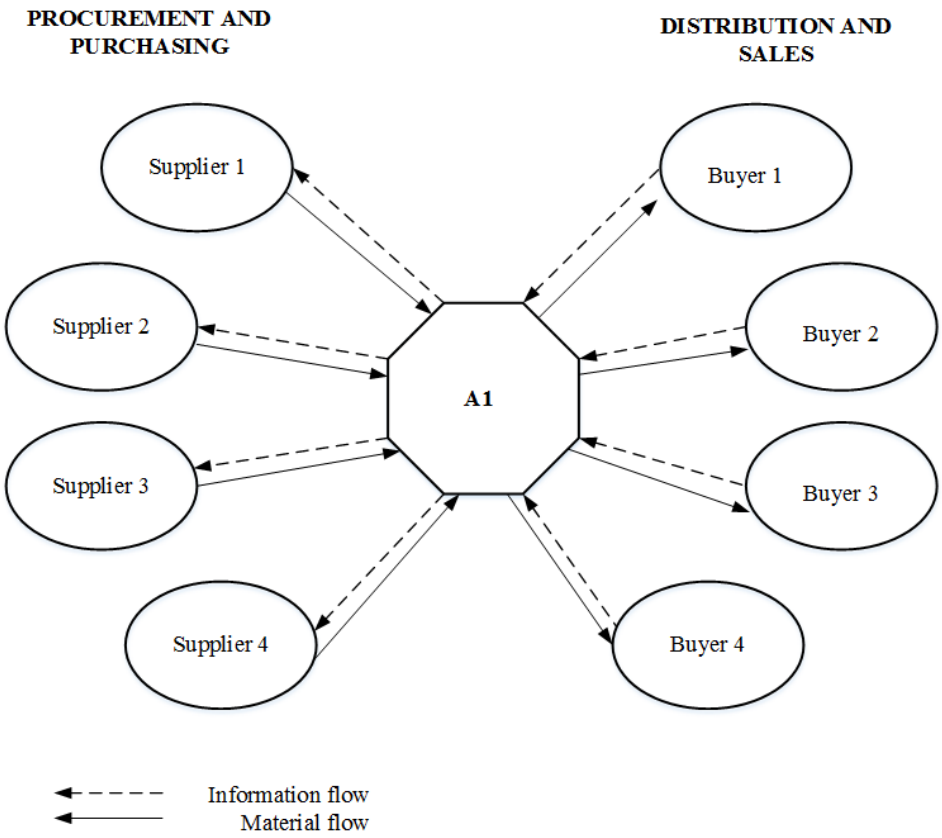
After an order is prepared, the warehouse operator confirms quantities and sends a batch number for each item. Delivery note is then prepared by the A1 assistant, and sent to the 3PL's warehouse operator. Delivery notes are printed at 3PL's and bundled with the shipment. Customers are contacted by A1 assistant regarding orders only in case of deviations and changes, or in case of their specific requirements. Delivery notes and invoices are sent to several customers before an order is being delivered to them. Estimated delivery time is 24 hours from the receipt of order, except for the islands.

Inbound and outbound transportation as well as whole logistics are carried out by the same enterprise. Truck transport has been chosen at the moment as most appropriate. One 3PL operator is chosen in order to minimise costs and time slack. The enterprise assistant gives an order to 3PL international transport department to collect shipment at the premises of a given supplier and to deliver it to the warehouse in Croatia.

The last logistics operation is reversed logistics when products are returned back to A1 because of wrong or damaged deliveries, short shelf life of products, product recalls, and functional returns. The latter refer to A1 pallets.

Based on above described processes of procurement, purchasing, distribution and sales I made a distribution network in SC for enterprise A1, as shown in Figure 9.

Figure 9. A1 Distribution Network



An integral part of the contract with a 3PL partner is a pricelist for warehousing, manipulation and transport. 3PL partner makes a proposal for every logistics service based on A1's internal assessment of current and future needs. Different fees shown in Table 7 are defined based on following monthly parameters:

- required number of pallet spaces;
- number of the purchase orders;
- number of pallets per purchase order;
- number of sale orders;
- average number of items per order, where the order of one item, regardless the quantity is defined as a line.

Table 7. A1 Logistics Fees According to Contract with 3PL

Type of Fee	Definition	Price Unit
Storage Fee	pallet space of 20 m2, average monthly number of the pallet spaces is invoiced	pallet
Receiving fee for the mix pallet	fee charged for the physically received goods, in case of the mix pallet	line
Receiving fee for the pallet	fee charged for the physically received goods, in case of full pallet	pallet
Order Fee per parcel	fee charged for picking and preparing of a parcel	parcel
Order Fee per pallet	fee charged for picking and preparing of a pallet	pallet
Oder fee per line	fee charged per each line of picking order	line
Administrative fee	all the necessary paperwork related to working with an order	order
Fee for valued added services: wrapping	fee charged for stretch wrapping of the pallet, in order to protect pallet from damage	foil kg
Fee for valued added services: labeling	fee for sticking the label on each product and box	label
Fee for valued added services: return of the documents	fee for return of signed delivery note from the buyer	delivery note
Fee for other material costs	fee for purchasing labels, packaging (transport boxes)	label/box
Shipping fee for the parcel (outbound transport)	amount charged for transporting parcels from warehouse to buyer. Varies per size of parcel, but is same for the whole country.	parcel
Shipping fee for the pallet (outbound transport)	amount charged for transporting pallets from warehouse to buyer. Varies per zone. All cities are classified in different zones, depending of distance from the warehouse.	pallet
Shipping fee for the pallet /more pallets (inbound transport)	amount charged for transporting goods per pallet from the supplier to the warehouse. Varies per place of loading/supplier and number of pallets. It decreases with the number of pallets.	pallet
Shipping fee for full truck (inbound transport)	amount charged for transporting full truck from warehouse to buyer. Varies per place of loading/supplier	truck

At the beginning of the cooperation with the 3PL partner, it was agreed that we will search for possibilities of lowering the contract prices, after the initial period of cooperation.

4.3.5 Description of the ERP System

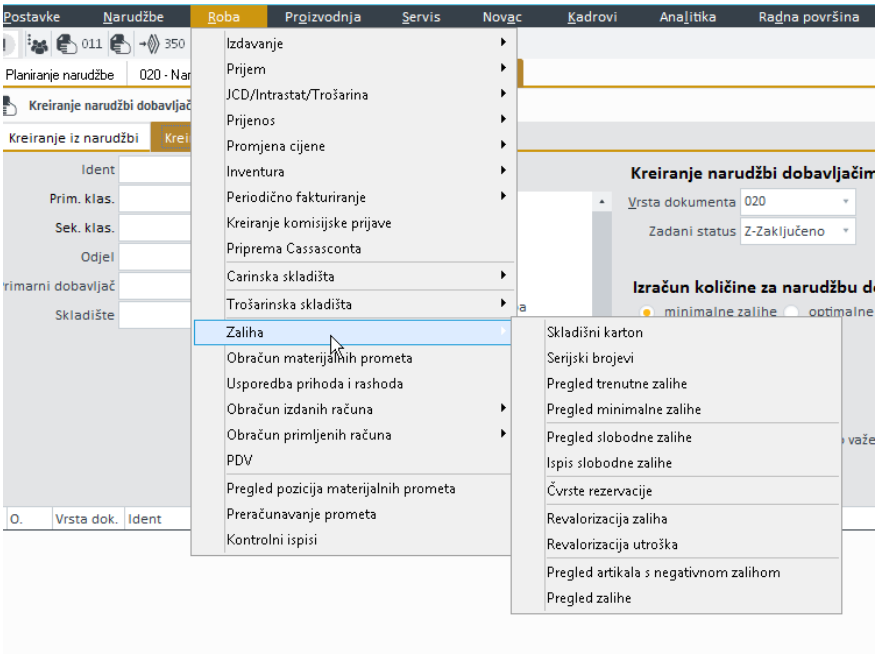
A1 uses the ERP system called “Pantheon”, which is package branded for SMEs. Developed by Datalab, it is an ERP system for SMEs. It covers the basic functions needed

for comprehensive business operations, financial management, sales management, inventory management and warehousing, E-business and online stores, travel management and basic HRM. The ERP system was chosen based on recommendation of ERP system experts, taking into account the current size of business and future plans for development.

Despite the fact that it is a package-branded ERP, it was adjusted to the needs of A1 as much as possible. The whole implementation period was planned to be 6 months, and it is now at the end of implementation. The focus was on modules which enable basic operations such as receiving orders, and all phases of order processing from issuing order, creating the picking list, issuing delivery notes and invoices. Most of these elements are adjusted to A1 needs. A key advantage of this ERP is a one-time data entry, which was also one of the reasons when deciding for higher investment into this IS instead of selecting some cheaper solutions.

Warehouse and stock module of this ERP is important for a part of the inventory management. It enables receiving and issuing of invoices which is linked with warehouse transfers and stock operations. All the invoices are automatically deducted from the stock at the warehouse. The ERP also performs a range of stock controls, preventing from issuing items that are not in stock. Overview of warehouses and stock is visible at all times. Filters with multiple parameters can be used to quickly locate items in the program. Inventory reports includes warehouse cards and current stock reports, periodical reports of items received or sold, overviews of current, available, and signal stock. All inventory reports can be seen in Figure 10.

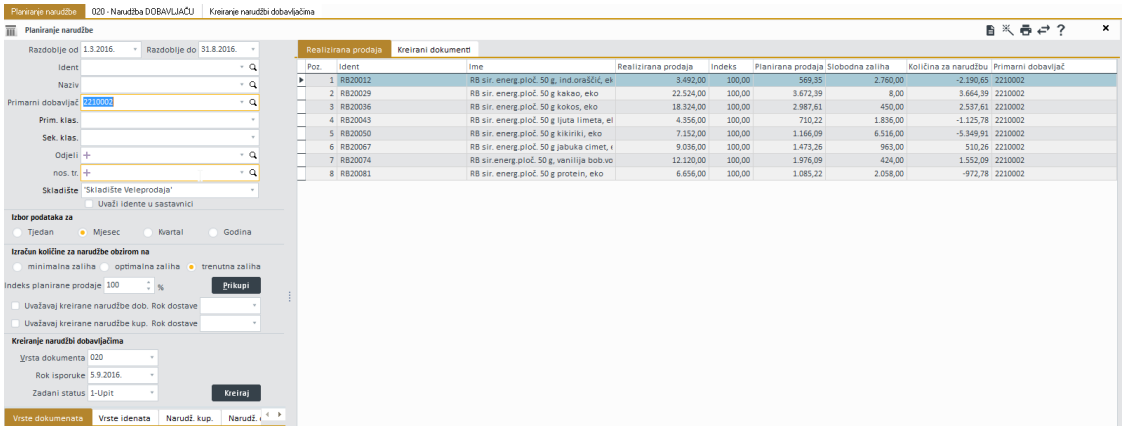
Figure 10. Pantheon Inventory Reports



Source: A1 d.o.o., *Pantheon ERP*, 2016.

Next important part of ERP is the “Order module” which is used to keep track of received orders, offers and preliminary invoices for customers, and issued orders, inquiries and preliminary invoices from suppliers. A system of statuses is used to track orders throughout the order cycle. This module enables to keep track of sales orders and purchase orders, with linking order operations with stock. “Order planning” is one of the tools to plan and create orders. Orders can be planned based on different parameters like: period of time, item or supplier, warehouse, sales data (weekly, monthly, quarterly, annually), projected trend of sales, taking in account minimal, optimal or current stock. ERP calculates quantity to order based on average sales per selected time unit. Order planning is shown in Figure 11.

Figure 11. Pantheon Order Planning



Source: A1 d.o.o., *Pantheon ERP*, 2016.

The largest aid of ERP is providing the A1 staff with updated information about inventory records every day for all items so that they can capture the right data to support their decisions regarding inventory. Currently, an ERP analytic tool is used in A1 to do monthly analyses of sales. Demand is projected using this analysis. Monthly reports of sales per item together with stock data on hand per item are exported to a spreadsheet. Stock now on order but not yet received is manually entered by the assistant. Further analyses are done in the spreadsheet, including calculation of average sales, as well as quantity to order according to equation 8 described in Chapter 4.3.3. on inventory policies.

The full functionality of the ERP is still not used. Information on optimal and signal inventory is still not entered into the ERP. These parameters should be revised quarterly, so that they are always updated following the current development of demand on the market. Finally, e-business functionalities are integrated into the ERP and are easy to use. A1 uses e-business functionalities in collaboraton with 3PL, buyers and suppliers. These functionalities allow automated export of preliminary invoices, offers, picking lists, delivery notes and invoices to PDF or spreadheet and delivery via e-mail. There is a possibility of further integration with the 3PL provider, as well as with some other service providers.

4.3.6 Defining the Perceived Problems

The enterprise started activities just few months ago. At this very beginning good foundations should be established, and a most appropriate model for logistics and inventory management should be chosen.

In order to minimise logistics and inventory cost and maximize profitability the following problems should be analysed:

(1) suppliers:

- current conditions - check possibilities to negotiate better conditions, in fields of lead time, minimum order size, transportation costs, pricing terms etc.;
- A1 bears part of logistics costs that are supplier costs, for example labelling costs. How would the transfer of this cost influence A1 logistics costs and would it be reasonable to transfer them to the suppliers;

(2) inventory policies:

- validity of calculated average sales, SS, ROP and input data for LT, delivery time, PP;
- at the moment all items are at same level of priority for A1. Necessity of classification of items; for better allocation of resources, time and focus;
- level of total inventory costs, are there any possibilities for their optimisation;

(3) logistics, purchasing and distribution:

- logistics outsourcing was chosen as the only and fastest solution. Check economic reasons for this solution, compare it with insourcing and make simulation of costs with turnover increase;
- detailed classification of logistic and inventory costs, possibilities for cost savings;

(4) ERP system:

- underutilization of use of ERP system possibilities in inventory management, possible ways of improvement.

4.4 Preliminaries for the Quantitative and Qualitative Analysis

4.4.1 Data Collection Methods

In this chapter, I present the parameters used as input data for the model, the model itself and the procedure for verifying the model's accuracy. Based on author's own experience

and the purpose of this thesis, the applied data collection methods provided a good foundation for qualitative research. I collected data from multiple sources such as: databases of A1 enterprise, databases from the former enterprise, data from retailers and suppliers and the 3PL enterprise. Since the enterprise has been in operation for only a short period of time, in this work I used historical sales data and historical average inventory data for three months of operation. For the purpose of this research I calculated and used average levels. The presumption was that purchase prices per item, wholesale prices per item and logistic fees per unit will remain the same for next 12 months.

Costs were classified in a manner that enables the calculation of total logistic costs and make comparison of logistic outsourcing vs. insourcing. Furthermore, costs were classified in order to calculate inventory holding or carrying costs and order costs, as these are parameters needed for analysed inventory models.

Regarding historical sales data I collected the monthly sales data for the first three months of operation in 2016, both in values and in units. For the seasonal items, I collected historical sales data for 2015, which I obtained from the former distributor. The forecast for 2016 is based on average monthly sales per each item in units, and from there I calculated annual sales/turnover in Euros for 2016. All the values are recalculated from Kuna to Euros, by using standard exchange rate of 1€=7.50 HRK.

The values of costs and accordingly calculated logistics costs are also historical data for the first three months of operation in 2016, and are expressed in Euros. For the purpose of this approach in the next chapter I use average logistic costs per month. The capital cost for the enterprise is calculated as opportunity cost of use of private equity which is source of financing the inventory. As opportunity cost in this case I chose the savings interest rate, which is based on market research, and it is 2%. The costs of depreciation are predicted based on my own experience and are on the level of 5%, and cost of obsolescence and damage is 2%.

Average inventory is based on historical data for the first three months of operation, both in units and in Euros by purchasing prices. According to the contracts with most important partners, A1 wants to guarantee 97% service level to retailers. The service level corresponds to the probability that the customer demand is satisfied from stock. I presume that factories' warehouses always have sufficient stock to meet the orders from upstream levels of the SC.

I also collected primary data from the enterprise's ERP and by interviewing 3PLs and suppliers. As I am the owner of the observed enterprise most of the information used in this thesis is from my own practical experience.

4.4.2 Structure of the Model and Model Accuracy Validation

In this subsection, I describe the structure of the model, methodology of calculations and explain the methodology for validation of model accuracy. The aforementioned data in the previous subsection, such as historical data sales, monthly demands, average inventory levels, logistic costs, lead and delivery times, inventory holding costs, inventory order costs and service level I use as basic input parameters for the development of the quantitative model based on the theoretical logistic and inventory models introduced in chapter 2 and chapter 3.

For the purpose of quantitative analysis and design of appropriate model for logistics and inventory management, I developed a quantitative model in a spreadsheet. Quantitative data in a spreadsheet were used for forecasting demand, analyses of costs in case of different approaches of logistics, analyses of logistic and inventory costs, ABC analyses, as well as for the simulation of different scenarios for different levels of turnover.

As to the dilemma of logistics insourcing vs. outsourcing all arguments why outsourcing was chosen is described in quality analyses. Afterwards, logistics costs are classified and average logistics costs are divided by average sales turnover, based on historical data for 2016 and forecast for the same year. The result was benchmarked with the same ratio in different industries presented in theoretical part of this thesis.

Logistics costs are classified and expressed as percentage of sales turnover, and percentage of total logistics cost. Inventory costs are classified according to classification from the theoretical parts of this thesis, and expressed as percentage of average purchased value of products.

For the purpose of inventory turnover rate, historical data for first three months of operation were used in order to calculate average levels of unit sales per month and average inventory per month. Then, average unit sales per month were multiplied by twelve and by the purchasing price per item. By dividing the cost of goods sold with average inventory, I calculated inventory turnover rate, based on which evaluation of efficiency of current inventory management and policy can be made.

4.4.3 Credibility / Reliability

The theoretical framework of this work was built based on scientific articles and books ensuring the credibility of the theories that were used in this thesis. When it comes to data collection, as the author is the owner of the enterprise the collected data is credible, she should be proficient in the enterprise's business activities and routine operations. As already stated, there is almost no literature on the subject of SCM or logistics for SMEs. However, the study is not longitudinal and the presented managerial decisions must be tested over time, hence the limitations in the credibility and reliability of this chapter.

5 EMPIRICAL ANALYSIS

5.1 Logistics Outsourcing vs. Insourcing and Analysis of Logistics Costs

A1 outsourced logistics to a 3PL partner. The main reasons for this decision are specified in chapter 4.3.4. Since this was a decision without a broad analysis, in this part I want to check its validity. Also, in this chapter I will check and compare logistics costs in case of business growth and increase of sales turnover.

A simple analysis was made to compare monthly logistics costs in case of outsourcing, and in case of insourcing. All outsourcing logistics costs are calculated according to price list of A1 with its 3PL partner. They are based on average values of each fee for first three months of operation.

In the case of insourcing based on experience the following assumptions can be made:

- rent of warehouse of 100 m2, 42 pallet spaces;
- 1 warehouse employee with average gross wage;
- leasing of 1 forklift;
- leasing of IT equipment;
- outsourcing of transport.

At the top I put the costs that are different in these two options - storage and cost of manipulation in case of outsourcing, all of which are variable costs. Rent of warehouse, cost of manipulation and overheads are a fixed cost. All other costs are assumed to be the same in both options, which includes: value added and material warehouse costs, ICC and transport costs. At the forecasted sales turnover it is obvious that the enterprise made a good decision to outsource logistics. In case of outsourcing all logistics, the total costs is 3,392.78 €, which is lower than in option of insourcing and partly outsourcing when the costs would be 4,032.22 €. In Table 8 I present the list of all logistics costs in case of insourcing and outsourcing.

Table 8. Average Monthly Logistics Costs in Case of Outsourcing and Insourcing

OUTSOURCING		**INSOURCING**	
Cost	**Average Cost per Month (€)**	**Cost**	**Average Cost per Month (€)**
Storage fee 21 pallets	147.00	Warehouse renting 100m2/42pallets	500.00
Manupulation costs		Manipulation and overhaed costs	
Receiving fee for pallet	5.00	Cost of work	712.67
Receiving fee for mix pallet	37.60	Cost of equipment	400.00

Continued

Table continues

OUTSOURCING		INSOURCING	
Cost	**Average Cost per Month (€)**	**Cost**	**Average Cost per Month (€)**
Fee for valued added services: labeling	833.58	Cost of IT equipment	200.00
Order fee per parcel	81.45	Overhead costs	300.00
Order Fee per pallet	36.90		
Oder fee per line	159.00		
Administrative fee per order	172.70		
Total costs of warehouse and manipulaton	1,473.23	Total costs of warehouse, manipulation and overhead	2,112.67
Value added and material warehouse costs		Administrative and material costs	
Fee for valued added services: return of documentation	182.50	Administrative fee for return of documentation	182.50
Fee for valued added services: wrapping	133.25	Material costs of wrapping	133.25
Fee for other material costs (labels)	76.25	Material costs (print of labels)	76.25
Fee for other material costs (packaging)	55.60	Material costs (packaging)	55.60
Total value added and material warehouse costs	447.60	Total administrative and material costs	447.60
Inventory carrying costs		Inventory carrying costs	
Insurance costs + 0.3% of net sales value	98.95	Insurance costs + 0.3% of net sales value	98.95
Capital costs (2% interest rate)	42.07	Capital costs (2% interest rate)	42.07
Obsolence, damage etc. 2%	42.07	Obsolence, damage etc. 2%	42.07
Other risk costs (5% depreciacion)	105.18	Other risk costs (5% depreciacion)	105.18
Total inventory carrying costs	288.27	Total inventory carrying costs	288.27
Transport costs		Transport costs	
Outbound transport	585.18	Outbound transport	585.18
Inbound transport	598.50	Inbound transport	598.50
Total transport costs	1,183.68	Total transport costs	1,183.68
Total logistics costs	3,392.78	Total logistics costs	4,032.22

In Table 2 of Apendix C, I made a simulation of how business growth would influence the logistics costs. In scenario 1, the turnover was increased by 100%, and in scenario 2, it was increased by 200%. I assumed that all other variable parameters were proportionally increased. Fixed costs remain the same in scenario 1, and in scenario 2 the assumption is that one more warehouse employee would be needed. Results show that in both scenarios logistics costs in case of insourcing would be lower, 5,928.31 € (Scenario 1) and 11,144.67 € (Scenario 2). The logic of these figures becomes obvious when compared to logistics costs in case of outsourcing which would be 6,762.10 € in Scenario 1, and 13,512.25 € in Scenario 2, respectively.

From Table 8 it is visible that certain costs have a large share in the overall logistics costs, especially the costs of value added services. Between them I could point out the fee for for the labelling, which was unexpected, as this is not a core service of 3PL. Outsourcing would be a better option in all scenarios if A1 finds a solution for the value added service of labelling of the products. This means that there should be space for lowering other costs as well, which will make outsourcing even more attractive.

I recommend that A1 carefully analyses the logistics costs and their trends during the initial 12 months of cooperation. On such a basis A1 will be able to single out the costs which deviate in relation to the overall logistics costs, and use these findings to negotiate a lower price with the 3PL partner in the future. Moreover, based on this analysis, A1 can undertake further steps in lowering logistics costs and pass some of the costs to suppliers, like: other material costs (printing labels) and cost of labelling.

In order to make benchmarking with level of logistics costs which were found in studies undertaken by Datamonitor (2008) in the UK and by Rushton et al. (2010), I made a classification of logistics costs in the A1 enterprise. Logistics costs can be identified based on invoices of the 3PL partner. All logistics costs are classified into transport costs, warehouse costs, inventory investment and administration costs.

The definition of each fee can be found in chapter 4.3.4, and types of logistics costs are defined in the theoretical part of this work. Capital cost is evaluated as opportunity cost, which is interest rate since the owner's investment is the only source of finances. I evaluated the cost of capital on the level of interest rate by a commercial bank, and 2% is taken as cost of capital. Insurance cost is based on fixed part according to invoice, and a variable part of 0.30% on forecast sales for current year; 5% for obsolescence and 2% for depreciation costs is an estimation based on owner's experience. A1 classification and the level of each logistics cost as percentage of total logistics cost is presented in table 9.

Table 9. A1 Classification of the Logistics Costs

Fee	Type of Logistics Costs	% of Total Logistics Cost
Storage fee	Warehouse costs	4.33
Receiving fee for pallet	Warehouse costs	0.15
Receiving fee for mix pallet	Warehouse costs	1.11
Fee for valued added services: labeling	Warehouse costs	24.57
Order fee per line	Warehouse costs	4.69
Order Fee per parcel	Warehouse costs	2.40
Order Fee per pallet	Warehouse costs	1.09
Fee for valued added services: wrapping	Warehouse costs	3.93
Fee for valued added services: packaging	Warehouse costs	1.64
Order fee per line	Administration costs	5.09

Continued

Table continues

Fee	Type of Logistics Costs	% of Total Logistics Cost
Fee for valued added services: return of documentation	Administration costs	5.38
Fee for other material costs (print of labels)	Administration costs	2.25
Insurance costs + 0.3% from net sales value	Inventory costs	2.92
Capital costs (2% interest rate)	Inventory costs	1.24
Obsolence, damage etc. 2%	Inventory costs	1.24
Other risk costs (depreciacion) 5%	Inventory costs	3.10
Shipping fee (Outbound transport)	Transport costs	17.25
Shipping fee (Inbound transport)	Transport costs	17.64
Total logistics costs		100.00

In Table 10 I showed logistic costs classified in four categories as percentage of sales turnover and as percentage of total logistics costs.

Table 10. Logistics Costs as a Percentage of Sales Turnover and Total Logistics Costs

Logistics Costs	% of Sales Turnover	% of Total Logistics Costs
Transport costs	4.36	35.00
Warehouse/Depot costs	5.49	44.00
Inventory Investment	1.06	8.00
Administration costs	1.59	13.00
Total logistics costs	12.51	100.00

According to the above calculation, the enterprise A1 has the logistics costs of 12.51% of the sales turnover. These results for logistics costs are benchmarked with different findings in studies presented in the theoretical part of this work. The calculated level of A1 logistics costs are in line with the benchmark of logistics costs as percentage of sales turnover, calculated by Datamonitor from 2008, according to which the overall logistics costs for the food industry are 13.73% of the sales turnover. When we break down logistics costs for A1 we could notice that the highest portion is taken by the costs of warehousing, which are 44% of total logistics costs, and within them the fees for valued added services are labelling (hereinafter: labelling costs), which are 24.57% of total logistics costs.

Due to such a high share of the labelling cost, A1 should undertake steps in order to lower them, or even avoid them entirely. As described in chapter 4.3.1, A1 is negotiating with its suppliers the possibility that they print Croatian labels, which is very common practice in the food industry. My proposal to A1 is to avoid labelling cost, which represents a part of the warehouse cost and pass this cost to suppliers, especially for the most important products with the highest turnover.

In simulation for transferring 50% or 100% of labelling costs from A1 to the supplier important cost savings are obtained. In case of transferring 50% of this cost to the supplier,

the total logistics cost for A1 would drop to 10.83% of the sales turnover, and the warehouse cost would drop to 37% of the total logistics costs. On the other hand, by transferring 100% of this cost to the supplier, total logistics cost would drop to 9.15% of the sales turnover, and the warehouse cost would drop to 26% of the total logistics costs. All other costs are at a satisfactory level and the enterprise should keep control over other logistics costs and maintain their level in the future.

5.1.1 Classification of the Inventory Costs

In order to benchmark inventory costs with the most common level of these costs in different industries, all costs connected with inventory were classified. The same has been done for logistics costs connected with inventories which were extracted from invoices of 3PL partner, for first 3 months of collaboration. All costs are classified into holding costs and order costs, and then to subtypes of these costs. In Table 11 the classification of inventory costs is displayed, as well as classification of subtypes of holding and order costs.

Table 11. Classification of the Logistics Expense into Inventory Cost

3PL Fee	Type of Inventory Costs	Subtype of Inventory Costs
Storage fee	Holding costs	Occupancy costs
Receiving fee for pallet	Order costs	Order costs
Receiving fee for mix pallet	Order costs	Order costs
Fee for valued added services: labelling	Holding costs	Handling costs
Order fee per line	Holding costs	Handling costs
Order fee per parcel	Holding costs	Handling costs
Order fee per pallet	Holding costs	Handling costs
Fee for valued added services: wrapping	Holding costs	Handling costs
Fee for valued added services: packaging	Holding costs	Handling costs
Order fee per line	Holding costs	Handling costs
Fee for other material costs (print of labels)	Holding costs	Handling costs
Insurance costs (fix+0.3% from net sales value)	Holding costs	Miscellaneous costs
Obsolence, damage etc. 2%	Holding costs	Obsolescence costs
Other risk costs (depreciacion) 5%	Holding costs	Miscellaneous costs
Shipping fee (inbound transport)	Order costs	Order costs

Based on the classification of inventory costs from the above table, average inventory cost is calculated per type of inventory cost, and expressed as percentage of average purchased value of products at purchasing prices. Average purchased value of products at purchasing prices is calculated for the same period of operation of A1. A1 inventory costs as percentage of average purchased value of products are displayed in Table 12.

Table 12. A1 Inventory Costs as Percentage of Unit Costs

Inventory Costs	% of Average Purchased Value of Products
Holding costs	
Cost of capital	0,30
Obsolescence costs	0.30
Handling costs	10,90
Occupancy costs	1,00
Miscellaneous costs	1,40
Total holding costs (I)	14,00
Order costs	
Transport costs	4,20
Receiving costs	0,30
Total order costs (II)	4,50
Total inventory costs (I+II)	18,50

By benchmarking A1 total inventory costs as percentage of average purchased value of products with textbooks on inventory management, the calculated level for inventory cost in case of 2% interest rate is 18.50%. In both cases, inventory cost of A1 is in line with the literature. The period of three months which was observed is too short to make any relevant conclusions. This analysis should be done on an annual basis to benchmark the results with literature, and to see if there is any specific cost of holding or ordering, which the enterprise could or should decrease.

5.1.2 ABC Analysis

Until now, all the products have received the same attention on the part of A1. It is important for A1 to pay more attention to more important products, and to minimize or prevent stockouts for these products. Based on ABC analysis A1 can focus on inventory control for items according to classification into categories A, B or C. In order to carry out classification of inventory items into A, B, C categories, the steps described below should be done.

Firstly, I projected an annual volume of sales per each item based on the annual demand forecast for A1 for 2016. This is presented in Appendix D In the next step, the annual projected volume of sales per each item was multiplied by purchase price to obtain the total annual value of sales for each item in Euros. Those values, quantity of units sold per each item, and the value of units sold per each item at purchase price are displayed in Table 13.

Furthermore, in Table 14 the items are ranked based on the value of units sold per item. For each item I calculated the share of value per item within the total value, and from there the cumulative percentage of value of each item within the total value was calculated. Cumulative percentage for items in the portfolio of 40 products was calculated, in order to classify the items. Items are classified into classes A, B or C. As a model for the

classification of the items, I chose the model “20-40-40”. First 20% of items are classified as A, next 40% of items are classified as B, and last 40% as C items. The same was done with the model “20-30-50”, which was used as a control model.

Based on analyses, and from figures shown in Table 14 we can conclude that the first eight items are the high priority A items (RB20029, RB20036, RB20074, RB20050, RB20067, RB20081, RA04359, DM10122). They should be always on stock, with 97 percent of product availability/service level. For the first seven of them the enterprise uses a periodical review model which is a consequence of production and inventory policy of supplier 1. For item DM10122, a continuous review policy is applied.

The next sixteen items are medium priority B items. They should have less control compared to A items. The last sixteen items belong to the lowest priority C items. B and C items could have lower service level of only 90 percent. For those items the enterprise should negotiate with buyers a lower service level as a part of the contract. According to the enterprise’s inventory policy they are reviewed continuously. For C items it would be proposed for A1 to reconsider the possibility of implementation of periodical review policy. Furthermore, it would be recommended to introduce class D, for last 20% of C items. D items are products that should not be on stock, and should be delivered only on request of buyer, if this is possible, which has to be explored. Table 13 and 14 follow on next pages.

Table 13. Determination of Value of Units Sold

No.	Item No.	Units Sold	Unit Value (€)	Total Value (€)
1	BS41424	110	5.67	623.33
2	BS41660	86	8.33	716.67
3	BS41707	136	6.03	820.08
4	BS41721	174	4.60	800.40
5	BS41844	148	5.92	876.16
6	BS41851	218	7.00	1,526.00
7	BS42001	52	4.00	208.00
8	BS42209	110	4.26	468.60
9	BS42216	114	3.99	454.57
10	BS42223	230	4.70	1,080.30
11	BS42551	170	6.05	1,027.83
12	BS42568	174	6.70	1,165.80
13	BS42575	138	5.64	777.82
14	DM10030	2,760	1.39	3,838.55
15	DM10054	1,640	1.42	2,325.12
16	DM10122	8,400	1.32	11,109.72
17	DM10245	2,080	1.03	2,149.24
18	DM11105	800	1.10	880.00

Continued

Table continues

No.	Item No.	Units Sold	Unit Value (€)	Total Value (€)
19	DM11129	704	1.10	774.40
20	DM93791	480	0.63	304.00
21	RA04311	2,832	1.61	4,559.52
22	RA04328	1,584	1.56	2,478.85
23	RA04335	1,584	1.56	2,478.85
24	RA04342	2,496	1.64	4,082.13
25	RA04359	9,408	1.82	17,122.56
26	RA04465	1,824	1.67	3,040.00
27	RA08012	150	3.86	579.69
28	RA08029	102	3.86	394.19
29	RA08036	120	3.86	463.75
30	RA08043	78	3.86	301.44
31	RA08050	96	3.86	371.00
32	RA08067	84	3.86	324.63
33	RB20012	8,448	0.84	7,096.32
34	RB20029	40,320	0.84	33,868.80
35	RB20036	32,904	0.84	27,639.36
36	RB20043	6,304	0.84	5,295.36
37	RB20050	16,944	0.84	14,232.96
38	RB20067	19,344	0.84	16,248.96
39	RB20074	17,388	0.84	14,605.92
40	RB20081	18,960	0.84	15,926.40
		199,694		203,037.27

Table 14. Ranking of Items, Using a 20-40-40%, and 20-30-50% ABC Classification

No.	Item No.	Units Sold	Total Value (€)	% of Total Value	Cumulative Percent		Model	Model
					VALUE	ITEMS	20-40-40	20-30-50
34	RB20029	40,320	33,868.80	16.68%	16.68%	2.50%	A	A
35	RB20036	32,904	27,639.36	13.61%	30.29%	5.00%	A	A
25	RA04359	9,408	17,122.56	8.43%	38.73%	7.50%	A	A
38	RB20067	19,344	16,248.96	8.00%	46.73%	10.00%	A	A
40	RB20081	18,960	15,926.40	7.84%	54.57%	12.50%	A	A
39	RB20074	17,388	14,605.92	7.19%	61.77%	15.00%	A	A
37	RB20050	16,944	14,232.96	7.01%	68.78%	17.50%	A	A
16	DM10122	8,400	11,109.72	5.47%	74.25%	20.00%	A	A
33	RB20012	8,448	7,096.32	3.50%	77.74%	22.50%	B	B
36	RB20043	6,304	5,295.36	2.61%	80.35%	25.00%	B	B
21	RA04311	2,832	4,559.52	2.25%	82.60%	27.50%	B	B
24	RA04342	2,496	4,082.13	2.01%	84.61%	30.00%	B	B
14	DM10030	2,760	3,838.55	1.89%	86.50%	32.50%	B	B
26	RA04465	1,824	3,040.00	1.50%	88.00%	35.00%	B	B
22	RA04328	1,584	2,478.85	1.22%	89.22%	37.50%	B	B
23	RA04335	1,584	2,478.85	1.22%	90.44%	40.00%	B	B

Continued

Table continues

No.	Item No.	Units Sold	Total Value (€)	% of Total Value	Cumulative Percent		Model	Model
					VALUE	ITEMS	20-40-40	20-30-50
15	DM10054	1,640	2,325.12	1.15%	91.58%	42.50%	B	B
17	DM10245	2,080	2,149.24	1.06%	92.64%	45.00%	B	B
6	BS41851	218	1,526.00	0.75%	93.39%	47.50%	B	B
12	BS42568	174	1,165.80	0.57%	93.97%	50.00%	B	B
10	BS42223	230	1,080.30	0.53%	94.50%	52.50%	B	C
11	BS42551	170	1,027.83	0.51%	95.01%	55.00%	B	C
18	DM11105	800	880.00	0.43%	95.44%	57.50%	B	C
4	BS41721	174	800.40	0.39%	96.67%	65.00%	C	C
13	BS42575	138	777.82	0.38%	97.05%	67.50%	C	C
19	DM11129	704	774.40	0.38%	97.43%	70.00%	C	C
2	BS41660	86	716.67	0.35%	97.79%	72.50%	C	C
1	BS41424	110	623.33	0.31%	98.09%	75.00%	C	C
27	RA08012	150	579.69	0.29%	98.38%	77.50%	C	C
8	BS42209	110	468.60	0.23%	98.61%	80.00%	C	C
29	RA08036	120	463.75	0.23%	98.84%	82.50%	C	C
9	BS42216	114	454.57	0.22%	99.06%	85.00%	C	C
28	RA08029	102	394.19	0.19%	99.26%	87.50%	C	C
31	RA08050	96	371.00	0.18%	99.44%	90.00%	C	C
32	RA08067	84	324.63	0.16%	99.60%	92.50%	C	C
20	DM93791	480	304.00	0.15%	99.75%	95.00%	C	C
30	RA08043	78	301.44	0.15%	99.90%	97.50%	C	C
7	BS42001	52	208.00	0.10%	100.00%	100.00%	C	C
		199,694	203,037.27	100.00%				

5.2 Inventory policy

The current enterprise inventory policy is described in chapter 4.3.3. From the perspective of its size, the enterprise currently uses the simplest model. Periodic review policy is used in A1 only as an exception, e.g. with supplier 1, whereas for all other current and new suppliers a continuous review policy should be used. The current ERP system enables such managerial practice without any additional resources in terms of time, people or costs.

General conclusion is that the period of 3 months is too short for any valid conclusion. It will be best for A1 to continue conducting the current policy, with implementing some changes on SS to avoid stock-outs, as described below, and finally to utilise more of the possibilities of ERP for inventory management. When it will be possible to calculate all parameters for EOQ equation, it would be recommended to calculate EOQ per item, and to compare it with order quantities according to current ordering policy. Based on this, inventory cost in both cases should be compared, and A1 can then decide on further steps of inventory optimisation.

Currently, I could not use EOQ equation to calculate order quantity, because I found that the input data is based on too short a period of time and the necessary input data like order

cost and holding cost are not appropriate. Hence, calculated results per item would not be valid.

During my research, I could notice that the enterprise has a mixed policy regarding the SS, and this has to be changed, since the demand is stochastic. The SS for Supplier 1 is set up at a level of two weeks' average demand. In case of other suppliers, where the continuous review policy is conducted, currently the enterprise operates without the SS. To avoid the stock-outs for those items and all related costs, the SS should be immediately introduced.

For the start, the most effective would be to introduce the SS per item on the level of two weeks' average demand, as is the practice for the items from Supplier 1. Accordingly, ROP should be increased for the level of SS, which would then amount to the quantity of the average monthly demand. As a next step, my proposal to the enterprise is to analyse if the above defined levels of SS are appropriate in case of all suppliers.

The enterprise should compare costs for the current level of SS, with costs of SS level calculated according to equation 7 (chapter 3.4.2). As mentioned earlier, the input data I collected is based on too short a period of time, so at the moment the calculations of SS and associated costs would not be valid. After collecting significant input data for all the items, further analyses and calculations should be done, and appropriate conclusions should be drawn based on the obtained results.

As a part of this thesis, I calculated inventory turnover rate for a better understanding of the efficiency of inventory management and policy, and as a relative measure that can be used for benchmarking within the enterprise or with other enterprises. By dividing the cost of goods sold with average inventory, I calculated inventory turnover rate which shows that the enterprise's current policy is efficient, bearing in mind that the operation of the enterprise is at the very beginning. Inventory turnover for the enterprise A1 is 8.09, which means that the average value of inventories is turned eight times per year. According to some expectancies described in literature the inventory turnover rate should be around 12, which means that further steps must be taken in order to increase inventory turnover.

$$Inventory\ turnover\ rate\ = \frac{203.037}{25.242} = 8{,}09$$

Further, the turnover rate was calculated per each item. This rate varies from product to product and is higher for products with a higher rotation. Based on this deeper analysis per item, further proposals are made for A1. It can be seen that the lowest turnover rates are observed with seasonal products. It would be recommended for the enterprise to do further deeper analyses of these items, check current inventory policy for those items and define the critical points. There are plenty of different possibilities causing a low turnover rate for those items. Turnover rates per each item are shown in table 15.

Table 15. Inventory Turnover for the Portfolio of Products in Enterprise A1

Item	Inventory Turnover Rate
RB20029	26.67
RB20036	13.92
RA04359	8.83
RB20067	10.08
RB20081	64.71
RB20074	21.52
RB20050	6.55
DM10122	6.96
RB20012	40.62
RB20043	12.12
RA04311	8.05
RA04342	7.85
DM 10030	4.36
RA04465	6.56
RA04335	18.86
RA04328	18.86
DM10054	4.17
BS41851	4.84
BS42568	4.14
BS42223	4.26
BS42551	5.00
DM11105	1.24
BS41844	0.47
BS41721	1.61
BS42575	2.42
DM11129	0.91
BS41660	8.32
BS41424	1.53
BS42209	0.51
BS42216	1.28
DM93791	0.53
BS42001	0.21

5.3 Future of the enterprise's procurement and distribution

Procurement can be considered as a core business with strategic importance. The top priority for A1 is to establish, maintain and develop long-term relationships with suppliers. The stable long-term relationship may ensure consistent delivery including consistent LT, sufficient delivery, demanded product quality and lowest prices.

In partnership with suppliers the best solutions should be found, in other to make further optimisation in their SC. If there is possibility, suppliers should take over the cost of

transport, for damages and obsolescence, allow longer payment periods etc., all of which is already calculated into their prices.

At the moment A1 and its customers use a simple procurement BM known as RMI. This means that when a retailer or distributor requires a product, they place an order with the distributor or supplier. The retailer has total control of the size and delivery times of the order. The retailer places orders to the supplier/A1 and A1 to the producer, each of whom will meet the expected demand.

Both the retailer and A1 make their inventory decisions based on what they think will be most favourable for them. This model includes a fixed ordering cost, inventory-holding and backorder-penalty costs. A1 as a supplier also has additional fixed and variable costs of ordering and delivery. The disadvantage of this system is that no information about the customer's needs is available in advance, forcing A1 to anticipate needs and keep safety inventories. In case of unexpected short-term demand, this leads to changes in purchasing and distribution procedures, creating additional costs.

In the future it should be a plan to change this model to VMI, for the biggest customers, where A1 will take over the responsibility of managing the customer’s stock. This will be possible by using the EDI system. According to information I got from the buyers, since A1 decided to implement the VMI system, it gained a permanent insight into stock levels and sale figures for each POS of the buyer. According to the buyers, it will be possible for A1 to create orders and maintain the buyers’ inventories on agreed levels. The benefits of this system will be a higher service level, lower stock-out risk and SS and an increase of inventory turnover. Almost all of five of the most important factors that lead to the successful implementation of VMI are already in operation in A1. Top management support, employee involvement, appropriate ERP and infrastructure are all additional reasons to obtain a competitive advantage for A1 with the implementation of the VMI system.

CONCLUSION

We live in a very challenging period for SMEs, especially in traditional industries like distribution. Micro- and small enterprises have to consider and implement BMs which were in the past exclusively part of strategies of LEs. SMEs have to be fast and flexible and implement innovative concepts in order to obtain competitive advantage.

In case of distribution, the adoption of the most appropriate model for logistics and inventory management is a great opportunity to obtain many competitive advantages. Managing the physical distribution means managing inventories, storage facilities, unitisation, transportation and communication. Enterprises continuously try to reduce operating costs within these functions and at the same time try to keep customer service at

a desired level. In addition to this, there is increased need for flexibility on the part of suppliers due to changes in the buyers' behavior.

It is important for a distributor to bring the desired products at the right place and at the right time, with minimal cost as one of the main goals of inventory management. Hence, there is a clear need, when designing the logistics and inventory model, to evaluate inventory logistics, inventory costs and service level and to check the possibilities of savings within different models.

In this paper, I firstly analyzed the current situation that the enterprise has with its suppliers and buyers, purchasing process, order processing and inventory policies. Qualitative methods have been used to describe the current situation in order to identify problems, and based on quantity analyses the solutions for the enterprise were proposed.

The enterprise is currently outsourcing all its logistics functions. Therefore, as part of this study, I checked the validity of this decision. In a simple spreadsheet, the comparison of average logistics costs in case of outsourcing with the logistics cost in case of insourcing showed that for the current level of operation this decision is appropriate and the costs are lower. Since the logistics model should be built for a longer term, simulation of the logistics costs in case of insourcing and outsourcing were also done.

Based on simulation, in case of of a 100% increase in turnover, and then for another 100%, I could see that due to some logistics costs, insourcing soon becomes a better solution. Prompted by literature in which it is obvious that outsourcing is widely used, and is a better solution for SMEs and LEs, I further analysed the logistics costs of A1. The analysis of logistics costs was done also in spreadsheet, the costs were benchmarked with the same cost level found in literature and the share of each logistics cost component within the total logistics costs was calculated. It turned out that in the total logistics cost there is a high proportion of value added cost for labelling. Simulations of logistics cost without labelling were done, and it turned out that without labelling logistic costs would drop significantly making outsourcing a better option than insourcing.

Based on the above, two proposals were made. Firstly, the enterprise should negotiate with the suppliers to transfer labelling to them, and to get labelled products or, alternatively, the suppliers should cover this part of the cost. This is based on common practice in food industry where products should be delivered with national labels, or the supplier covers the costs of labelling. Secondly, for the next year the enterprise should negotiate better conditions with the 3PL, since in the first year there were no elements for negotiation. Based on deep logistic cost analyses and future sales plans, better conditions should be obtained than is now the case.

Regarding the development of the inventory management model, first of all I made a classification of all inventory costs, which were divided into holding and order costs, and

benchmarked it with literature. Most of the literature states that the cost of capital is the largest element of inventory costs, and consequently, we placed a particular focus on this cost segment. I took the savings interest rate of a commercial bank as the opportunity cost of the owner's capital invested in inventory.

Based on calculation of inventory costs and by benchmarking with appropriate figures in literature, it is obvious that inventory costs are in line with literature, and at the moment no further steps are needed. Since the period of operation is very short, it is recommended that analyses are done regularly and that inventory costs remain on the existing level of costs presented in percentages.

Further, the ABC analysis was done in order to classify products into A, B or C group. A items are high priority and should always be on stock, reviewed continuously except for the ones that have to be reviewed periodically. B items have a medium priority, and C items are the ones with the lowest priority. For B and C items the enterprise should try to negotiate a lower service level with the buyers – at a level of 90%, and include this lower service level into the contract.

Furthermore, for C items it would be recommended to implement a periodic review policy. Within this category, my proposal for the enterprise is to classify the last 20% of items as D items which should be discontinued from regular sales, and should be delivered only upon the request of the retailer or final consumer. It should be advantageous for the enterprise to make further analyses and check how the discontinuing of D items influences the enterprise's logistics and inventory costs and inventory turnover.

Lastly, the inventory policy of the enterprise was analysed. A periodic review policy is used only for supplier 1 items, because of supplier's inventory policy. Continuous review policy should be used for all other A and B items, and periodic review policy for C items. In order to determine quantities that are ordered, the current policy could be used and SS should be introduced for all the items.

Likewise, all parameters should be recalculated regularly. Currently, the enterprise operates without the SS for the items where a continuous review policy is conducted. To avoid the stock-outs and all related costs, the SS should be immediately introduced for those items, and accordingly, ROP should be increased for the level of SS. After collecting significant input data for all the items, further analysis and calculation should be done, and appropriate conclusions on SS levels should be drawn based on the obtained results.

In the calculation of inventory turnover rate, C items showed the lowest turnover rate. This calculation confirmed the importance of portfolio management. Company should do further analyses and research exploring what is the cause of the low inventory turnover rate. Based on these analyses further steps should be defined.

Procurement is a strategic function for A1 as wholesaler and distributor. It is my proposal to the enterprise to use a better negotiation position in the future and pass some of the logistics cost to the suppliers, such as costs of transport, damages and obsolescence, to get better payment terms. In sum, this will result in the lowering the logistics costs and optimisation of SC for the enterprise.

The outcomes from this master's thesis may be also useful for other micro start-up enterprises. Moreover, it can be used as a starting point for new researches in the area of SCM for SMEs which face a variability and uncertainty of demand. Further research should address other relevant topics of the SC of SMEs.

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APPENDIXES

TABLE OF APPENDIXES

Appendix A: List of Abbreviations

3PL	Third party logistics providers
BM	Business model
COTS	Commercial off the Shelf
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
FCMG	Fast moving consumer goods
ICC	Inventory carrying cost
ICR	Inventory carrying rate
ICT	Information and communications technology
LE	Large enterprise
LO	Logistics outsourcing
LSP	Logistics service provider
PL	Private label
OOS	Out of stock
OTIF	On time in full
RMI	Retailer-Managed Inventory
ROP	Reorder point
SC	Supply chain
SCM	Supply chain management
SME	Small and medium-sized enterprise
VMI	Vendor-Managed Inventory

Appendix B: Standard Deviation for Different Service Level

Table 1. Standard Deviation for Different Service Level

Z	Service Level in %
1.1	86.4
1.2	88.5
1.3	90.3
1.4	91.9
1.5	93.3
1.6	94.5
1.7	95.5
1.8	96.4
1.9	97.1
2.0	97.7
2.1	98.2
2.2	98.6
2.3	98.9
2.4	99.2
2.5	99.4
2.6	99.6
2.7	99.6
2.8	99.7
2.9	99.8
3.0	99.9

Source: B. Rusjan, *Management proizvodnih in storitvenih procesov* [Management of manufacturing and service processes], 2013, p. 338.

Appendix C: Logistics Costs Classification and Simulation

Table 1. Classification of the Logistics Fee into Logistics and Inventory Costs

3PL Fee	Type of Logistics Costs	Type of Inventory Cost	Subtype of Inventory Cost
Storage fee	Warehouse costs	Holding costs	Occupancy costs
Receiving fee for pallet	Warehouse costs	Order costs	Order costs
Receiving fee for mix pallet	Warehouse costs	Order costs	Order costs
Fee for valued added services: labelling	Warehouse costs	Holding costs	Handling costs
Oder fee per line	Warehouse costs	Holding costs	Handling costs
Order fee per parcel	Warehouse costs	Holding costs	Handling costs
Order fee per pallet	Warehouse costs	Holding costs	Handling costs
Fee for valued added services: wrapping	Warehouse costs	Holding costs	Handling costs
Fee for valued added services: packaging	Warehouse costs	Holding costs	Handling costs
Order fee per line	Administration costs	Holding costs	Handling costs
Fee for valued added services: return of documents	Administration costs		
Fee for other material costs (print of labels)	Administration costs	Holding costs	Handling costs
Insurance costs (fix+ 0.3% from net sales value)	Inventory costs	Holding costs	Miscellaneous costs
Capital costs (2% interest rate)	Inventory costs	Holding costs	Cost of capital
Obsolence, damage etc. 2%	Inventory costs	Holding costs	Obsolescence costs
Other risk costs (depreciacion) 5%	Inventory costs	Holding costs	Miscellaneous costs
Shipping fee (Outbound transport)	Transport costs		
Shipping fee (Inbound transport)	Transport costs	Order costs	Order costs

Table 2. Average Monthly Logistics Costs in Case of Outsourcing and Insourcing at Annual Turnover of 650,000 €/1,300,000 €

OUTSOURCING			**INSOURCING**		
Cost	**Average Cost per Month (€) (650,000 € Turnover)**	**Average Cost per Month (€) (1,300,000 € Turnover)**	**Cost**	**Average Cost per Month (€) (650,000 € Turnover)**	**Average Cost per Month (€) (1,300,000 € Turnover)**
Storage fee 42 pallets	294.00	588.00	Warehouse renting 100m2/40 pallets	500.00	1,000.00
Manupulation costs			Manipulation and overhaed costs		
Receiving fee for pallet	10.00	20.00	Cost of work	712.67	1,425.33
Receiving fee for mix pallet	75.20	150.40	Cost of equipment	400.00	400.00
Fee for valued added services: labelling	1,667.16	3,334.32	Cost of IT equipment	200.00	200.00
Order fee per parcel	162.90	325.80	Overhead costs	300.00	500.00
Order fee perpallet	73.80	147.60			
Oder fee per line	318.00	636.00			
Administrative fee per order	345.40	690.80			

Continued

Table continues

OUTSOURCING			INSOURCING		
Cost	**Average Cost per Month (€) (650,000 € Turnover)**	**Average Cost per Month (€) (1,300,000 € Turnover)**	**Cost**	**Average Cost per Month (€) (650,000 € Turnover)**	**Average Cost per Month (€) (1,300,000 € Turnover)**
Total costs of warehouse and manipulaton	2,946.46	5,892.92	Total costs of warehouse, manipulation and overheads	2,112.67	3,525.33
Value added and material warehouse costs			Administrative and material costs		
Fee for valued added services: return of documentation	365.00	730.00	Administrative fee for return of documentation	365.00	730.00
Fee for valued added services: wrapping	266.50	533.00	Material costs of wrapping	266.50	533.00
Fee for other material costs (labels)	152.50	305.01	Material costs (print of labels)	152.50	305.01
Fee for other material costs (packaging)	111.20	222.40	Material costs (packaging)	111.20	222.40
Total value added and material warehouse costs	895.20	1,790.41	Total administrative and material costs	895.20	1,790.41
Inventory carrying costs			Inventory carrying costs		
Insurance costs + 0.3% from net sales value	174.44	336.94	Insurance costs + 0.3% from net sales value	174.44	336.94
Capital costs (2% interest rate)	84.14	168.28	Capital costs (2% interest rate)	84.14	168.28
Obsolence. damage etc. 2%	84.14	168.28	Obsolence. damage etc. 2%	84.14	168.28
Other risk costs (depreciacion) 5%	210.35	420.70	Other risk costs (depreciacion) 5%	210.35	420.70
Total inventory carrying costs	553.07	1,094.20	Total inventory carrying costs	553.07	1,094.20
Transport costs			Transport costs		
Shipping fee (outbound transport)	1,170.36	2,340.72	Outbound transport	1,170.36	2,340.72
Shipping fee (inbound transport)	1,197.00	2,394.00	Inbound transport	1,197.00	2,394.00
Total transport costs	2,367.36	4,734.72	Total transport costs	2,367.36	4,734.72
Total logistics costs	6,762.10	13,512.25	Total logistics costs	5,928.31	11,144.67

Appendix D: Demand Forecast

Table 1. Demand Forecast in Units for 2016

Item No.	1	2	3	4	5	6	7	8	9	10	11	12	Annual Demand	Category
RB20029	3,360	3.360	3,360	3,360	3,360	3,360	3,360	3,360	3,360	3,360	3,360	3,360	40,320	A
RB20036	2,742	2,742	2,742	2,742	2,742	2,742	2,742	2,742	2,742	2,742	2,742	2,742	32,904	A
RA04359	784	784	784	784	784	784	784	784	784	784	784	784	9,408	A
RB20067	1,612	1,612	1,612	1,612	1,612	1,612	1,612	1,612	1,612	1,612	1,612	1,612	19,344	A
RB20081	1,580	1,580	1,580	1,580	1,580	1,580	1,580	1,580	1,580	1,580	1,580	1,580	18,960	A
RB20074	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	17,388	A
RB20050	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	16,944	A
DM10122	700	700	700	700	700	700	700	700	700	700	700	700	8,400	A
RB20012	704	704	704	704	704	704	704	704	704	704	704	704	8,448	B
RB20043	525	525	525	525	525	525	525	525	525	525	525	525	6,304	B
RA04311	236	236	236	236	236	236	236	236	236	236	236	236	2,832	B
RA04342	208	208	208	208	208	208	208	208	208	208	208	208	2,496	B
DM10030	230	230	230	230	230	230	230	230	230	230	230	230	2,760	B
RA04465	152	152	152	152	152	152	152	152	152	152	152	152	1,824	B
RA04328	132	132	132	132	132	132	132	132	132	132	132	132	1,584	B
RA04335	132	132	132	132	132	132	132	132	132	132	132	132	1,584	B
DM10054	137	137	137	137	137	137	137	137	137	137	137	137	1,640	B
DM10245	173	173	173	173	173	173	173	173	173	173	173	173	2,080	B
BS41851					73	73	72						218	B
BS42568					58	58	58						174	B
BS42223					77	77	76						230	B
BS42551					57	57	56						170	B
DM11105	67	67	67	67	67	67	67	67	67	67	67	67	800	B
BS41844					49	50	49						148	B
BS41707					45	46	45						136	C
BS41721					58	58	58						174	C
BS42575					46	46	46						138	C
DM11129	59	59	59	59	59	59	59	59	59	59	59	59	704	C
BS41660					29	29	28						86	C
BS41424					37	37	36						110	C
RA08012						150							150	C
BS42209					37	37	36						110	C
RA08036						120							120	C
BS42216					38	38	38						114	C
RA08029						102							102	C
RA08050						96							96	C
RA08067						84							84	C
DM93791	40	40	40	40	40	40	40	40	40	40	40	40	480	C
RA08043						78							78	C
BS42001					18	17	17						52	C
TOTAL													199,694	