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# SUPPLY CHAIN MODELLING. A PRACTICAL APPROACH

Case: Go Double A Oy



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ABSTRACT

The purpose of this thesis was to suggest an update to the supply chain management model for a startup company Go Double A Oy specialized in selling out electrical bike equipment. The aim was to conduct a research project and find out new suppliers of equipment parts, to describe the new strategy of the company, its shipping process, and to make a costs analysis. The current thesis was focused on the inbound part of the Supply Chain Management.

Mostly, the requirements of this project provided by the case company were focused on the inbound part of the Supply Chain Management. Hereby, the general concept of the Supply Chain Management was introduced here. However, the empirical part of the project was focused on inventory issues, inbound logistics issues and international transportation of particular goods.

In the theoretical part of the thesis, the process of supply chain modeling is described from the point of view of its role in the strategy of a company and its influence on the overall company performance. The aim was to examine the supply chain modeling process, its objectives, and the factors influencing the forming of the model. Also, there is an analysis of the current situation in the company and its strategy.

The practical part of the thesis contains supply chain modelling approach and outcomes with the final suggestion of the new supply chain model, its overall structure and detailed description of the decision making processes during particular stages.

This project can be recognized as significant approach for the case company in terms of future development. The tools and ideas presented here can be extended or modified for the changing needs of the company.

**Keywords** Supply Chain Management, inventory planning, logistics, modeling.

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## 1 INTRODUCTION

Supply Chain Management (SCM) is generally assumed as an essential part of almost any business process. According to a business dictionary, it is the management of material and information flow in a supply chain to provide the highest degree of customer satisfaction at the lowest possible cost (Business Dictionary, 2016).

One can state that effective SCM can help a company to achieve a competitive advantage which means having greater profitability than an average of all the companies in the industry (Hill & Jones, 2010).

This thesis project was focused on one the development of the Supply Chain Management for a young start-up company.

### 1.1 Background and objectives of thesis project

The primary objective of the thesis project was to design a new Supply Chain model for a start-up company Go Double A Oy specialized in selling electrical bike equipment. This model should meet specific requirements of the case company. Currently, Go Double A Oy operates in the business-to-consumer field and has a relatively low flow of materials within its operations. However, the CEO of the company is planning to extend the amount of orders by turning the operations of the company into business-to-business operations.

Hereby, there is a need for a higher capacity, lower costs, and higher efficiency of the Supply Chain Management activities. This research project was implemented to recommend a new model that would satisfy such needs and contain a guide for the young company that would describe the whole process in a detailed way.

The theoretical framework of this project was about Supply Chain modeling and implementing it. The theory part was written to give a clear view on how to build the actual Supply Chain strategy and how to apply it to an actual business.

The practical part of the thesis contains a recommendation for a new supply chain model with detailed guide about the parts of this process.

### 1.2 Research questions

In order to create a competitive solution for Go Double A Oy and to meet the required needs, there were several research questions to be answered. This thesis was based on the following questions.

- Why is there a need for a new Supply Chain strategy?
- What are the customer needs that have to be satisfied by distribution strategy?

- What are the crucial elements of the Supply Chain strategy?
- How should the inventory approach be implemented?
- What is the demand for the supplies?
- Who are the potential suppliers?
- How will the delivery of a product be proceeded?
- How to implement the new strategy?
- Will the new strategy be effective and profitable?

The project questions that are detailed here were answered during both theoretical and practical parts of the thesis.

## 2 ROLE OF SUPPLY CHAIN MANAGEMENT IN BUSINESS OPERATIONS

It is generally assumed that effective management of the chains of supply can be considered as a key element in achieving a competitive advantage for the company of any size. There are a lot of examples throughout the history where Supply Chain Management has become one of the main reasons for the great success of a company.

Examples like Walmart story of success are exponential. A successful management of the chains of supply has been the main reason for the success of Walmart and made this company to become the world's largest retailer. (Lu 2014.)

### 2.1 Definition of Supply Chain Management

In order to describe the concept of Supply Chain Management, it is crucial to answer the question of what are chains of supply. The textbook of Supply Chain Management describes a supply chain as a network of facilities and transportation channels that allows to implement procurement of materials, production or assembling of the materials into the finished products, and distribution of the products to the customers (Bhatnagar 2009, 1).

Hereby, Supply Chain Management can be recognized as an active management of supply chain activities in a way to achieve the highest possible customer value at the lowest possible costs (Handfield 2011). One can state that effective SCM can help a company to achieve a competitive advantage which means having greater profitability than an average of all the companies in the industry (Hill & Jones, 2010).

#### 2.1.1 Aspects of Supply Chain

Supply chain management is a complicated process covering a very wide range of business processes and activities. These activities are divided into five basic areas of the decision making process in Supply Chain Management also called the five drivers of a Supply Chain, which are production, inventory, location, transportation and information.

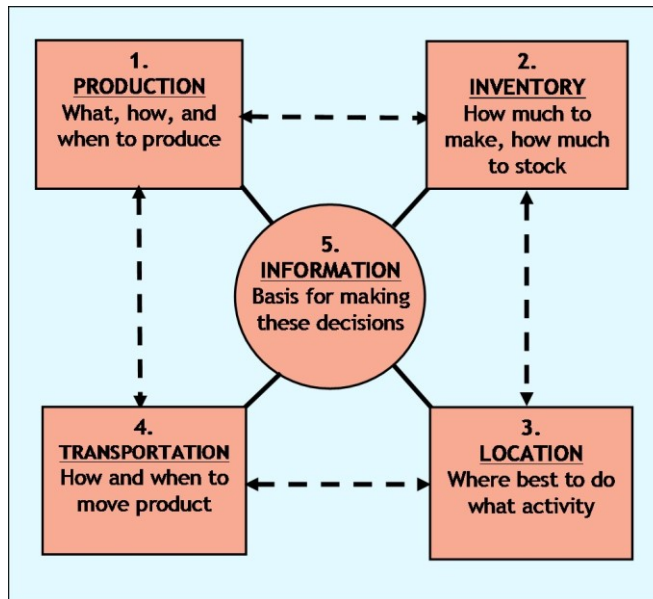


Figure 1 Drivers of the Supply Chain (SCM Globe 2014)

As can be seen in Figure 1, each of the drivers answers specific questions and relates to a particular element of business process.

Production covers most of the issues regarding the product itself. The typical questions in this area are the following. What is the product? How much should be produced? Further, production refers to the aspect of storing the product. Hereby, factories and warehouses are recognized as the main facilities of production. (Bhatnagar 2009, 3.)

Inventory describes how much of inventory should be stocked at each stage and how much of the products should be hold assembled or as raw materials. When making decisions regarding the inventory issues, there are three adjustments to be made. First, there is cycle inventory, which means the required inventory for covering the demand of the product. Second decision is safety inventory. Safety inventory is a defense against force-majeure situations which allows company to continue sales in case of break up in production. Finally, seasonal inventory requires changes in inventory level depending on demand fluctuations affected by certain periods of the year. The very basic example is winter and summer tires for cars. (Bhatnagar 2009, 3.)

Location answers the question “Where”. In more detail, it refers to the geolocation of supply chain facilities. This driver has a very strong impact on performance of a company’s supply chain. Costs of holding the facilities varies from place to place in a wide range. Also, it has a great impact on product flow which is a highly important aspect of logistics operations.

Transportation – how should inventory be delivered during each stage of supply chain? The most important decision to take at this stage is the kind of transport. There a six basic options in a modern world which are rail, pipelines, trucks, airplanes and electronic transport. The advantages and



disadvantages of each type were analysed in a practical section of this thesis.

Information – which data is essential and how much of it should be collected? The main targets of information flow are to coordinate daily activities and forecasting. (Bhatnagar 2009, 3.)

In order to build successful supply chain strategy, all these drivers are to be covered in a way that every decision regarding particular driver is integrated with each other helping to achieve strategic goals of the supply chain management.

### 2.1.2 Parties in the Supply Chain

In its very basic formulation, a supply chain can be performed with only three parties, which are suppliers, producers and customers. However, in any given supply chain, there is a set of companies having various functions. There might be suppliers of suppliers or customers of customers or the final customer in case of business-to-business operations, for example. Further, there are a lot of companies which are service providers at any given step of supply chain activities. (Bhatnagar 2009, 14-16.)

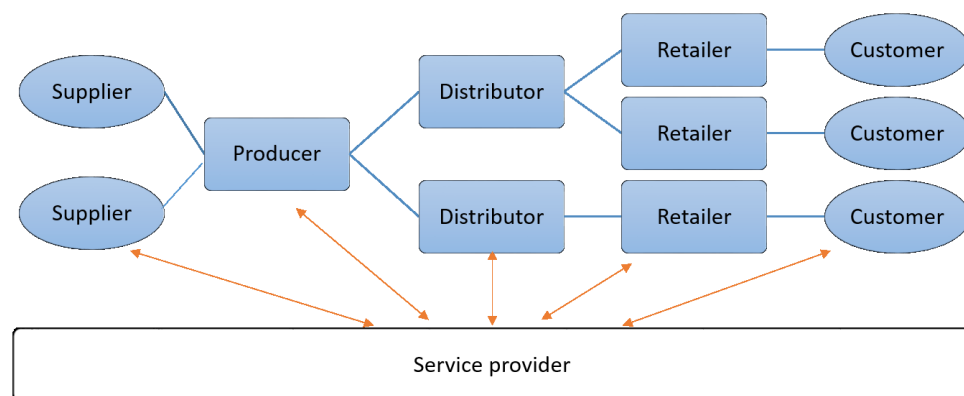


Figure 2 Parties in the Supply Chain

**Producers.** These are the ones who make the actual product. This can be manufacturer of certain goods or raw materials. Producers of raw materials can perform as suppliers for producers of finished goods. Moreover, companies that offer intangible products like services are also included into this category.

**Distributors.** Sometimes these are also known as wholesalers. A distributor is an organization which buys a product from a producer in a far larger quantity than consumers do and then sells it to its final customers. The dis-

tributor performs such functions as sales, promotion, inventory management, warehouse operations, and product transportation etc.

Retailers. Their main functions are to stock the inventory and sell to general consumers. Any retail shop like Lidl is a good example of this.

Customers. These are the ones who actually buy the product. This can be either people (consumers) or organizations.

Service providers. As it was mentioned before, these are the companies that provide services at any step of the supply chain. They might supply services in logistics, marketing or information technologies. (Bhatnagar 2009, 14-16.)

## 2.2 Supply Chain Management and business strategy

“A well-executed supply chain strategy results in value creation for the organization” (Happek 2005, 1). Huge numbers of historical examples like Walmart, Honda, UPS and others lead us to the statement that having a competitive supply chain strategy is not a privilege but a must for a company if it wishes to remain competitive.

The term competitive strategy means setting up a company’s goals and objectives in a way to achieve competitive advantage, which means having a greater performance than the average level of the particular industry (Hill&Jones, 2010). It is crucial to understand that supply chain strategy is closely linked with company’s business strategy. However, these terms should be distinguished.

Business strategy determines the overall direction of the company development while supply chain strategy establishes the real operations that have to meet the specific supply chain objective (Happek 2005). In order to set up supply chain objective, the specific market needs have to be determined.

To conclude, the supply chain strategy of a company has to respond the specific needs and requirements of the market where it operates and to do it in a way that supports the business strategy of the company.

### 2.2.1 Market needs

First and foremost, it is crucial to understand the market needs. There are several issues that need to be examined before implementing a strategy. These aspects are: the quantity of the product needed, the response time that customers are willing to wait, the variety of the product needed, the service level required, the price of the product, innovation of the product. (Bhatnagar 2009, 17-18.)

Speaking about the quantity of the product needed, it is crucial to understand the demand for the required product. The main questions here are:

What are the customers of the product? Do they buy small amounts of goods or larger quantities of goods? For example, in most cases, business-to-business customers require much higher volumes of production for purchase rather than ordinary consumers.

Another important issue to cover is the response time or the waiting time for the customer. This aspect reflects the maximum duration of time that the customer is willing to wait before getting the item. One can state, that business customers ordering large quantities are willing to wait longer than individual consumers. This, of course, is forced by the different order size and purchase behavior. It is crucial to figure out, what is the required response time, based on the type of the customer.

Further, there is a need to estimate the variety of the product needed. In terms of supply chain management, it is essential to understand if the company trying to offer a wide range of products or if it is focused on a narrow market segment by offering specific product of a limited variety but with specific qualities. (Bhatnagar 2009, 17-22.)

Also, the service level required is an aspect that has to be covered. What are the services to be offered to the customer? Are the customers waiting all the products to be available or do they accept partial deliveries? Should the product be delivered to the customer or is there picking up place? All these questions are important and have to be researched.

Pricing of the product has an influence on the supply chain strategy. As were mentioned earlier, the supply chain strategy aims to satisfy customers' needs by achieving lowest production costs possible. Pricing plays an essential role in both aspects of the strategy.

Last, but not least is the innovation of the product. Basically, this means answering the question of how often should the new products or features arrive for sale. (Bhatnagar 2009, 17-22.)

### 2.2.2 Needed capabilities of Supply Chain

After the market needs are analysed and the company's role and position on the market is defined together with the role which company plays in the supply chain of these markets, the next step – development of needed capabilities which supports these roles is to be implemented.

According to a textbook of supply chain management: “This development is guided by the decisions made about the five supply chain drivers” (Bhatnagar 2009, 18). As it was already mentioned before, the five drivers of the supply chain are: production, inventory, location, transportation, and information. Further, the role of these drivers in the development of capabilities were described.

The drivers can be managed either to be responsive or efficient. Responsive driver means that it is agile, fast, service driven. Contrary, efficient driver is lean, cost and efficiency driven.

Commonly an efficient strategy is matched with the cost-leadership business strategy while a responsive strategy fits the differentiation strategy. Cost-leadership and differentiation strategy are the two basic concepts of making business according to Porter depending on whether the company wishes to achieve competitive advantage by lowering down its costs which reflects the price strategy or by satisfying bigger amounts of customer needs, respectively. So, in order to get the deeper understanding of this statement, the role of each driver was analysed in a more detailed way. (Cetinkaya, Cuthbertson, Ewer, Klaas-Wissing, Piotrowicz & Tyssen 2011, 4.)

First, there is the production driver. The production driver refers to the production process itself. In other words, it answers the questions of what, how and when to produce. The responsive method here is to produce large quantities of variable products. Moreover, another method for achieving responsiveness for a company is to reduce the delivery time by splitting up the production facilities into smaller ones which are closer to locations of customers. On the other hand, if efficiency has a higher priority, the company may produce smaller amounts and optimize its production process. (SCM Globe 2014.)

Inventory. In order to achieve responsiveness in terms of inventory driver, the company can stock the high levels of inventory meaning keeping large quantities of wide range of products. Additionally, responsiveness can be achieved by having stock in various locations in order to make products in stock immediately available for the customers. Alternatively, a company may turn into efficiency strategy by reducing the stock level. This especially refers to products with low selling frequency. Further, centralization of stocks is also a method to gain efficiency. (SCM Globe 2014.)

Location. This driver gains responsiveness by opening many locations of a company in order to stay closer to the customers. On the other side, the efficiency in this approach means to centralize activities of a company in few locations that perform more activities. (SCM Globe 2014.)

Transportation. The transportation driver, referring to logistics part of supply chain management, achieves responsiveness through high speed and flexibility. That means delivering lower amount of products but doing it more often and fast, which decreases the response time for the customer. Another way is to achieve efficiency by transporting larger quantities with less frequency. (SCM Globe 2014.)

Finally, the information flow has also high importance level. Information can be recognized as a core element affecting decision making processes in a company. It connects all the activities and decisions in a Supply Chain network. It also helps to increase overall profitability in case it is handled accurately. (Bhatnagar 2009, 19.)

There are two purposes of information in supply chain: Coordination of daily activities and forecasting. The first purpose is related to all other

drivers of the supply chain. The information flow on a daily basis helps managers to decide concerning transportation routes, working schedules, inventory levels etc. Forecasting and planning allows to adapt company's strategy in accordance with tactical forecasts and set up monthly and quarterly production schedules and timetables. (Bhatnagar 2009, 10-11.)

### 2.3 Types of Supply Chain

Based on the information above, there are several ways to distinguish supply chain types. The very basic and core differentiation between supply chain designs is the concept of push and pull strategies.

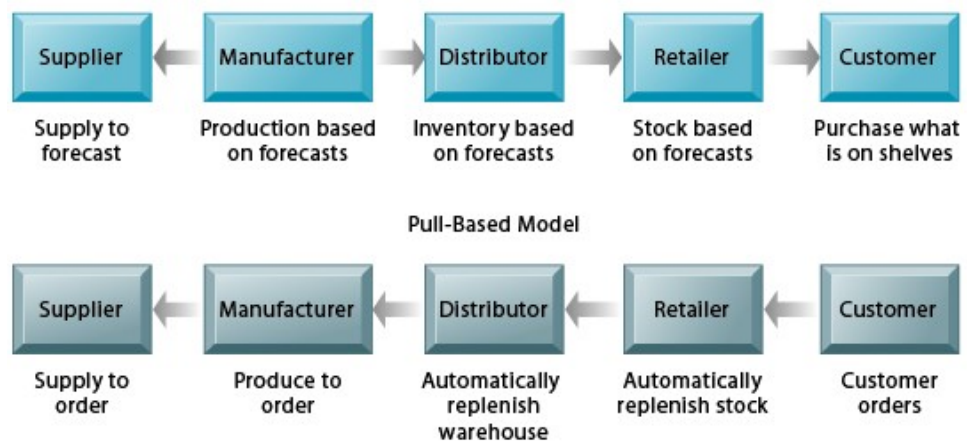


Figure 3 Push/Pull Supply Chain (Laudon & Laudon n.d.)

Push strategy requires application of forecast approach. Supply chain processes are based on a company forecasts. The company tries to sell the products they have already produced to the customers. Obviously, that causes several disadvantages in sense that forecasts might be wrong.

Contrary to the push strategy, the pull strategy is based on a demand data. It is driven by the actual consumption at the store. There is a downstream product flow that takes place to cover the immediate need. (Pittman 2014.)

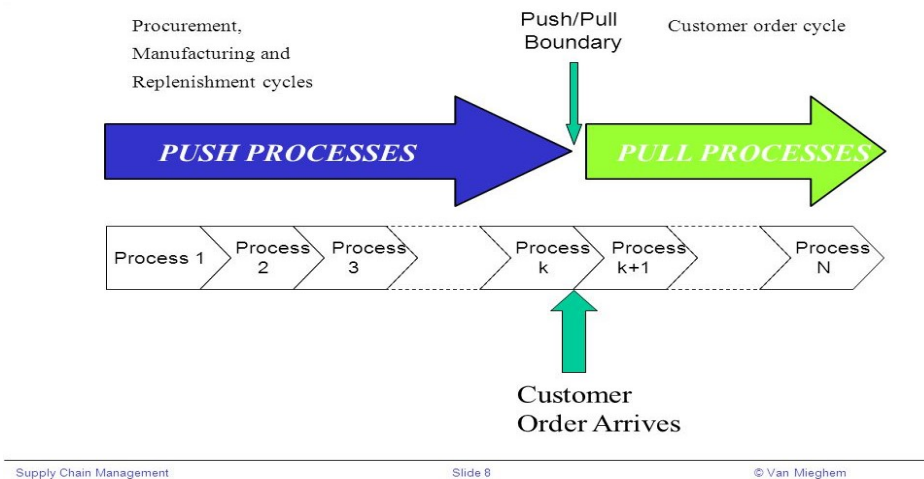


Figure 4 Push/Pull boundary (Brame n.d.)

However, nowadays, most strategies face the combination of these two approaches. Commonly, push and pull processes are separated from each other at some particular stage. For example, company may hold the inventory at its distribution centres waiting for the incoming orders that would pull the process forward. This creates the push/pull boundary.

### 2.4 Value of Supply Chain Management

“In today’s marketplace, companies no longer compete one-on-one; their supply chains do” (Tommelein 2004, 1) Nowadays, strong Supply Chain Management has a strong effect on a company’s performance. This is achieved by reducing the operating costs and increasing the value. Michael Porter, in “Competitive Advantage”, describes the term value as how much does the customer willing to pay for the product or service that offered by company. This leads us to the concept of value chain, presented by Michael Porter in 1985.

A value chain is a set of activities carried out by an organization in order to increase the value for its customers. The main target of value chain is to convert inputs into outputs in a way to make value to overweight the costs. Hereby, one can state that amount of value created by the company directly affects its profitability. Accordingly, this is a way of achieving competitive advantage. (Porter 1985.)

Looking through prism of supply chain management, value chain can be considered as a reverse reflection of supply chain. Value chains focus on advantages relevant to customers and internal dependent processes that creates this value. The following figure shows how value is defined through customer perspective. (Bhatnagar 2009, 24.)

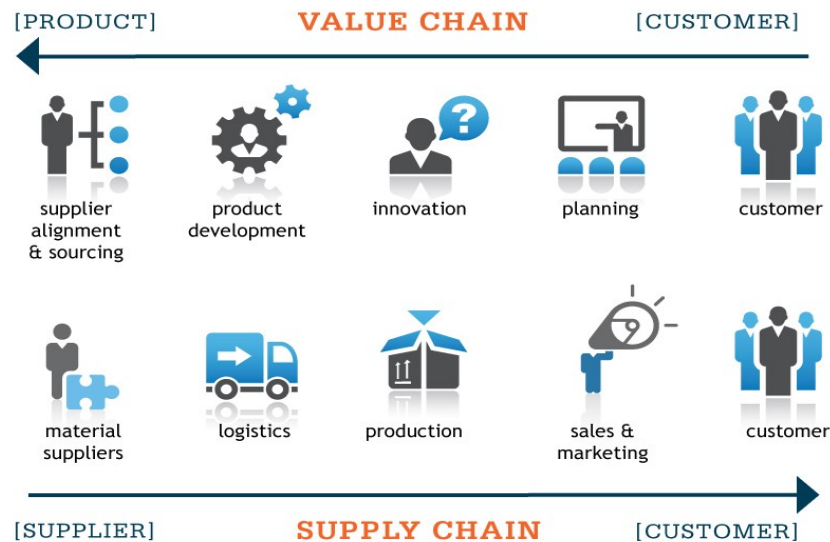


Figure 5 Value Chain vs. Supply Chain (Weiner n.d.)

In order to create an effective value chain that will generate profit for a company, it is crucial to answer two basic questions: Who are the customers and what do they value? (Bhatnagar 2009, 25.)

Nowadays, companies primarily focus on a policy of knowledge of customer needs and values. After the firm has gained an understanding of its customer, it can organize its operations in a way to effectively satisfy those needs. Effective satisfaction means doing it fast, but accurately at the lowest cost possible. (Bhatnagar 2009, 25.)

Hereby, most companies nowadays combine the concepts of a value chain and a supply chain. Integration of these concepts brings up a new level of business. This is highly important for integrated production capability, delivery process and bringing value to the customer by reducing non-value activities and bringing into focus those activities which will help to achieve customer satisfaction of particular needs.

### 3 SUPPLY CHAIN DESIGN

The main purpose of this chapter is to describe the process of supply chain modeling. What steps have to be carried out? What should be considered during the design of supply chains? These are the main questions that are answered in the following chapters.

Furthermore, it was already detailed in the previous chapters that supply chain management is a complicated process involving a wide range of operations and activities. This chapter also describes each particular step in Supply Chain Management in a more detailed way.

How is the production planning process proceeding? How to implement inventory planning, what are the possible options? All these questions refer to drivers of supply chain (chapter 2.1.1). The following chapter also contains a description of all particular planning processes in supply chain design in order to introduce the general supply chain planning approach for the case company.

#### 3.1 Modelling of Supply Chain

According to Dong (2001), there are five basic types of supply chain modelling:

- **Supply Chain Network Design Method.** This method of modelling requires determination of the production location, locations of stocking and sourcing facilities, as far as channels the products take through them. In its basics, first introduced in 1974, this model aims to optimize finished product flows from plants to the distribution centres and customers.
- **MIP Optimization Modelling.** The MIP (Mixed-Integer Programming) type includes various important supply chain models. This includes most models for vehicle routing and scheduling, facility location and sizing, shipment routing and scheduling, freight consolidation and transportation mode selection. Mixed-integer models are often difficult to optimize, as there can be an exponential number of possible decision alternatives (Dong 2001).
- **Stochastic Programming and Robust Optimization Methods.** Stochastic programming deals with a class of optimization models and algorithms in which some of the data may be subject to significant uncertainty. Uncertainty is usually characterized by a probability distribution on the parameters. Such models are appropriate when data evolve over time and decisions need to be made prior to observing the entire data stream. In robust optimization, the uncertainty about problem data is treated as deterministic, unknown-but-bounded (e.g., via intervals of confidence for the data). A robust solution is one that tolerates changes in the problem data up to a given bound known as a priori.



- **Heuristic Methods.** Heuristic is another important class of methods for generating supply chain alternatives and decisions. A heuristic is simply any intelligent approach that attempts to find good or plausible solutions. Generally, mathematical programming methods are used to solve strategic and higher levels of tactical supply chain planning. This method generally works only for solving linear- and some integer-based models, commonly used in strategic levels of planning. Tactical and operational models are usually not linear and are much too complex to solve using mathematical programming methods. For this reason, heuristic methods are generally used in tactical and operational planning level solvers. Heuristic methods used in supply chain planning and scheduling include the general random search approaches such as simulated annealing, genetic algorithms and forbidden algorithms.
- **Simulation based Methods.** This is a method by which a comprehensive supply chain model can be analyzed by considering both its strategic and operational elements. This method can evaluate the effectiveness of a pre-specified policy before developing new ones. The dynamic nature of supply chains makes the simulation methods necessary for studying the time-varying behavior of supply chains.

Dong, 2001

One can state that supply chain planning is an extremely complicated process, especially in terms of major enterprises. The current project mostly appeals to MIP Optimization Modeling aiming to optimize the inbound raw material flows. In order to implement this approach, there is a need to consider various aspects of the supply chain model.

### 3.2 Steps of supply chain design

As defined before, the supply chain strategy has to be closely integrated with the overall business strategy. In this case, the competitive supply chain strategy will help the company to achieve its business goals. In order to create a supply chain strategy that meets the needs of a company in the most efficient way, there are several steps to be carried out by the decision makers. (Profit Point 2003.)

First and foremost, it is essential to clearly define the objectives. The decision making persons have to clarify first what targets does the supply chain strategy aims. This, in turn, depends on the overall business targets. There are several complicated questions to be answered during this step. What is the production process of the company? How should the inventory be carried out? The “where” question related to the location driver of supply chain management. How should the logistics and transportation be planned? How will the information flow integrate all together? Obviously, all these questions contain a wide range of smaller questions. Hereby, it is clear that this step is the most important during the design of supply chains. Clearly selected targets will create the right direction of develop-

ment for the company and will allow to achieve competitive advantage. (Profit Point 2003.)

Secondly, the supporting data must be collected. In order to make correct decisions concerning the questions above, the appropriate data should be collected. This includes the product demand data, customer value data, transportation costs, transportation times, warehousing costs, inventory costs, production costs, procurement costs etc. (Profit Point 2003.)

The third step is modeling of a supply chain network. Nowadays, there is a wide choice of software for simulation processes. It is up to the decision makers whether to use one of those for running different supply chain models or to make modeling manually. The model components to test includes capacity, customer requirements, and costs of different options, operating capabilities etc.

The fourth step is analyzing. After the supply chain model has been created, it is very important to analyze it. There are a lot of “what if” scenarios to be considered. In order to make a proper analysis, there is a need for a deep knowledge of both the business processes and the software solutions. A good analysis is essential for the final design of a supply chain. (Profit Point 2003.)

The last, the fifth step is implementation. After the theoretical part is done, it is time to apply the strategy into real life. Here, the implementation part takes place.

It is important to realize, that there are no static business situations. Everything changes all the time. Hereby, all these processes have to be reconsidered after a defined period of time. New customers appear, costs changes, laws and regulations might change as well. Supply chain management department have to be flexible and, together with the business strategy, adapt to the new reality all the time. (Profit Point 2003.)

The following chapters cover the parts of a supply chain network and the designing process related to each part.

### 3.3 Production planning

The production process in supply chain management refers to storing the product, assembling it or its actual production (Slide Share 2013). Factories and warehouses are considered as facilities of the production driver. In a simple form, the questions of what, how and when to produce have to be answered during production planning stage.

In order to satisfy the customer order, there are a lot of processes triggered within the supply chain (Dong, 2001). Generally, there are four applications for the production planning process.

- Make-to-stock (MTS). Within this application, the production process takes place before the customer order. The received orders are

to be fulfilled with the products from stock and the stocks are then replaced with new products. The advantages of such approach are, obviously, immediate response time for the customer order and cost-efficiency regarding the organization of the production process. However, inventory holding costs causes big risks in case of losing the customers or low demand.

- Assemble-to-order (ATO). Within this environment, the products are assembled after the customer order is received, however, the spare parts are produced in advance. This strategy is very efficient in case of high variability of options for the final product.
- Make-to-order (MTO). This approach refers to the pull strategy as the entire production process is triggered with the customer order. If the customers are willing to wait for its product and having, instead, the unique features – this is the optimal solution.

Ravikumar, 2013

With the case company, as is described in the following chapters, there is no fabrication process itself. Instead, the company purchases goods from its vendors further selling them to its customers and offering several services for their products. Thereby, the procurement of all the related details of a product as far as assembling and storing of it, take place. The next chapter focuses on the supplier relationship management and procurement processes.

### 3.3.1 Analysis of suppliers

Strong supplier analysis and supplier evaluation can be expected to bring strong benefits for the company. This will allow firm to make the right choice concerning its vendors and further relationships with them. There is a wide range of benefits brought to a company through good evaluation of potential suppliers. Further, the analyses of particular areas in vendor evaluation was implemented. (Arsan 2011.)

First, it is highly important to discover the possible delivery options linked with the vendor. Vendors with noteworthy delivery offers reduces unnecessary costs related to the purchasing of additional inventory costs, storage costs, and financial wastes of multiple time material transfers. If vendor is able to deliver the material in a way that satisfies the purchasing company, it definitely increases its value and increases the priority of the supplier during the selection process. (Arsan 2011.)

Flexibility of a vendor is another important issue. As it was mentioned before, modern business world never has a static position. There is a numerous amount of things that might change in an extremely short periods of time. Hereby, the supplier that is able to adapt to the changing requirements of a purchaser, caused by changing environment, will allow the company to avoid crises caused by force majeure situations. Flexibility is

a key for survival nowadays, especially for small companies. (Arsan 2011.)

Quality and reliability are also points to consider. Vendors providing exceptional quality and reliability of products will have more chances for long time and successful relations with the company. This will reduce the costs concerning counting items at the receiving point and quality inspections. Moreover, reduced losses caused by a lower rate of defective products take place. (Arsan 2011.)

Further, it is essential to analyze the pricing conditions. Beneficial pricing of the supplies causes lower costs for the company. As was stated earlier, one of the main postulates of supply chain management is to achieve the maximum value at minimum costs. However, it is essential to understand, that lowest price offered by a vendor is not necessary the best offer. But in combination with other aspects of vendor evaluation, if all other conditions are similar, the supplier who offers lower prices will gain higher priority. (Arsan 2011.)

The next thing to take into consideration is the technical capabilities of a vendor. Technologically leading vendors provide ability for the purchaser to become the technological leader as well, in its sector. Continuous improvement of products and equipment is also caused by exceptional technical capabilities. (Arsan 2011.)

The last but not least is the financial and business stability of a vendor. There is no doubt that there are more chances to build long term successful relations with a supplier that do not tend to ruin in the nearest future. Moreover, stable companies are easier to predict, hereby, are preferable in terms of partnership. (Arsan 2011.)

There is no doubt that all the issues listed above can cause various costs. In order to achieve successful partnership, there is a big amount of work required from both supplying and purchasing companies. From buyer point of view, a lot of attention should be paid on procurement process.

### 3.3.2 Procurement

According to Business Dictionary (2016), procurement is the process of purchasing or buying goods and services. Due to the fact that current chapter is linked with production driver of supply chain management, the procurement from business point of view was presented. The procurement process from customer point of view was described as well in further chapters.

The procurement of a product or service is a complicated process in business-to-business operations. The diagram representing the process was presented in figure number 6.

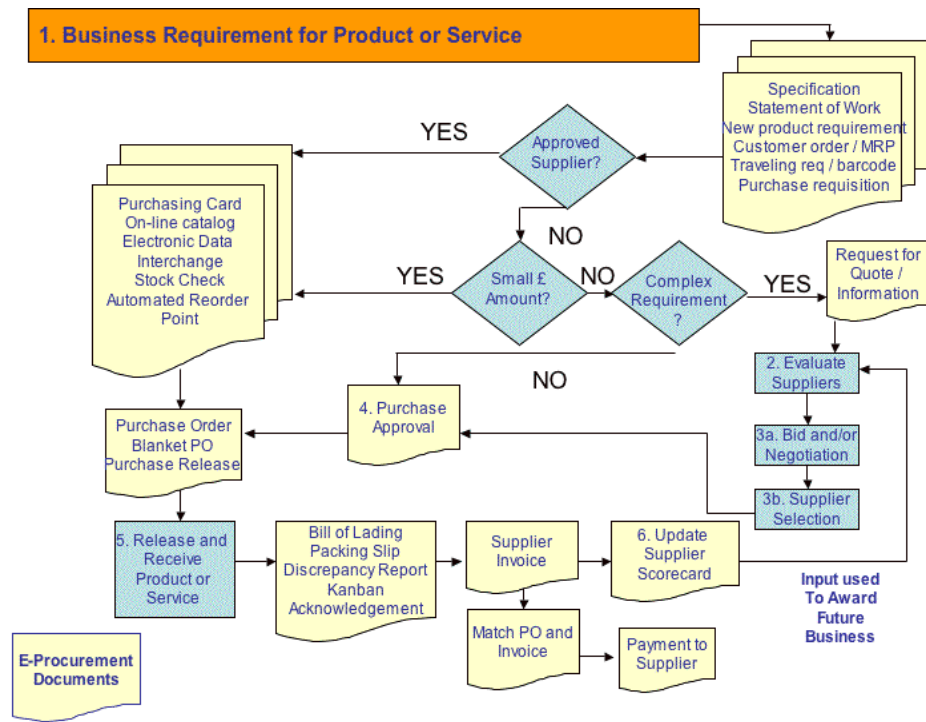


Figure 6 Procurement in Business-to-Business operations (Handfield 2011)

In a modern business environment, there is no more space for a traditional belief that procurement only relates for purchasing of goods and services in order to respond the internal needs of a company. The following chapter describes the role of procurement within an organization and what should be done in order to make outstanding procurement process that will lead to an overall success of a firm. (Handfield 2011.)

First and foremost, purchasing department have to understand the business requirements. This means buying products from the right source, for the right price. The product must meet the customer requirements. Thereby, purchasing process is closely linked with business strategy. Further, there must be correct quantity of the product ordered. The topic of the order size was described in greater detail in further chapters. Finally, the delivery must happen at the right time. This refers to the inbound logistics process, which is described further as well. (Handfield 2011.)

There is a wide range of activities to be taken in order to achieve these goals. The three very basic steps of efficient procurement process are identifying opportunities, managing the internal operations and achievement of objectives.

Identifying of opportunities is one of the key steps to add value for the company. First of all, this step consists of evaluation and selection of the suppliers. The importance of this step was described in previous chapter. In order to implement efficient analyzes of potential and exciting suppliers, the company tends to improve the sourcing team. Moreover, it is very useful to make engineering, or any other product-related staff, a part of

this process. Their knowledge of a product is a valuable point for the selection process. (Handfield 2011.)

Another issue concerning opportunities identification is review of specifications or statement of work. Meaning to analyze the specifications of the material or service. This will allow the company to figure out alternative materials which might be a cost saving decision. (Handfield 2011.)

Contacting the supplier can be considered as separate issue within procurement process. First, it is important to figure out the most efficient method of contact. Whether it is email or phone calls, every method has its advantages and disadvantages. While a phone call is often the fastest way to get the response, it might occur several difficulties, regarding, for example different time zones. (Handfield 2011.)

Moreover, it is essential to manage the database of suppliers. The business is a dynamic environment and having up to date information is a must for every company. It is important to know if the current suppliers are still competitive, always to search for new potential suppliers and to develop relationships with them.

The second key step in procurement planning is managing of the internal operations in an effective manner. This requires an effective management of the procurement department, involving professional training. Another issue is clear definition of the strategy and procurement structure, which includes plan development, measurement development, and usage of modern technologies and systems.

Finally, these objectives are achieved if the following actions are taken: efficient sourcing management, collaboration, teamwork and ownership as well as accountability of sourcing. (Handfield 2011.)

As a conclusion, the procurement process has a great impact on company's performance. It is highly important to take it into consideration, even in small sized companies.

### 3.4 Inventory planning

Inventory management may be considered as the very core process within supply chain relationships that involves product flows. In order to manage both forward and reverse flows of a product within a supply chain in an effective manner, a company faces the supplier exchanges from the upstream and the demand of a customer having a downstream nature. (Esper & Waller 2014.)

The firm has to find a balance between fulfilling the customers' demands and dealing with supplies of products effectively. Therefore, one can state that inventory has a role of managing the balance of demand and supply. (Esper & Waller 2014.) Moreover, effective inventory management gains optimization of the whole chain of supply and, in turn, helps to satisfy the company's strategy goal (Meng 2006, 3).

There are several aspects of the inventory that allows the company to achieve the target stated above. The first issue to mention is maintaining flexibility of operations. This means that inventory reduces the amount of setups of a material on a workstation. The second issue is handling the variations in the demand. A very common situation is when the demand is not known exactly. In this case, managing of the safety stock allow firm to absorb unexpected changes of the demand. Moreover, safety stock plays a role of a buffer in case of variations in raw material delivery time. If some delays occur, the firm does not face stops in production and loses of sales.

The last point is the size of the economic order. This issue is called Economic Order Quantity and means the required amount of ordered materials targeting to achieve the lowest possible costs of order per unit.

For this research project, the two of the most important issues required by the case company were the safety stock level and an economic order size. They were analyzed in a more detailed manner in the following two chapters. (Meng 2006, 11.)

### 3.4.1 Safety stock analysis

As was mentioned before, safety stock is the amount of inventory to carry in order to prevent stock outs caused by either the variations in demand or in material delivery from the vendor. The key to manage successful safety stock determination is mathematical approach. This approach allows to calculate the optimal stock level using mathematical formulas. The key target of inventory calculations is to find a balance between inventory costs and customer satisfaction level. (King 2011, 33.)

The first thing to calculate is reorder point. The reorder point is the quantity of stock required to generate an order. In case of absolute absence of any uncertainties, if the demand is known exactly, the reorder point is equal to the demand during the lead time. (Vermorel 2007.)

However, it is not possible to make the exact predictions of the demand in real world. Hereby, one can state that demand variations has the major influence on safety stock level. (King 2011, 34.)

So, in practice, due to variances that tend to happen in reality, the reorder point is calculated as shown in the following formula.

$$\mathbf{ROP = DDLT + SS}$$

**ROP**      =   **Reorder point**  
**DDLT**     =   **Forecast demand during the lead-time**  
**SS**        =   **Safety stock**

Figure 7 Reorder point formula (Cudworth n.d.)

Assuming the not biased forecasts, the zero safety stock leads to 50% of service level. The service level expresses the probability that a certain level of safety stock will not lead to stock-out. The meaning of not biased forecast is assuming the great chance of the future demand to become greater or lower than the lead time demand and not having the same variance all the time. (Vermorel 2007.)

In practice, the estimation of forecast variances can be based on the historical data of the company. This leads for the following variance expression. (Vermorel 2007.)

$$\sigma^2 = E[(y_t - y')^2]$$

E – mean operator  
 $y_t$  - historical demand for the period t (sales volume)  
 $y'$  - forecasted demand

Figure 8 Forecasted variances' formula (Vermorel 2007)

The safety stock level is calculated as standard deviation of error multiplied by service factor. More formally:

$$S = \sigma * icdf(P)$$

S – safety stock  
 $\sigma$  – square root of the formula above  
cdf - the normalized cumulative normal distribution (zero mean and variance equal to one)  
P – service level

Figure 9 Safety stock formula (Vermorel 2007)

Thereby, the reorder formula obtains a new view. Let the R be the reorder point, we have  $R = y' + \sigma * icdf(P)$ . (Vermorel 2007.)

### 3.4.2 Economic order quantity

The economic order quantity, also called EOQ is the required purchase order quantity that minimizes total holding the inventory and ordering costs



for the company. The most popular formula for calculating the EOQ is the Wilson Formula created in 1913. (Vermorel 2012.)

$$Q = \sqrt{\frac{2D_y S}{H_y}}$$

$D_y$  - the annual demand quantity  
 $S$  - fixed cost per order (costs associated to the operation of ordering and shipping)  
 $H_y$  - the annual holding cost

Figure 10 EOQ Wilson formula

However, according to several researches, this formula does not feel the requirements of the modern world. This formula assumes ordering costs to be a flat per order which does not tend to happen in most cases. (Vermorel 2012.)

Hereby, the new formula, offered by researches of “Lokad” company, takes into consideration the trade-off of inventory costs and volume discounts.

$$Q = \operatorname{argmin}_{q=\delta+1..∞} \left( \frac{1}{2} (q - \delta - 1)H + ZP(q) \right)$$

$Z$  - lead demad  
 $H$  - carrying cost per unit for the duration of the lead time  
 $\delta$  - the delta inventory quantity needed to reach the reorder point  
 $P$  - the per unit purchase price, depends on the order quantity  $q$

Figure 11 EOQ formula

The changes comparing to the previous formula are the following. First, the time scope is now considered as the lead time. Hereby, the annual carrying cost  $H_y$  is now replaced with  $H=H_y*d/365$ , where  $d$  is the lead time expressed in days. Second, the delta quantity considers both the stock on hand and the stock on order. So,  $\delta=R-q_{hand}-q_{order}$ . (Vermorel 2012.)

The above formula is perfectly matching the Microsoft Excel and this approach was shown in practice in further chapters.

### 3.5 Location

The next important point regarding supply chain decisions is the location factor. This factor has the great influence on profitability in international logistics. The location of facilities responsible for production, assembling, storing the inventory and transportation can have a serious effect on profit and loss balance. The reason for that are variances in cost factors depending on the country specifications, the currency exchange factors and law aspect including various taxes regarding international trade. (Supply Chain Resource Cooperative 2011.)

Moreover, location decisions affect transportation models. This includes the choice of transportation models, building of transportation links, the direct delivery of materials, the inbound movements of material between the facilities, and relationships between company and customers. (Melo, Nickel & Saldanha-da-Gama 2007, 1-3.)

However, transportation is not the only factor affected by location decisions. It also affects procurement, production and inventory (Melo, Nickel & Saldanha-da-Gama 2007). Hereby, one can state that it is highly important to take the location factor into consideration.

Even though, the country of origin of the company and, hereby, its major customers are more or less clear issue, there are still things to consider. First of all, this issue is about customer demand and the value transferred to the customer. It is essential question of how should the product be delivered to the customer, and thereby, the location of production and distribution facilities plays an essential role.

Furthermore, it is important to concentrate on the location of vendors. This affects the total costs of production, the delivery time and the customer response time. Also, as it was mentioned before, the law impact regarding the international trade has a great impact on operations. So, there might be several options for the company to consider of which supplier to choose. And, it often occurs that the combined strategy might become the most optimal decision.

### 3.6 Transportation

It is not possible to achieve the complete efficiency of a supply chain strategy without well-developed transportation system. Good transportation system allows company to increase logistics efficiency, reduce operation cost, and provide better service quality.

The role of transportation in logistics processes is to connect all the steps related to transformation of material into finished goods and, further, into product in the hands of customer. Moreover, transportation system targets not only to link all the steps with each other, but do it in a way to achieve lowest costs possible and, at the same time provide maximum service level for the customers. (Tseng, Yue & Aptaylor 2005.)

Providing of maximum service level for the customer, in terms of transportation means to deliver the right goods, of right quantity at the right place during the time period required in order to satisfy customers' demand. There are several aspects to consider when planning the transportation system. This was presented in the following subchapters.

### 3.6.1 Inbound logistics

The inbound logistics is a process related to transportation of the materials or released product from the vendors, handling the receipt of materials for further distribution (Supply Chain Resource Cooperative 2011). The inbound logistics is combined with the outbound logistics in terms of supply chain management aiming to maximize the efficiency of distribution network and to minimize the operation costs. This, in turn allows to create competitive supply chain strategy and increase overall performance of the company. (Ingram 2016.)

The inbound side of logistics and transportation management involves collaboration with suppliers. The company may organize the transportation of materials either on its own or by cooperation with third party distributors. In any case, the transport agreement, that specifies the areas of financial responsibilities regarding transportation of materials and any possible damage occurring during transportation, takes place. (Ingram 2016.)

The most common rules for such agreements are presented through incoterms. Incoterms, or international commercial terms are international set of trade terms used in sales contracts. They are differentiated based on the following questions. First, who is responsible for the cost of transporting goods, including insurance, taxes and duties? Where the goods should be picked up from and transported to? Who is responsible for the goods at each step during transportation? The following figure represents the incoterms types and their difference.

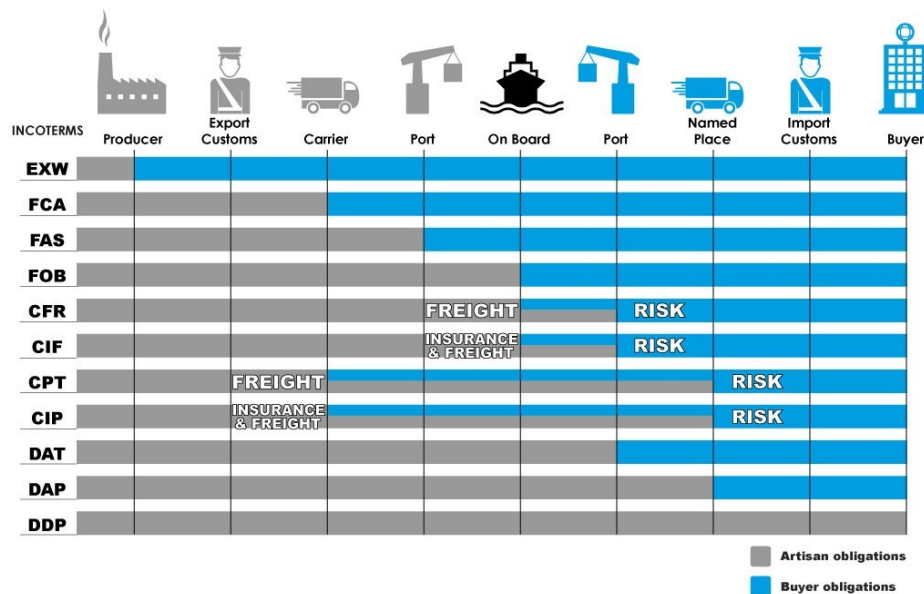


Figure 12 Incoterms (Italian Artisan 2015)

The incoterms illustrated in Figure 12 can be distinguished into four groups. The first group consist of only the incoterm called EXW, or ex works. Within this incoterms, the seller is responsible for making the product available at the production facility, whereas buyer is taking shipment risks and costs. (Italian Artisan 2015.)

The second group conducts incoterms FCA, FAS, FOB. According to these terms, the seller is responsible for delivering the goods to the destination point requested by the buyer. In case of FCA, or Free Carrier, the seller delivers goods to the carrier chosen by the buyer. FAS, or Free alongside Ship, requires the seller to deliver the goods on the harbor dock. Finally, FOB, which means “Free on board”, the responsibility of seller takes place until the goods are loaded in the ship. (Italian Artisan 2015.)

The third group of incoterms refers to boarding matters. Materials are delivered to the shipper point before the transportation to the buyer. The responsibilities of the seller cover the costs and risks before agreed loading point. In particular, CFR, or cost and freight incoterm means that the agreed place is the port of destiny. The responsibilities are transferred to the purchaser as far as goods are loaded on board. The CIF clause (cost insurance and freight) means that seller also pays for the insurance. In contrast, CPT Incoterm means carriage paid to. In this case, responsibilities of a buyer start at the first carrier at the shipment point in the country of export. The CIP clause also includes insurance responsibility for the seller. (Italian Artisan 2015.)

The last group includes incoterms which are meant to make the seller bear all costs and risks until the product delivery to the agreed place. DAT clause, or delivered at the terminal, makes the seller being responsible for the delivery until destination port or terminal. DAP (delivered at place) incoterm means that responsibilities of a seller take place until unloading of the goods at the arrival point. DDP (delivered duty paid) means that seller is responsible for product delivery to the warehouse of the purchaser at the country of origin and the seller pays all required duties and taxes. However, in this case, the seller is not responsible for unloading. (Italian Artisan 2015.)

According to the research, CIF and FOB incoterms are used most commonly within international trade. However, for every particular case, there might be different options preferable. And this is the important point to analyze for the decision maker when designing the transportation model for the inbound logistics. (Italian Artisan 2015.)

### 3.6.2 Outbound logistics

In contrast to inbound logistics, outbound process refers mainly to transportation of the finished goods from last production step to the customer. The transportation aspect is a complex process since this is a variable that tends to fluctuate over time. Hereby, the managing staff have to take into

consideration the changes of factors like fuel costs, delays etc. (Dowler 2015.)

The outbound logistics process consists from various amount of stages to go through for the company. For example, this might be obtaining the order first, then confirmation of the inventory records of whether it is possible to fulfil the order, further, the order is sent to warehouse, the product is picked and packed and then shipped to the customer. At the end, the customer is being invoiced. (Dowler 2015.)

However, direct work with the client is not the only option for the company. Basically, most companies do use the channels of distribution. The role of the distribution channel might belong either to individual or to a distribution convey who provides the product to the final customer. (Dowler 2015.)

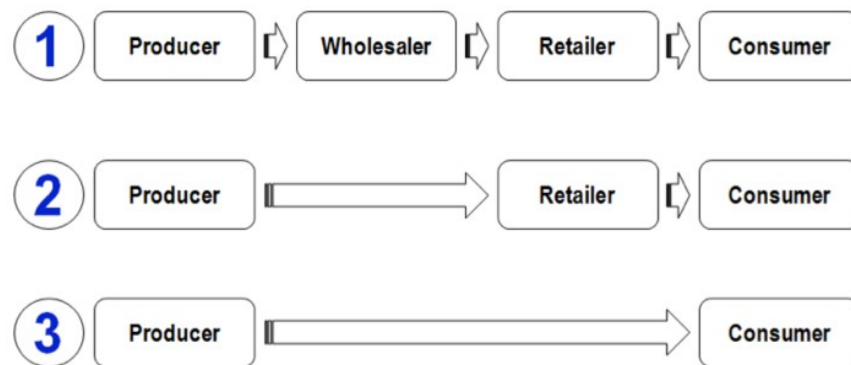


Figure 13 Distribution channels (Tutor2u 2015)

The purpose of the distribution channel is to link together the production of the product by the company and consumption of one by the end customer. Each intermediary of the final distribution process which is involved into the process of delivering the product to the final customer is called a channel level. As it is shown in the picture above, the channel level structure can be very simple including only the producer and the end consumer, or it can consist of several levels making the channel structure more complicated. (Tutor2u 2015.)

The company might decide to operate over the cooperation with the wholesalers. The wholesalers keep the large quantities of the product at their warehouses for further distribution to retailers by separating the total inventory into smaller parts. Another option is to make the partnership directly with the retailers. Finally, the company may sell its products directly to the final customer.

There are several issues to be taken into consideration when planning the way to transfer the product to the final customer. First and foremost, the type of the product is important. Whether it is fragile or not, is it technically complex, how customizable is it, etc. (Tutor2u 2015.)

The next point to consider is the market situation. The geographical aspect is vital here meaning how spread is the area of operation of the company, does the business involves overseas operations? Further, the competition aspect of the market plays its role. Obviously, the business itself has an important meaning. The size of the company, its marketing objectives, and its current distribution network are also points to consider for the management group. The last but not least are the legal issues. It is important to understand the risks of selling the product through the third party, what will happen if the intermediary sells the product to the wrong customer or in an inappropriate manner. Also, if there are any limitations for sales of the particular product in the particular region. (Tutor2u 2015.)

To the final conclusion, the transportation driver is a complicated aspect of supply chain management. It answers the question of how the product should be delivered from the material to the final product to the end customer. Hereby, the inbound and outbound logistics decisions should be closely linked with each other in order to build an efficient strategy to minimize the costs of operations and to achieve maximum customer value.

### 3.6.3 Transport types

After the management group have developed the overall distribution strategy in linkage with inbound logistics decision, the next issue to decide is the transport type for actual movement of the product. There are six basic ways to transport the product, which are ship, rail, pipelines, trucks, airplanes and electronic transport. Each of them has its own advantages and disadvantages as far as several limitations. (Bhatnagar 2009, 9-10.)

Ship is traditionally recognised as one of the most cost efficient transports. However, there are several obvious limitations in use depending on geographical locations of the facilities. Rail is a very wide spread transport mode, which is also a cost efficient way to transport the goods, but in some cases it is a low speed way. Pipelines are obviously can only be used for liquid or gas material transfers. The most flexible transport mode is trucks, but the fluctuations costs of use variable has a very high ratio. It depends on fuel prices, road taxes variations in different countries, etc. (Bhatnagar 2009, 9-10.)

Airplanes is the most expensive transport mode. The company might choose it if the response time and the speed have the top priority for the business and overweight the costs aspect. Finally, the electronic transport is only used for intangible things – the information, energy, and media data. (Bhatnagar 2009, 9-10.)

As it was mentioned before, the transport type decision should be based on the particular case of each company. Its market situation, geographical location, etc.

### 3.7 Role of information in Supply Chain Management

As far as it is considered, the importance of information flow within the supply chain should not be underestimated. The information driver covers data and analysis of inventory, transportation, facilities within the supply chain which allows to monitor the current situation and make estimations. Moreover, it is a link between all the particular stages throughout the supply chain allowing to coordinate the operations of a company on every level like production scheduling, inventory levels, etc. (Ambarwati 2011.)

Information management also affect the competitiveness of the supply chain allowing the one to be responsive and efficient at the same time. Unlike the other drivers that requires the balance of efficiency and responsiveness depending on company needs. In contrast, effective information flow reduces the need for a trade-off. (Ambarwati 2011.)

Nowadays, information technologies are not recognised as an outstanding privilege for any company. One can state that usage of modern software is a must for survival. Thereby, modern IT market offers an extremely wide range of information technologies solutions for various business processes. This includes internet usage, ERP systems, various Supply Chain Management software, and common office solutions. (Ambarwati 2011.)

The supply chain manager should take into consideration several aspects when planning the information decisions within the company. First, based on whether the company uses pull or push supply strategy, there is a need to plan of how the information will flow inside the supply chain. In case of push strategy, the information within the Material Request Planning (MRP) should be managed. On the other hand, if the firm sticks to pull vision, the demand information have to be quickly transmitted from the customer to the production stage.

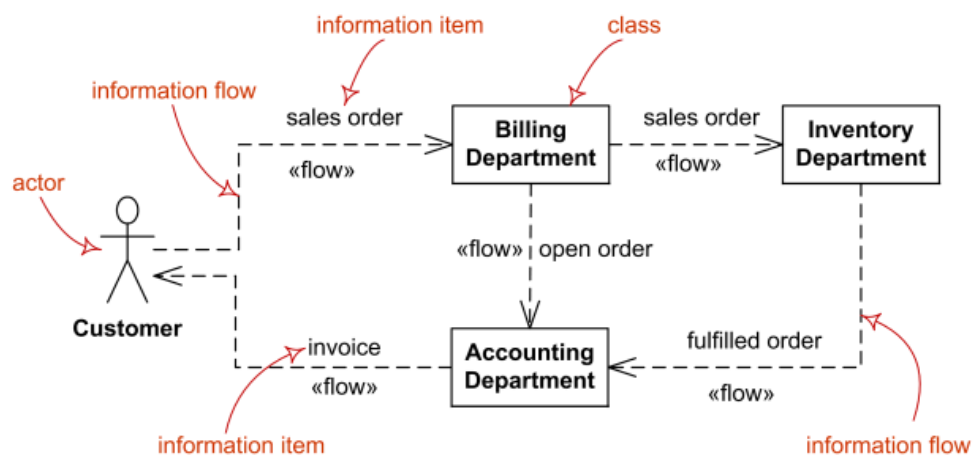


Figure 14 Information flow within the Supply Chain (UML 2016)

Further, the managing group have to decide how information will be used in terms of coordination and sharing between various departments and

stages. Finally, the forecasting and planning processes have to be planned within the information driver.



## 4 INTRODUCTION OF THE CASE COMPANY

The current thesis project was implemented in order to create competitive supply chain strategy for a young growing company Go Double Oy. The following chapter contains information about the company, its current operations, strategy and future development plans. Moreover, the particular expectations from this project of Go Double Oy were detailed in this chapter.

### 4.1 Company overview

Go Double Oy is a start-up company operating in a growing market of electric bicycles for two years. The company offers electric kits that are used to upgrade any normal bike into the e-bike. Moreover, they also offer to the clients' various services including installation of the kits. Currently, the firm operates in B2C business format. However, the B2B operations are not excluded from the future plans.

The major customers that are being targeted by the case company are young people and students who needs to ride to school. Also, adults living far away from their jobs, old people and various postmen and deliverers are the target groups of Go Double.

The company aims to provide value for its customers by selling low cost and high quality electric bicycles equipment. The core idea is to bring benefits for the people by replacing the car with the e-bike. This will allow the consumers to lower their long-term costs due to cheap maintenance, avoidance of fuel expenses and taxes conducted from the car usage. Moreover, the health aspect plays a vital role in the ideology of electric transport. Another important issue is environmental safety being of this transport.

Currently, the company operates in Finland, targeting big cities like Tampere, Helsinki, Vantaa, Espoo and Turku. However, smaller cities also have its meaning by having older customers.

### 4.2 Product description

The company offers various products for its customers. This includes three installable kits which are "Magic Pie 4", "Smart Pie 4" and "Pro Kit". These set-ups differ by the characteristics and price. The following elements are included into each kit: DC motor, battery, braking system, controllers, and cables. The more detailed description was provided in the attachments section. Moreover, several accessories and installation tools are provided.



Figure 15 Smart Pie 4 example (Golden Motor 2016)

At the moment company installs only “Golden Motor” products on their customers’ bicycles. Golden Motor is a Chinese manufacturer of electric motors and other appliances known worldwide.

Smart Pie 4 and Magic Pie 4 (which are almost same kits from type and functionality point of view) are direct driven motor kits, programmable, powerful and very reliable. Pro Kit is a simple version of e-bike kit, geared, with less features, but at the same time is more affordable.

The cost (wholesale prices) for the kits goes as follows. Pro kit wholesale price equals to 210 EUR, Smart Pie 4 is 276 EUR, and Magic Pie 4 – 290 EUR. Selling prices are 399 EUR, 499 EUR and 599 EUR including VAT. According to the CEO (Interview 16.09.2016): “Our pricing policy is that we have most profit coming from motor kits and installation, meanwhile there is almost no profit margin on Li-ION batteries”.

Table 1 Products of the case company

Product	Wholesale price per unit	Delivery costs per unit	Selling price per unit	Profit
Pro Kit	EUR 210	EUR 35	EUR 399	EUR 154
Smart Pie 4	EUR 276	EUR 35	EUR 499	EUR 188
Magic Pie 4	EUR 290	EUR 35	EUR 599	EUR 274

Hereby, there are few points to be noticed, during planning of the delivery process. First and foremost, the restrictions and limitations regarding batteries transportation have to be taken into consideration. Further, it com-

monly happens that importing electric motors requires additional taxes issued by the government of the entry country.

### 4.3 Current Supply Chain

The current supply chain operations can be determined since the actual sales of the product began, which happened in July 2016. Hereby, the sales volumes at the moment cannot be recognized as high. This fact has a great impact on company's operations. This is crucial to understand, that current supply chain model is reliable in given circumstances. However, there are great development plans arise in the firm. This creates the demand for the new supply chain.

The supply chain model of Go Double Oy can be recognized as a pull-driven approach. A pull strategy involves minimizing stock levels caused by the just-in-time approach of inventory management (Lander 2016). Pull strategy requires Make to Order approach, meaning that all supply chain processes are caused by customer order (Lean Manufacturing Japan 2008). The case company starts its supply order, inbound delivery and other processes after the direct order from the customer took place.

As it was stated before, the case company do not implement any actual production of the product. Instead, it operates as a dealer, by selling the parts ordered from the manufacturer and offering various services to its customers. The manufacturer of the e-bike kits, introduced above, is a company from China named "Golden Motor". However, ordering kits from China is less effective method for the company at the moment. First reason for that is low sales volumes which turns the company into on-demand business approach. This approach means not having any stock and ordering the products as soon as the customer order arrives.

Golden Motor offers its dealers wholesale prices which makes this option more preferable. But, this is only possible for orders that are more than 5000 dollars at once. But the start-up company cannot afford such investments at the moment, especially without orders that would fulfil such a demand. On the other hand, ordering one by one products initiated by pull strategy would create an enormously long delivery time, and as a result, high response time which would decrease the customer value.

Since the company operates on demand, it is more efficient for them to order all of the supply parts including the kit, battery and accessories from one supplier. After considering the information stated in the paragraph above, the management board of Go Double decided to cooperate with Golden Motor dealers in Europe. The cooperation goes with two companies. "Miromax" is a dealer located in Lithuania and, in some cases the kits are ordered from Devi-Motion in Netherlands.

Currently, it costs Go Double 35 euros to deliver the product from the suppliers in Europe. At the moment, the whole process looks as follows: the client makes its order through company services which are either web site form, phone call or email request. The very same day, the case com-

pany create purchase order for its vendor. In normal conditions, the product arrives within five working days and one extra day is needed for the installation onto the customer's bicycle. Hereby, it can be stated that the response time for customer order is about one week.

### 4.4 Expectations from research project

The demand for the current project appeared after company's development plans appeared. The case company is going to make a serious increase in the sales volumes and in that case, current on-demand strategy will lose its effectiveness. Higher sales volumes require stock on hand levels, bigger sales orders and lower response time. Hereby, the opportunities to make supplies within wholesale conditions appears.

As it was mentioned before, the target of this project is to design new supply chain strategy for the case company. Generally, the new strategy should involve all steps required for the supply chain design in order to achieve maximum value at lowest costs possible. However, there are three major areas which are expected to be analysed in the most detailed way.

First, the detailed analysis and evaluation of current and potential suppliers is expected to be done. Moreover, the case company requires to present the proven selection choice of the vendors. Second major issue in terms of the current project is to provide clear and accurate calculations of inventory related figures, including inventory level, safety stock, reorder point, etc.

The third major point considers logistics matters. This includes detailed description of transportation process, costs, time frames and all other related issues. Nevertheless, other aspects of supply chain strategy are also to be covered. The general picture of the new strategy and the new database, that includes all the variables in the supply chain management, are expected as the outcomes of the project.

## 5 METHODOLOGY

The following chapter describes research methods and various tools that were used in order to support the thesis project. Moreover, such aspect as information required for the practical section, was covered.

In terms of methodology, it is first essential to describe the information that needed to be collected. Further, one should identify the research methods required for collection of the information stated above. However, there is also analyses to be implemented.

Hereby, it is important to identify the tools to be used in terms of such analytical approach. Finally, all the required data and outcome of the analyses should be collected and organised into a suitable database in order to reduce the complexity of the practical application.

### 5.1 Data collection and analyses

As it was stated before, the first thing to be considered is the understanding of what information is required to make the practical approach possible. One of the major sources of information was the case company itself. In order to realize the targets of the project and to implement the deep understanding of the industry and specifications of the market, the interview with the CEO of the case company took place.

The interview has been mentioned several times during the thesis. The full session with the CEO can be found in the attachments section. Further, in terms of Supply Chain management, the data collection can be directly linked with five drivers of the supply chain. Hereby, it should be grouped into five sections according to the drivers.

The supplier evaluation in this particular case can be referred to the production process. Thereby, all information regarding current and potential vendors have to be collected. This should be done mainly through online services including online search and communication methods with the suppliers. This will allow to gain the information regarding their prices, delivery options, network of the supplier, its location, product requirements and cooperation possibility.

The next point for data collection and analyses is inventory planning. Qualitative methods of data collection play an essential role in this case. The mathematical tools to be used in this section were described in relative chapter in theory part. However, there are also Excel predefined tables to be used in order to provide required calculations.

The location and transportation issues to be discovered require large volumes of data to be collected. This includes law specifications of importing this kind of products. This especially has its meaning in terms of DC motors. Moreover, there are various taxes depending on the operation type and location of the supplier. This information can be gained from online law regulative resources.

Further, in order to define the transportation method, large scales of information must be defined. This includes types of transport, possible restrictions, costs, and response time. This can also be done through online research and communicating with possible transporters by inquiries and emails.

Finally, in order to evaluate required response time, customer demand and customer value, this thesis was made in cooperation with marketing department of the case company and all the data was based on the researches and forecasts made by Go Double Oy.

## 5.2 Calculations

As it was mentioned before, one of the most important parts of the project was the inventory planning. In order to implement this approach, several mathematical formulas were used. One can find them described in greater detail during theoretical and practical sections.

These formulas have been inserted into the Microsoft Excel table. Hereby, there is an inventory calculator that can be successfully used for inventory planning. Moreover, it is advisable for the case company to use it for further planning processes.

Assumptions	Past Sales			Forecasted Sales		
	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
	0	5	3	6	12	18
	-12	-7	-9		12	
	Lead time (months):		1			
	Service level:		0.9			
Calculations				Formulas	Comments	
	Lead time demand:			SUM(H4:J4)	Summing the forecasts	
	Standard Deviation:			STDEV(E5:G5)	Deviation in the past sales	
	Service factor:			NORMSINV(D7)	Inverse of the normal distribution	
	Lead time factor:			SQRT(D6)	Square root of lead-time to forecast ratio	
	Safety stock:			D10*D11*D12	Combining factors	
Reorder point:			D9+D13	Lead time demand + safety stock		

Figure 16 Safety stock calculations example for Smart Pie 4

The same approach was implemented for different inputs of sales and lead time data for further comparison and analyses. EOQ figures were calculated in a similar way but with usage of EOQ related formulas which were described in the corresponding chapters.

Economic Order Quantity (EOQ) with volume discounts			
Order quantity	Unit price		
1	€ 220.00		
11	€ 210.00		Order quantities have to be reached for the discounted unit price to get into effect. Extra lines can introduced
51	€ 193.00		if needed. Don't forget to update the cell B13 to account
101	€ 173.00		for the extra range.
Sample order qty	1		
Unit Price for order qty	€ 220.00		
Delta to reorder point	15		Delta+1 is the minimal quantity to be ordered in order
Lead demand	12		to get the inventory level back to the desired level as
Holding cost per unit (per lead time)	€ 12.50		defined by the reorder point.
EOQ with volume discount	16		

Figure 17 EOQ calculations example for Smart Pie 4

### 5.3 Supply Chain Modelling process

After collection of all the required information, targets determination and analyses implementation, the modelling process took place. The analytical approach was used in order to suggest the most optimal solution regarding the overall supply chain network for the case company.

This was only possible after considering of all the aspects of different option for the new strategy. This included inventory calculations for different suppliers. Those calculations needed to be done separately due to different lead times of the vendors.

Moreover, the costs aspect is also very important for the supply chain modeling. The analyses of the costs, times, delivery and order processing were implemented in order to form a decision. Further, the most optimal solutions were found and the new model was created.

During one of the stages of the project, the author faced the need to research the logistics matters between China and Finland. This was successfully implemented by searching for information about general situation in this area, analyses of possible transportation methods, costs and time analyzes and, of course, taxation issues related to the import process.

Hereby, the results of the current thesis were only possible after implementation of the research methods mentioned above.

## 6 SUPPLY CHAIN STRATEGY ENHANCEMENT FOR “GO DOUBLE A OY”. PRACTICAL APPROACH

In order to implement a successful supply chain strategic approach, one should go through all the supply chain drivers and make decisions related to each one of them, but, at the same time make them integrated with each other in a way to create a united, comprehensive network that will bring most benefits to the company.

The following chapter contains practical approach of the theoretical part of this thesis and aims to present a new supply chain strategy for the case company.

The chapter is separated into several parts in order to describe the decision making process during each stage. Nevertheless, it is important to realize that all of these steps are closely linked with each other and each decision affects other parts of the supply chain design.

### 6.1 Evaluation of suppliers

The choice of the suppliers is an extremely important point in terms of supply chain management. First, as it was stated in chapter 3.2: In sense of the case company, which was described in further chapters, there is no fabrication process itself. However, the procurement of all related details of a product as far as assembling and storing of it, take place.

Hereby, the suppliers' evaluation can be considered as the first step in production driver of the supply chain management. In order to select the proper supplier, the first thing to be done is setting up the list of requirements expected from the partner company. This should be based on the demand of the company. The main question is which supplier will be the most efficient option providing more value by lower costs.

At the moment, company operates with two suppliers from Lithuania and Netherlands. Moreover, the management is also in contact with the actual manufacturer of the products – Chinese company “Golden Motor”. Also, during the market research of the e-bike kit suppliers, one more candidate was chosen by the author. This is a Spain based company named “CicloTek” which offers wide range of related products and several B2B selling options (Cicloprofecional 2016). The following chapter contains analysis of all vendors presented above and the reliability of each one was figured out.

First company to review is Golden Motor, based in China. This is the original manufacturer of Magic Pie and Smart Pie products. Golden Motor Technology Co Ltd is recognized as shop for various personal electric vehicles including, among others, electric bikes' supplies. It has a dealer networks operating in 60 countries. The company is positioned by itself as a provider of top performance equipment over a competitive price.



In terms of actual supplies, Golden Motor is capable to offer all the products required for the operations of the case company. This includes motors, controllers, battery packs and various accessories. Golden Motor is well known exporter of electric products, according to them, over 80 per cent of their products are exported to abroad markets.

Hereby, they offer opportunities to become their official dealer through B2B operations. It is possible to get the wholesale prices of their products under several conditions. Basically, the mentioned conditions were the main reason for the Go Double not to buy products from China. However, under the new circumstances, it is becoming a possible option.



Figure 18 Golden Motor headquarter (Golden Motor 2016)

In order to become the official dealer of Golden Motors, one have to order a minimum of USD 5000 worth of products on the first order. Dealers get the wholesale prices. (Golden Motor 2016.)

Table 2 Wholesale prices and products' specifications

Product name	Specifications	Amount	Price per unit
Pro kit	Voltage: 36V Power: 250W	1-10	USD 143
		11-50	USD 133
		51-100	USD 123
		>100	USD 113
Smart Pie 4	Max phase current: 50A Continuous current: 18A Voltage: 20-60V Power: 200-400W	1-10	USD 220
		11-50	USD 210
		51-100	USD 193
		>100	USD 173
Magic Pie 4	Max phase current: 80A Continuous current: 30A Voltage: 20-60V Power: 500-1000W	1-10	USD 240
		11-50	USD 230
		51-100	USD 213
		>100	USD 193

Obviously, Golden Motors offers the best prices for the products. However, there are several points to be taken into consideration. First, that the above prices are only possible for orders that worth 5000 USD. Moreover, the shipment of products from China will obviously take more time than the same operation from European country into Finland. However, the transportation issues were discovered in greater details in further chapter.

The next two partners operate in a very similar manner. These are Miro-max, the official dealer of Golden Motor in Lithuania and Devi-Motion, company from Netherlands. It is also possible to order all the required kits. However, prices of the products vary from ones being offered by Golden Motor.

Table 3 Wholesale prices from current suppliers

Supplier	Product	Cost	Selling price
Miromax	Pro Kit	EUR 210	EUR 399
	Smart Pie 4	EUR 276	EUR 499
	Magic Pie 4	EUR 290	EUR 599
Devi-Motion	Pro Kit	EUR 210	EUR 399
	Smart Pie 4	EUR 276	EUR 499
	Magic Pie 4	EUR 290	EUR 599

As it can be seen from the picture, wholesale prices for the products are the same for both suppliers. Basically, there is no difference between operating with these two vendors. However, CEO of the Go Double Oy stated that operating with Miromax (Lithuania) is more common for the case company due to longer relationships between them and “more responsible attitude from Lithuanian partners”.

The delivery process is conducted in this case by the selling company. It takes about 5 working days in order to receive the item after the purchase order has been placed. The delivery cost for the item is 35 Euros.

The last potential supplier to consider is Spain based company “Ciclo Tek”. Go double Oy has not been cooperating with this vendor before. However, after the meeting with CEO, it was decided to consider and analyze this company as well. The main reason for this decision was that this firm claims to offer special B2B platform for bike shops or manufacturers.

Ciclo Tek does not offer exactly the same products, but there is a wide choice of analogs with similar, or even the same characteristics. However, after careful consideration with management board of the case company, it was decided that powerful analogs of Magic Pie 4 and Smart Pie 4 kits are offered for far higher prices. Moreover, these kits are more complicated, and at the moment, the assembling employee does not have enough capability to implement efficient maintenance of the product.

Nevertheless, this vendor is not to be eliminated from the vendor list. The reason for that is their offers of road legal e-bike motor kits of lower power, comparable with Pro kit. It should be mentioned also, that there are

several limitations of power for e-bikes that are driven by roads of common use. Hereby, the most powerful kit, which is Magic Pie 4 is only suitable for off-road use. This explains its low sales volumes, described in inventory chapter.

According to the answers of the CEO during interview, the case company management is totally satisfied with Smart Pie and Magic Pie kits, but completely disappointed with the Po kit due to its technical characteristics. “Smart Pie 4 and Magic Pie 4 kits earned a reputation of good and unique direct driven motors. They are affordable compared to nearest competitors and have impressive characteristics and reliability. One possible improvement here could be working with Golden Motor directly rather than with their dealer. Pro kit is the model we aren’t satisfied with at all. It would be great to switch to another brand and supplier.” (Sytnyk 2016.)

Table 4 Products of Ciclotek

Product name	Specification	Cost	Shipping cost
Platinum L1	<ul style="list-style-type: none"> <li>Motor type: Brushless geared.</li> <li>Nominal Voltage: 36v.</li> <li>Torque: (25 km/h model): 32 nm</li> <li>Nominal power: 250 Watt. (350 watt. continuous, 600 Watt. peak)</li> </ul>	EUR 151.41	EUR 45.00
Platinum LED3	<ul style="list-style-type: none"> <li>Motor type: Brushless geared.</li> <li>Nominal Voltage: 36v.</li> <li>Torque: (25 km/h model): 32 nm</li> <li>Nominal power: 250 Watt. (350 watt. continuous, 600 Watt. peak)</li> </ul>	EUR 151.41	EUR 45.00
Platinum LCD 5	<ul style="list-style-type: none"> <li>Motor type: Brushless geared.</li> <li>Nominal Voltage: 36v.</li> <li>Torque: (25 km/h model): 32 nm</li> <li>Nominal power: 250 Watt. (350 watt. continuous, 700 Watt. peak)</li> </ul>	EUR 158.02	EUR 45.00
Platinum B.O.S	<ul style="list-style-type: none"> <li>Motor type: Brushless geared.</li> <li>Nominal Voltage: 36v.</li> <li>Torque: (25 km/h model): 32 nm</li> <li>Nominal power: 250 Watt. (350 Watt. continuous, 700 Watt. peak)</li> </ul>	EUR 177.85	EUR 45.00

The table of products shows that even the most expensive and reliable analogs of Pro kit model are cheaper than offers of partners from Lithuania and Netherlands even though, the delivery costs happen to be 10 Euros more expensive. However, there is a question of quality arises. Hereby, at 9<sup>th</sup> September 2016, case company made a testing order of the Platinum B.O.S kit. As a result – complete satisfaction of the management board caused by the price and quality ratio. Hereby, during further analyses and suppliers' selection, Ciclotek will be viewed only in terms of delivery the low-power kits supplies.

### 6.2 Inventory management

Author of this thesis considers inventory issues as the most critical issue in decision making. In this particular case, inventory decisions will directly affect all other drivers of the supply chain management. The proper inventory management is required in order to balance between the fulfilment of the customer demand and dealing with product supplies (Esper & Waller 2014).

The main information, required for inventory planning is the forecast regarding future sales. As it was stated before, the management of the case company has enormous development plans. The output of these plans is expected growth within sales volumes. Hereby, the on-demand model might not be effective anymore and the firm requires more complicated inventory management including safety stock, reorder point calculation and Economic Order Quantity.

The first things to be calculated in terms of new inventory management approach, are safety stock and reorder point. As it was mentioned in chapter 3, safety stock is the amount of inventory kept in case of big variances between forecasted and actual demand, between expected and actual delivery time or in case of unforeseen emergencies (Business dictionary 2016). Reorder point is, in turn, amount of inventory left in stock that initiates the new order (Vermorel 2007).

The theoretical approach of safety stock and reorder point calculations was presented in the theoretical part of this thesis. Moreover, the Microsoft Excel table with all required calculations is shown in the attachments section.

During the practical implementation, calculations regarding safety stock and reorder point were conducted for each of the products separately. Moreover, inventory management approaches are different, depending on the supplier. This is due to the fact, that there are several options of delivery: either from China or from European countries. This affects, first of all, the lead time input. In turn, lead time differences make the result figures very different.

Hereby, the calculations were conducted separately for all options. This is needed in order to find the most optimal way of operations. The cost analyses of all option was also conducted.

In order to calculate the appropriate reorder point and safety stock, the following input data was taken. The sales for each product type over the last three months, forecasted sales over the next three months. This data is needed in order to estimate forecast error variance (Vermorel 2007).

Table 5 Sales assumptions

Product name	Past sales			Future sales		
	Jul	Aug	Sep	Oct	Nov	Dec
Pro kit	3	2	0	3	6	9
Smart Pie 4	0	5	3	6	12	18
Magic Pie 4	2	0	0	1	2	3

According to the interview with the CEO, the sales figures over the past three months were spread as follows. The actual sales started in July 2016 by selling 5 items, where 3 order were received for Pro kit and 2 orders for Magic Pie 4, whereas Smart Pie 4 remained unordered. The next month showed fairly better results by having 7 orders, two of Pro kit and 5 of Smart Pie 4. During September, the company has got only 3 orders of Smart Pie 4. There are two main conclusions to be made out of these results. First, that Smart Pie 4 is the most popular product of the company which made 8 sales for the three-month period, whereas there were only 5 items of Pro kit sold and only 2 Magic Pie kits.

The second conclusion was given by the CEO of the company: “Our goal in now to systemize the process and work more on marketing. The September drop in sales was related to our changes in marketing operations – we are improving website and introducing new advertising channels. The goal for next 3 months is to increase number of sales by 10 every month. So October: 10 sales, November: 20 sales, December: 30 sales. Those figures might seem not very impressive, but we are only starting our first venture and also autumn-winter are not “e-bike” seasons at all. We expect that Smart Pie 4 will be our most popular model making 60% of total orders, Pro kit – 30%, Magic Pie 4 – 10%.”

Next important data inputs are lead time and lead time demand. Lead time is the amount of time needed to complete the required process (Business dictionary 2016). In this particular case, lead time is the time needed to deliver the product to the stock. In turn, lead time demand is the amount of products that will be bought during the lead time (Vermorel 2007). After the practical calculations took part, the following results, shown in the table below were achieved.

Table 6 Inventory calculations

Product name	Lead time (months)	Lead time demand	Safety stock	Reorder point
Pro kit	1	6	2	8
Smart Pie 4	1	12	3	15
Magic Pie 4	1	2	2	4

The above calculations were done under the conditions of shipment the products from China. Hereby, the lead time equals to 1 month. One can find detailed information related to China – Finland logistics issues in further chapters. After the formulas, described in theoretical parts were integrated into sample Microsoft Excel table, which can be found in the attachments' section, the following results were achieved.

Lead time demand is an average figure of product to be sold during the lead time. Having the forecasts of sales for the next three months, provided by the case company, the average monthly sales can be calculated by taking the medium meaning of those three figures. Hereby, the Pro kit lead demand equals to 6 items, Smart Pie 4 is 12 items and Magic Pie 4 has the lowest result which is 2 pieces of product.

The safety stock is the amount of inventory to be kept in case of unforeseen situations. Referring to the theoretical part of this thesis, safety stock expression can be performed as standard deviation of error multiplied by service factor.

Generally, historical data variances are used as good empirical basement to calculate error deviations within forecasted data. “David Piasecki also suggests to use the forecasted demand instead of the mean demand in the variance expression” (Vermorel 2007). However, it should be mentioned that in this particular case, forecasted demand period is equal to lead time.

Service factor, also called error level is converted out of service level percentage. In order to do this, the inverse cumulative normal distribution is used. This operation has its own corresponsive Excel function (NORMSINV) and are integrated into the Excel calculator which can be found in the attachments section and highly recommended for the case company for further usage. (Vermorel 2007.)

As a result, the following figures were achieved: the safety stock for Pro kit equals to 2 items, Smart Pie 4 recommended safety stock level is 3 items and Magic Pie 4 is 2 items to be stocked.

The reorder point can be calculated by simply adding lead time demand and safety stock figures. In order to start the new order of Pro kit, there should be 8 items left in stock, for Smart Pie 4 this figure equals to 15 pieces, and Magic Pie 4 is 4 items.

The next step is to calculate the actual size of the order for every product. This is called Economic Order Quantity, or EOQ. The formula used in this thesis has a very important feature – it takes into account volume discounts. And this is crucial point in terms of Chinese partners, as they are the only ones who offers such discounting policy.

Table 7 EOQ calculations

Product name	Reorder point	EOQ
Pro kit	8	11
Smart Pie 4	15	16
Magic Pie 4	4	5

After entering all of the required inputs into the Excel calculator, based on formulas described in chapter 3.3.2. Hereby, it can be concluded that based on the data collected and calculated, the recommended size of the order from Golden Motor is basically one or two items bigger than the reorder point. This means, that first orders will come after shorter intervals of time and will require some investments for the future. However, since the operations tends to continuous growth, later one, this will come to a more stable balance between sales and purchase orders.



Figure 19 Purchase order processing

The graph above shows the approximate order processing with inventory calculations based on the Chinese manufacturer conditions. The zero point is assumed to be the time of first arrival of all orders in quantities, according to EOQ. Further, the X axis shows time in months, and table below represents time periods until new order for each product.

The described inventory approach is related to dealing with Golden Motor manufacturer in China. The main difference, in this particular aspect, is the lead time, which is different for European suppliers due to relatively faster delivery process. Hereby, the inventory planning for other vendors was implemented.

First, it is to be mentioned, that in practice, for the case company there is no difference between suppliers from Lithuania and Netherlands. However, the CEO of Go Double stated that they are primarily cooperating with Miromax in Lithuania. Hereby, in target of simplicity, only this case was analyzed.

Table 8 Inventory calculations for European suppliers

Product name	Lead time (months)	Lead time demand	Safety stock	Reorder point
Pro kit	0.25	2	1	3
Smart Pie 4	0.25	3	2	5
Magic Pie 4	0.25	0.5	1	1

After changing the lead time variable to one week, according to the information provided by the case company during the interview with CEO, the following figures were achieved (Table). As a result, a totally different inventory strategy takes place. In this case, the orders and the total product flow becomes more frequent. Moreover, this approach is much more flexible due to shorter lead time and smaller order sizes. EOQ figures also tends to reduce in comparison with previous case.

Table 9 EOQ for European Suppliers

Product name	Reorder point	EOQ
Pro kit	3	4
Smart Pie 4	5	6
Magic Pie 4	1	2

It should also be mentioned, that in case with cooperation with partners in Spain, lead time factor would be the same for the Pro kit. However, it might become a more reliable option. Reasons for that were described during costs and transportation analyses.

### 6.3 Transportation

After the demand for the product and the inventory issues have been analysed, the transportation aspects have to be worked through. As it was stated in the previous chapter, lead time variances between European and Chinese suppliers varies due to big differences in delivery time. Hereby, the transportation process in its different aspects was presented in this chapter.

#### 6.3.1 China Finland logistics in general

One of the main goals that were set up by the case company in terms of this thesis project is to create the detailed description of the delivery process between China and Finland. The reason for such prioritization is the fact that transportation issues related to the delivery of the product between European partners and Go Double in Finland is very well known by the management of the firm.

It has already been discussed in the theoretical chapters that there are several transport types exist nowadays. No doubt that there are several options of cargo delivery from China to Europe, and, particularly – Finland.



Throughout decades, Finland has been an important intermediary between China and Russia. This happened due to various reasons. Despite the fact of having a common land border between these two countries, goods from China are mainly being transported to Russia by sea shipping. In this case the economic space is not the same as the physical path of the goods delivery. And big amount of Russian importers choose transit through Finland or Latvia as the most acceptable solution. At first glance, the route looks like a roundabout way, but this way gives a real opportunity to reduce the transportation cost. (Transmare logistics 2016.)

The reason for such advantages is the fact that the Russian eastern ports are not able to accept large ocean-going vessels, and shipping with small vessels cannot compete with the giant ocean-going vessels with far larger capacity. Further, delivery of goods from China by the Trans-Siberian way were not considered as a reliable alternative to the sea route, due to the state tariff policy of Russia in relation to transit, as well as the impossibility to calculate the time of delivery of goods because of the lack of clear rules and methods of customs clearance, the lack of a single transit document and the presence of large number of participants in the chain of delivery of goods from China. (Transmare logistics 2016.)



Figure 20 China - Finland sea transportation (Transmare logistics 2016)

Hereby, the shipping route between China and Finland became a very popular way of freight delivery, very well known by the companies and having a lot of opportunities offered by third party logistics companies.

“At the moment, a major part of the freight between East and West goes by sea. The dominant or near monopoly position of marine shipping companies means shippers cannot expect a reduction of their transport costs. Rail transport offers a reasonable economical alternative to shipment by sea.” (Russian Railways 2016).

Nowadays, global business environment has changed and railway connection between China and Europe, including Finland, has become a competitive alternative way for freight transportation.

On August, 2014 logistics service provider from Finland has signed a letter of intent. The target of this action was to build a new railway route that will seriously decrease the time of the way from China to Finland. This letter was signed between Nurminen Logistics from Finland and UTLC, which is the joint venture of the Russian, Kazakhstan and Belorussian state railways. (Nurminen Logistics 2014.)

Furthermore, the most traditional way that connects China with Europe, that is Trans-Siberian Railway, has been developed and changed in many ways (Russian Railways 2016). According to Russian Railways (2016): “Trans-Siberian as a major freight artery offering a fully developed container service across Eurasia from Berlin to Beijing, with links to major cities in Europe, including Helsinki, Kaliningrad, Warsaw, Minsk, Kiev, St Petersburg, Smolensk and Yekaterinburg.”



Figure 21 Trans-Siberian railway (Russian Railways 2016)

It is now clear, that Trans-Siberian route can really become an opportunity for freight transportation for the case company of the Thesis. Russian Railways claims several advantages of using such a route. According to their statements, container delivery from China to Finland can take less than 10 days in comparison with a month that averagely is taken by sea transport. Moreover, the transshipment processes are minimized, which, in turn, reduces the cargo costs. (Russian Railways 2016.)

Nowadays, the Trans-Siberian way offers modern infrastructure and different services allowing better delivery processing. This includes electronic goods declaration, which reduces inspection time from 3 days to 1.5

hours, full monitoring services for customers, etc. (Russian Railways 2016.)

It can be concluded, that nowadays, both sea and railway transport can become a suitable option for freight delivery. The Golden Motor manufacturer is located in a town, very close to Shanghai, which makes it possible to use all the main delivery routes including sea transportation and railway method.

Another option to deliver products from China is air transport. However, it is recognized as the most expensive transport mode (Bhatnagar 2009). It is usually used for some products that requires extremely high responsiveness. Moreover, there is a battery attached to each e-bike kit, which might cause unnecessary problems.

### 6.3.2 Options for sea transport

There are various logistics service providers that specialises on sea freight delivery from China to Northern Europe, including Finland. Below, there is part of the table presented. This is the list of the most attractive potential deliverers in terms of the current project.

Table 10 Sea transport companies overview

Trademark	Route	Transit time (days)	Pricing	Min. order	Additional services
SEABAY	Shanghai - Helsinki	30-60	USD 30 / CBM	1 CBM	Picking from all China cities; warehousing in SH; FCL/LCL
VICTORY SHIPPING	Shanghai - Helsinki	15-30	USD 10 / CBM	1 CBM	FCL/LCL; warehousing in China; trucking, insurance, packing, door-to-door.
EVERGRAND	Shanghai - Helsinki /Vaasa/Pori	15-30	USD 23-45 / CBM	1 CBM	FCL/LCL; warehousing; insurance
VICTORY SEA FREIGHT	Shanghai - Helsinki	15-30	USD 5 / CBM	1 CBM	FCL/LCL; Door to Port, Door to Door; insurance
WINGSPEED	Shanghai - Helsinki	15-30	USD 1-5 / kilogram	0.5 KG	quality control, door-to-door; everyday departure; packing

It can be concluded from the analyzes, that the management board of Go Double Oy have to contact and select one of the mentioned freight companies. However, during this thesis it is possible to estimate the average time of sea shipping and approximate costs of the service.

First and foremost, it is clear that average shipping time is one month. It is visible from the table above. Moreover, a lot of informational resources claims such a delivery time. Most of the companies conduct its pricing policy based on volume (CBM – cubic meter), weight and value of the cargo. For this purposes, the dimensions of the packed product should be mentioned. At the official Golden Motor web site, it is stated that box dimensions are the following: 66 cm \* 66 cm \* 22 cm, kit gross weight is 11.5 kg.

The personal suggestion of the thesis author is to contact “Wingspeed” company at first. This is widely known company with good reputation (Alibaba 2016). Moreover, its service might be recognized as the most optimal solution for the case company.

First, it is easier to calculate the cost of shipment, as it is being calculated per kilogram. Moreover, the minimum order quantity is only half a kilogram, which makes it possible to order any amount of product required by the inventory management for the particular supplies. (Alibaba 2016.)

Further, this service is being claimed as one of the fastest sea transportation methods and, at the same time, one of the cheapest. Moreover, in comparison to other companies, Wingspeed offers departure of its ships every day from major ports of China. The most common case for other companies is every week departure. Obviously, such approach brings much more flexibility for the operations. And it is generally assumed that flexibility can be recognized as an essential point for any young company.

Moreover, there is a big amount of additional services that simplifies the delivery process. That is one more serious advantage for the small company with lack of experience in international trade. This includes door-to-door service, packing services, quality control, documentation services, warehousing, and maximum flexibility regarding delivery schedule and the route, cooperation with various logistics companies all over the world.

Finally, it is offered that all the responsibilities for the shipping, up to the destination point are taken by the delivering company. However, the particular incoterms conditions have to be agreed individually. The company supports all major modern payment methods. This is very important issue regarding trading with Chinese companies. Nevertheless, this firm accepts Alipay, Western Union, Master Card, Pay Pal, ESCROW, Visa, etc.

In order to make a request, one should send the inquiry form to the company. This can be done through Alibaba service. All the required links were attached to the source section. So, in order to make an inquiry, the buyer should state brief product description, its physical specifications like size and weight, amount of the product, introduction of the own company,

and preferable incoterms. Moreover, if there are any special requests, it should also be mentioned in the form.

In the following, one can find the map of the delivery process of the freight from China to Finland using the sea transport.

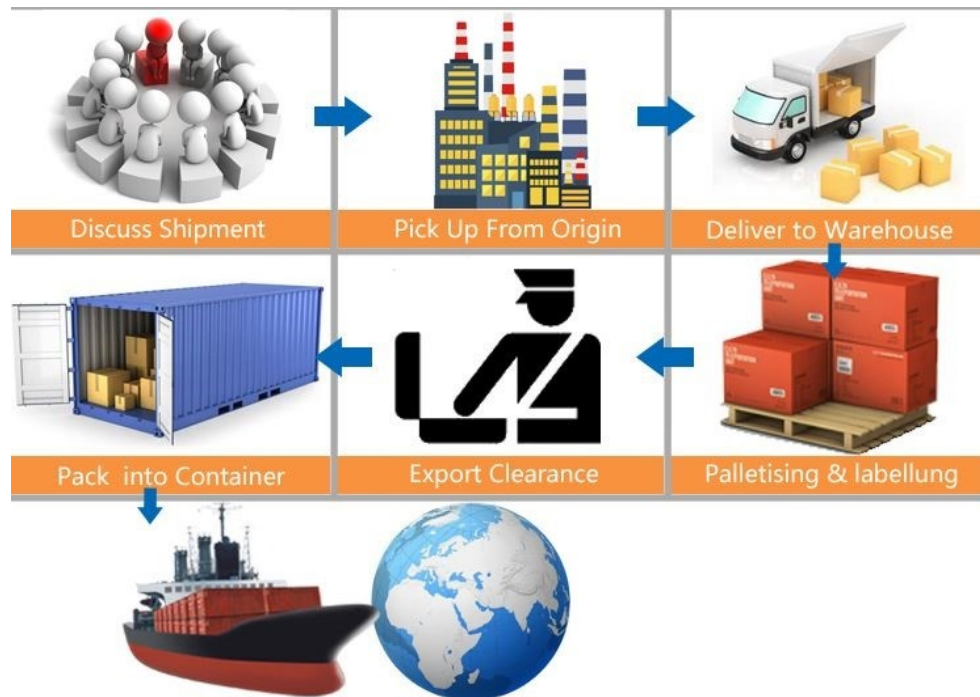


Figure 22 “Wing speed” shipment process (Alibaba 2016)

### 6.3.3 Railway freight

After careful consideration, the author has come to a conclusion, that railway transportation does not fit the requirements of the new supply chain strategy of the case company. Even though, Russian Railways claims this method as a cost – efficient alternative, it is not hundred per cent correct in current situation. It should be mentioned one more time, that there is a small company case taking place. Hereby, the amount of freight will be very low in order to send trains from China.

Even though, China develops its rail connections with European countries, one should notice that the trains are going through other countries as well. Hereby, any kind of political instability may strongly influence transcontinental freight services. In order to implement successful management of the international railways, the logistics service company has to deal with various rail operators, customs regimes and laws. (Examine China n.d.)

Moreover, there is a question of expenses take place. Obviously, faster transport will require higher costs, but saving around 10 days would cost the customer from three to two times more than sea transportation (Examine China n.d.). And this is the main reason why most of the companies prefer maritime transport. Railway transport is recognized as unsuitable and uneconomical for small traffic of goods (Your article library n.d.).

Nowadays, a lot of firms consider railway transport mode as an emergent approach which will allow to save time. However, air transport is much more efficient in sense of time management, rail freight can compete in price segment as expensive rail transportation is still cheaper than airways.

To the final conclusion, railway connection between China and Europe tends to develop and grow in a fast manner. This might lead to serious cost reduction for such transport option in the future. (Examine China n.d.) Moreover, if the case firm shows tendency to develop and increase its sales volumes, one day the management board should take train cargo transportation into consideration as an alternative way of its supply chain connections.

At this particular moment of the development history of a young company, the maritime transportation seems the most optimal way in case of cooperation with Chinese partners. If the management decides to start supplies from Golden Motor in China with the demand, described in chapter 6.2, it should consider sea transportation as the main option for product delivery.

Low costs and high reliability of this method are clear advantages. Moreover, the disadvantage of a long delivery time can be compensated by a smart inventory policy, right amount of safety stocks and clearly calculated reorder points and sizes of the orders.

### 6.4 Costs

The main thesis of Supply Chain Management concept is to achieve highest possible customer value at the lowest possible costs (Business dictionary n.d.). Hereby, cost analyzes is the essential parts of the SCM. Moreover, comparison of the costs associated with product supplies will allow to make the final decision regarding the suppliers and method of delivery of the product, which in turn affect inventory management issues and all other related activities.

In order to compare the chains of supply that involves suppliers from different countries, it is important to clarify the variables that affects total costs. First and foremost, this is the supplier's price for the product. It should be noticed, that it is different among the vendors. The cheapest option is offered by Golden Motor, moreover, its wholesale prices decrease if the order size becomes bigger. However, there is a limitation takes place. In order to get the wholesale prices, the first order should be more the 5000 dollars valued.

#### 6.4.1 Product costs

In order to calculate costs of the products, one should notify the possible volume discounts which are not offered by every supplier. This can become a critical issue during the vendor selection process. Thereby, refer-

ring to the EOQ figures, and prices per product, there is the following table arises.

Table 11 Vendors comparison

Supplier	Product	Item cost (EUR)	EOQ	Order cost
<b>Golden Motor</b>	Pro Kit	304.06	11	4,151.36
	Smart Pie 4	374.79	16	7,445.07
	Magic Pie 4	402.35	5	2,497.86
<b>Miromax</b>	Pro Kit	439.06	4	1,756.36
	Smart Pie 4	505.06	6	3,030.36
	Magic Pie 4	519.06	2	1038.12
<b>Ciclotek</b>	B.O.S. (Pro kit)	387.68	4	1,548.00

It is now noticeable, that the prices vary in comparison with previous table. This is caused by several reasons. First, prices of Golden Motor were presented in USD at their official price list. According to Central Bank of Europe, one dollar of the United States equals 0.9186 Euros at 22.10.2016. The prices in the table above are shown in Euros as the case company operates in Finland which has Euro as an official currency.

Further, the graph “Item cost” contains price of the particular kit combined with the battery price added. The battery is a separately purchased product. However, obviously, the kit cannot be sold or operated without battery. Go Double uses Li-ION 36V battery that costs 198 dollars at Golden Motor, which equals 181.88 euros. Miromax offers the same battery for 229.06 EUR and vendor from Spain sells 209.83 EUR battery. That were the steps implemented in order to achieve mentioned figures.

The major conclusion from this analyzes is the comparison of costs between suppliers. It is clearly visible, that Golden Motor company prices are relatively lower than the ones by its European dealers. However, due to lower order size, ordering from Miromax and Ciclotek is much more flexible option and requires significantly lower investments for each order.

## 6.4.2 Comparison of delivery costs

Another important issues to analyse the costs associated with the transportation matters. The major figures are the actual delivery costs. As it was mentioned in chapter 6.3.2, the advisable transportation company takes from 1 to 5 USD per kilogram. Hereby, in order to understand the delivery costs of 1 kit, one should refer to its specifications.

Table 12 Packed product specifications

Product	Dimensions of the box	Weight (kit + battery)
Pro kit	66 * 66 * 19 CM	17 KG (11.5 + 5.5)
Smart Pie 4	66 * 66 * 19 CM	17 KG (11.5 + 5.5)
Magic Pie 4	66 * 66 * 19 CM	17 KG (11.5+5.5)

Hereby, it can be concluded that the price for the delivery of one kit box would cost around USD 43 (approximately EUR 38). However, prices might vary and must be clarified with the transporting company. The very worst scenario would require EUR 76 per one kit.

In comparison with the delivery figures, shown during the delivery from Lithuania, which costs 35 EUR and Spain, which requires EUR 45 deliver per one kit, a comparison analyzes might be implemented.

It is now absolutely clear, that delivery process from China is obviously more expensive, however, the wholesale prices offered by Golden Motor influence the costs of the case company far stronger due to big price difference between products by original manufacturer and official dealer.

Nevertheless, there is one more crucial point to consider. The international regulations of the trade and taxes, required for importing of such a product.

## 6.4.3 Taxes

“The taxes most commonly levied upon import are customs duties and value added tax. When goods are being imported from outside the EU, so-called third-country customs duties are levied on them. This duty rate based on the customs tariff is levied on goods from third countries unless preferential treatment, tariff quotas or tariff suspensions lower or remove the duty.” (Tulli 2016.)



The duties of the customs are generally calculated in a form of percentage of the total customs value. Moreover, several goods are obligatory for specific duties which might be based on such parameters as weight or amount. Customs duties are determined based on the classification system. This system includes customs tariff code for each type of goods. (Tulli 2016.)

Customs value is generally assumed as the amount paid for the product. Moreover, the transportation costs that took place up to the first entrance of the European Union, are also considered as part of customs value.

Another important point of consideration is preferential tariff. Preferential tariff means having lower duties on products than it is required within the terms of import the product from outside of the EU. It might be based on particular agreements between the EU and other countries. Currently, there are approximately 40 of such agreements. (Tulli 2016.)

These agreements are primarily targeted on the trade with developing countries. Preferential agreement can decrease or eliminate customs duties depending on the goods type. Generally, the majority of all countries around the world are under some preferential treatment, excluding approximately 20 countries like Russia, USA, Japan, etc. (Tulli 2016.)

Nevertheless, the main taxes to be considered are import VAT, or value-added taxes. Commonly, VAT is based on the customs value of the goods, transportation costs, loading and unloading, insurance and other import related costs. VAT is incurred since the goods first entered Finland or the EU. In most cases, value added tax equals to 24%, however, some exceptions are possible. (Tulli 2016.)

In order to calculate taxation, it is important to classify the imported product and figure out VAT and the import duty rate for the particular product. One delivered box contains lithium-ion battery and the e-bike kit itself. Thereby, coming by classification as “Electronics & Video Games → Batteries & Chargers → Batteries | rechargeable - lithium-ion” will show that these batteries has a commodity code 8507.60.0090 has a 2.7% import duty rate. (Duty calculator 2016.)

The e-bike can be classified as “Sports & Leisure → Bikes & Bike Parts → E-bike”, the commodity number of this type of goods is 8711.90.1000. The import duty rate for e-bike being imported to Finland is 6% (Duty calculator 2016). In the following, there is a comparison table of import duty rates for the e-bike in several countries.

Table 13 Import duties and taxes

Import to country	Commodity code	Duty rate	Sales tax
Lithuania	8711.90.1000	6 %	21 %
Netherlands	8711.90.1000	6 %	21 %
Sweden	8711.90.1000	6 %	25 %
China	8711.90.1090	45 %	17 %
Finland	8711.90.1000	6 %	24 %

## 7 FINAL RECOMMENDATIONS

The next step after detailed analyses of all aspects regarding Supply Chain Management approach for the case company, is to create an overall scheme of the new supply chain strategy. First and foremost, it is important to realize the size of the case company. Being a young start-up company does not allow the Go Double to make huge investments into its supply chain strategy.

Moreover, high risks associated with possible failure would be very sensitive at this stage of firm operations. So, the new supply chain has to be very efficient in order to satisfy the demand and, at the same time flexible enough in order to prevent possible failures and be able to adapt to the rapidly changing business environment and possible variations in demand.

Thereby, the following chapter describes the final recommendations concerning current supply chain operations, possible options of flexibility and future development ways.

### 7.1 New Supply Chain strategy

After careful consideration, it was decided that current supply chain model cannot be recognised as efficient anymore. Moreover, new conditions that were predicted, forces the management board to switch to a new model.

The new model presented in this project is the total outcome and combination of the research conducted above. During this project several options for inventory management, suppliers and logistics issues were analysed.

Generally, the new recommended supply chain model cannot be recognised as pull approach anymore. Instead, it is suggested to implement the combined view of the model.

In sense of current thesis project, the “combined view” actually means different approach for each product type of the case company. This is caused by completely different demand for the products of the company. According to the CEO of Go Double: “We expect that Smart Pie 4 will be our most popular model making 60% of total orders, Pro kit – 30%, Magic Pie 4 – 10%”. Taking into consideration the amount of expected sales, it is absolutely clear that Smart Pie 4 product has far bigger demand comparing to other products. And, on the other hand, Magic Pie 4 has very little demand by having only few sales per month.

Hereby, it has brought completely different figures from inventory estimations. Those results have affected, first of all, the supplier selection process. After careful consideration, it has been decided that the optimal option would be switching to cooperation with different suppliers for each product type.

Even though, the CEO of the firm has stated during the interview, that working with one supplier is more efficient way for them at the moment,

the better option for future operations with increased demand would require more flexibility.

This is caused by several reasons. The graph below represents the inventory and ordering approach in case of 1-month lead time, which happens if the cooperation with Chinese supplier takes place. Due to high demand of the Smart Pie 4 product, ordering directly from Golden Motor can be seen as a perfect opportunity to save costs due to lower prices of the product and volume discounts which are possible to achieve with such order sizes. Moreover, the time period between orders and for the realization of the product volumes is relatively shorter for the Smart Pie 4 in comparison with other products.

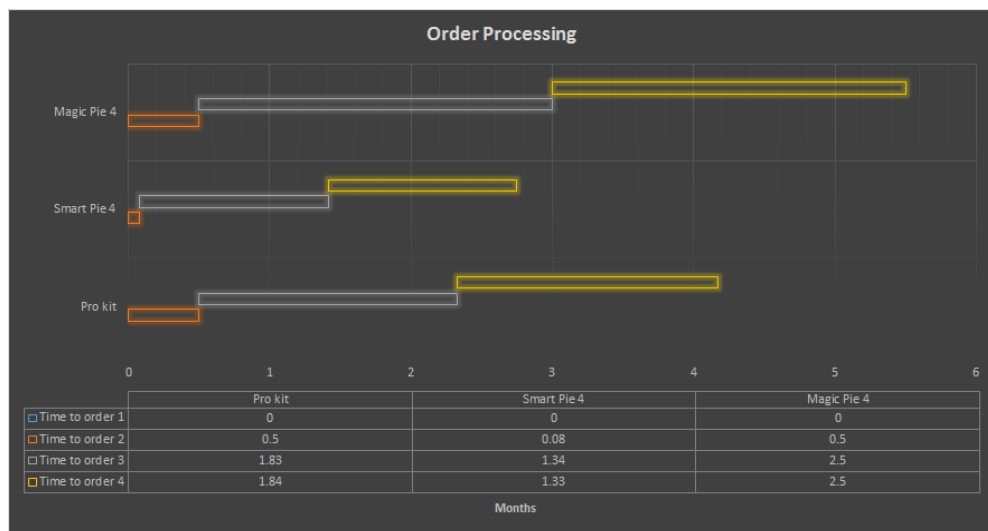


Figure 23 Order Processing

Furthermore, the most economical inventory approach does not require ordering all the products at the same time. Hereby, it leads to the situation when each product has to be ordered separately. However, the order sizes vary from each other. In order to achieve efficiency within inventory management under the conditions of having Chinese supplier, the Smart Pie 4 has to be ordered in quantity of 16 items and reordered each time when there are 15 products left in the stock. The graph shows that in this case, the new order will happen approximately after 1 month and 1.5-week period of time.

In comparison, the Pro kit model would require 11 pieces' order size with the reorder point equals to 8 items. This will lead to approximately 2-month period between orders. This is a serious reduction of the flexibility for the company. And such factor can become fatal for the start-up company. Moreover, it should be stated that the case company is not completely satisfied with the Pro kit model from the technical point of view.

Magic Pie 4 shows even worse situation. Due to low demand for this expensive product, the time gap between orders will contain 2.5 months. Moreover, the order quantity of only 5 items, whereas approximately 6

pieces to be sold per month, ordering of this product from Golden Motor almost does not have any sense.

For the conclusion, it is being advised for the case company to deal with suppliers in the following manner.

Table 14 Inbound logistics overview

Product	Supplier	Operation type	Lead time	Lead demand	EOQ	Safety stock
Smart Pie 4	Golden Motor (China)	Predictable	1 month	12 items	16	3
Pro kit (analogue)	Ciclotek (Spain)	Predictable	1 week	2 items	4	1
Magic Pie 4	Miromax (Lithuania)	On-demand	1 week	1 item	1	0

The major product in sense of the demand is Smart Pie 4. Hereby, the final recommendation for this product type is to order it from the original manufacturer in China – Golden Motor. The order size of 16 kits with batteries will cover up the mandatory condition for the first order to be at least 5000 USD. Hereby, it will become possible to get the wholesale prices. Moreover, 16 pieces is the enough amount to get the first level volume discount that is also a serious reduction of the product cost in comparison with dealers in Europe.

The second product in terms of demand is the Pro kit. As it was already mentioned several times, the management of the case company is not fully satisfied with this particular product. Thereby, it was decided to search for new vendors. After careful selection, the company named Ciclotek, based in Valladolid, Spain was chosen. The case company has ordered one product for testing. This was their own analogue of the Pro kit, having same characteristic and suitable for mid road drive in Europe.

Smaller demand for this product and its lower priority in comparison with Smart Pie 4, makes it more reasonable to order the items from European dealers. First and foremost, this allows to keep more flexibility in the process. There is no need to wait for big orders to arrive in a month. Instead, there are much smaller orders with delivery time of less than a week. This will allow to stop ordering if needed with minimal loses.

For instance, if the demand for the product will show stable growth, that would be possible to switch almost immediately to the cooperation with the Chinese suppliers by simply adding this product to the original order and by stopping orders from Spain. On the other hand, if this product will

not achieve the targeted sales volumes, that would be less painful for the company to stop the orders and switch onto on-demand model. Moreover, there will be no overstocks in this case.

Finally, the Magic Pie 4 is the most complicated product from technological point of view. Moreover, it is the most powerful e-bike kit only suitable for off-road usage. As a result, the expected demand for this product is significantly lower in comparison with other models. Thereby, it is advisable for the company to keep this product in the current sales model.

Sales of this item by using the on-demand strategy will not cause big loses in comparison to other models. Moreover, long – distance shipping of such a small amount of goods might become unreasonably expensive. Further, approximate sales volume of 2 items per month makes the forecasts very unstable, it would be hard to predict the variations in demand due to the fact that simply one extra order would increase the sales per month by 50%.

Hereby, the final recommendation of the author concerning the Magic Pie 4 model is to keep it going without any changes.

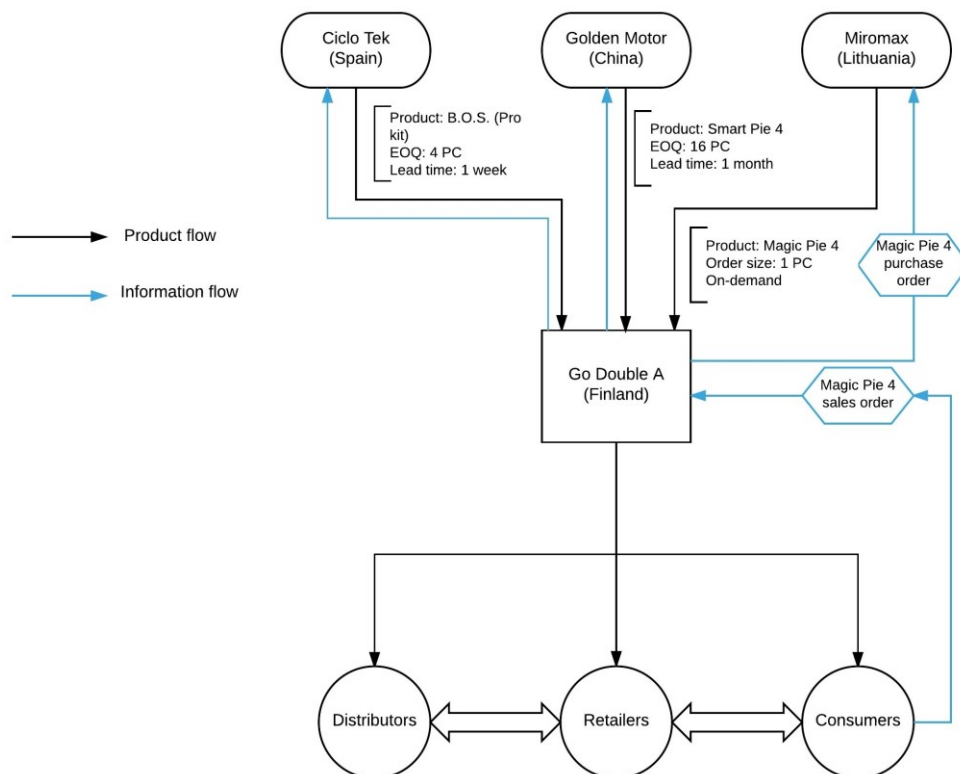


Figure 24 Supply Chain Model

The figure above represents the new supply chain model in brief. It is to be noticed, that current thesis was mainly focused on inbound aspect of Supply Chain Management. Hereby, the lower part of the chart represents, very briefly, the company’s planned distribution model.

The main target of the diagram is to conclude the final recommendations for the case company. In addition, it describes the route of each product between the supplier and final customer. These ways are different depending on the product. For instance, Magic Pie 4 ordering is a pull process, starting after the customer order arrives. Thereby, the response time in this case would conduct one week. In contrast, Smart Pie 4 is a push process, whereas big orders for wholesale prices take place, the inventory management implementation is at maximum level and the response time for the customer is only one day required for bicycle upgrade.

### 7.2 Information driver approach

One last point to consider is the information management. Go Double is a young company with great development plans. Obviously, this requires changes in the Supply Chain Management in the future. In order to implement strategic approach and to analyse new situations in order to make new model, there is an IT approach required.

There is a big variance of SCM software on the market. However, until the sales volume are growing up and did not become really huge, there is sense in using simple tools that are capable enough to support SCM decisions at this stage of company development.

SCM and ERP (Enterprise Resource Planning) software integration allows company to achieve visibility of all operations within the business. This allows to increase the speed and efficiency of the operations. Supply Chain Management requires interaction with different suppliers, partners and departments within the company. This is needed for obtaining the raw materials and resources into the finished goods in the most efficient manner. (Computada 2015.)

Hereby, one can state that ERP software is a very important asset in terms of creating and maintaining efficient SCM model. The following table presents the short overview of various SCM and ERP software that might be useful for the case company (Software advice 2016):

Table 15 Software comparison

Name	Business size	Main features	Price range	Rating
Fishbowl Inventory	Small/Midsize	Inventory control, material requirements planning (MRP) and job shop floor control/manufacturing execution	Low	4/5
Freightview	Small/Midsize	Less-than-truckload (LTL) freight and working with multiple carriers or brokers.	Low	5/5
3PL Warehouse Manager	Small/Midsize /Large	Access to real-time information and provides turnkey integrations with warehouse management technologies, including EDI, barcode scanning, e-commerce shopping carts	Low	4.5/5
U Route	Small	Direct e-carrier management, user-friendly procurement, RFQ development and bid capabilities, load tendering, robust analytics	Low	4.5/5
Synapse Software	Small/Midsize	Warehouse management, Inventory management, Billing, IT planning, Deployment assistance	Medium	4.5-5

The major conclusion is that there is a wide range of the software on the market. And this software is not necessary specified for large enterprises like SAP ERP. There are a lot of options for non-expensive software solutions for small businesses.

The personal suggestion of the author is to test different options and select some ERP or SCM program that would support the business activities of the company and will allow to increase the efficiency of the supply chain operations.

## 8 CONCLUSIONS

As a final conclusion, this thesis project was conducted in order to suggest a new supply chain model for a start-up company and it was primarily focused on the inbound aspect of Supply Chain Management. The general idea was to apply the supply chain knowledge and to implement the research project in order to provide comprehensive analysis of possible solutions for the case company which would support its development plans.

As a result, a totally new supply chain model was suggested for the case company. The new model takes into consideration the overall strategy of the company, the requirements of the industry and the market. Furthermore, a lot of options were analyzed during its creation. Totally different methods of product delivery from the initial supplies to the final customers were compared and clarified. Thereby, the advantages and disadvantages of each method were presented and compared in this project.

Moreover, procedures that were unknown to the case company were clarified and presented in this thesis project. These includes such issues as having a practical approach of inventory planning process and the logistics of a product between China and Finland which allows to cooperate with the actual manufacturer of the given product instead of its retailers existing in other European countries.

The delivery process of the e-bike kits and batteries from China to Finland was analyzed in detail. The aspects that were unknown before, were clarified. This included transportation options, time, costs and reliability of each method. Moreover, an examination the imports' processes was conducted. The rules, law regulations and taxation of importing the required products were discovered.

The outcomes of the thesis project were presented in the chapter seven. The final version of the offered supply chain model suggested a very flexible approach at the lowest investments possible. To the personal opinion of the author, this would be a competitive solution for a young company with development plans.

It should also be stated that Supply Chain Management is a dynamic process. Thus, the offered model has to be modified and adapted in case there are changes. Whether these are internal changes or general market changes, the management of the company has to be flexible in order to stay competitive.

The main results of the thesis can be recognized as follows. First, there is a flexible model of optimizing the supply chain in the nearest future, when the sales are expected to grow. Secondly, the planning approach was presented, providing a powerful tool for the management board to plan and develop its supply chain strategy in accordance with its overall business strategy.



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Interview with Andriy Sytnyk, CEO of Go Double A

- What products do you order from your suppliers? Kit models, specifications, costs, selling price.

Answer: At the moment we install only Golden Motor products on our customers' bicycles. Main models are Smart Pie 4 and Pro kit, as well as Magic Pie 4. What we like most about Smart Pie 4 and Magic Pie 4 (which are almost same kits from type and functionality point of view) is that they are direct driven motor kits, programmable, powerful and very reliable. Pro kit is a simple version of e-bike kit, geared, with less features, but at the same time is more affordable. The cost (wholesale prices) for the kits goes as follows: Pro kit – 210 EUR, Smart Pie 4 – 276 EUR, Magic Pie 4 – 290 EUR. Selling price is 399 EUR, 499 EUR and 599 EUR including VAT. Our pricing policy is that we have most profit coming from motor kits and installation, meanwhile there is almost no profit margin on Li-ION batteries.

- Who are your current suppliers?

Answer: since we work on demand (we don't have stock and order products as soon as we receive inquiry from customers), it's less expensive for us to get all product parts (kit, battery, accessories) from one supplier. We used to work with several suppliers but now usually order only from Miromax (official Golden Motor dealer in Europe, Lithuania). In some cases, we order from Devi-Motion (Netherlands).

- How do you proceed with the delivery process? What are the costs?

Answer: So as said before, we work using “on-demand” model. Yes, it takes more time for a customer to get a final product, but we greatly save on expenditures and can afford to lower the prices. In future, when we will get more orders, of course we will need to have stock. Meanwhile, it costs us 35 EUR to get products delivered from a supplier.

- What is your response time? From customer order to final product delivery for the consumer.

Answer: So, basically we order products for the customer the same day he placed an order. It takes about 5 working days to receive all items. Plus 1 day for installation. The next day we can deliver the e-bike to the customer.

- What were your sales volumes over the last five months? For each item per each month, please.

Answer: We started our sales in July, receiving 5 orders (MP4 - 2 kits, Pro kit - 3) for e-bike conversion. The next month we had 7 orders (SP4 - 5,

Pro kit - 2) and only 3 (SP4 - 3 kits) in September. Smart Pie 4 made most of sales: 8 kits, Pro kit: 5 kits and Magic Pie: 2 kits.

- Do you have any forecast regarding future sales? How much do you plan to sell for the next three months? (for each item per each month)

Answer: our goal is now to systemize the process and work more on marketing. The September drop in sales was related to our changes in marketing operations – we are improving website and introducing new advertising channels. The goal for next 3 months is to increase number of sales by 10 every month. So October: 10 sales, November: 20 sales, December: 30 sales. Those figures might seem not very impressive, but we are only starting our first venture and also autumn-winter are not “e-bike” seasons at all. We expect that Smart Pie 4 will be our most popular model making 60% of total orders, Pro kit – 30%, Magic Pie 4 – 10%.

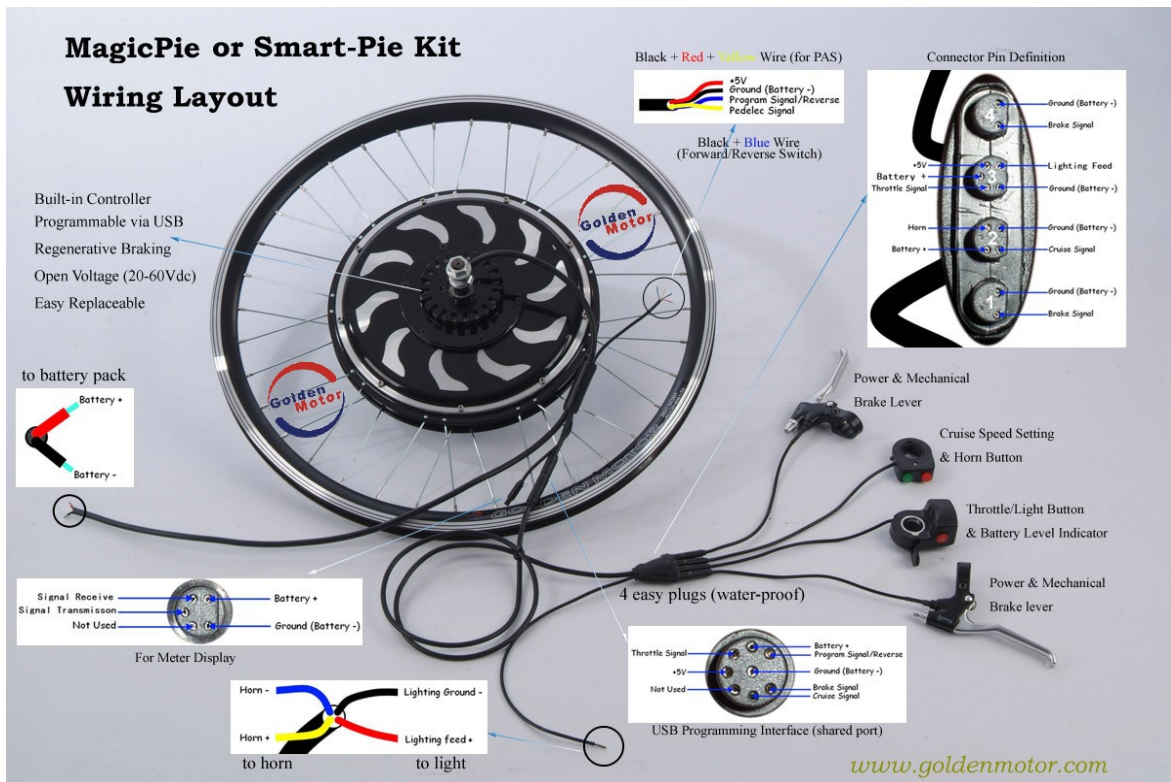
- Do you intend to search for the new suppliers?

Answer: definitely, our goal is to find more valuable products: from quality and cost point of view. Also, though we mostly work with one supplier, it's better to have “plan B” in case of inventory shortages.

- Do you need the exact same kits or you are willing to switch for another one with similar characteristics?

Answer: Smart Pie 4 and Magic Pie 4 kits earned a reputation of good and unique direct driven motors. They are affordable compared to nearest competitors and have impressive characteristics and reliability. One possible improvement here could be working with Golden Motor directly rather than with their dealer. Pro kit is the model we aren't satisfied with at all. It would be great to switch to another brand and supplier.

Magic Pie & Smart Pie Wiring Layout



## Inventory calculations. Pro Kit

A	B	C	D	E	F	G	H	I	J
<b>Assumptions</b>	<b>Past Sales</b>			<b>Forecasted Sales</b>					
	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07			
	3	2	0	3	6	9			
	-3	-4	-6		6				
	Lead time (months):			1					
	Service level:			0.9					
<b>Calculations</b>				<b>Formulas</b>		<b>Comments</b>			
	Lead time de- mand:		6	SUM(H4:J4)		Summing the forecasts			
	Standard Devia- tion:		1.527525	STDEV(E5:G5)		Deviation in the past sales			
	Service factor:		1.281552	NORMSINV(D7)		Inverse of the normal distribution			
	Lead time factor:		1	SQRT(D6)		Square root of lead-time to forecast ratio			
	Safety stock:		1.957602	D10*D11*D12		Combining factors			
	<b>Reorder point:</b>		7.957602	D9+D13		Lead time demand + safety stock			



EOQ calculations

Economic Order Quantity (EOQ) with volume discounts			
<b>Order quantity</b>	<b>Unit price</b>		
1	€ 220.00		Order quantities have to be reached for the discounted unit price to get into effect. Extra lines can introduced if needed. Don't forget to update the cell B13 to account for the extra range.
11	€ 210.00		
51	€ 193.00		
101	€ 173.00		
Sample order qty	1		
<b>Unit Price for order qty</b>	€ 220.00		
Delta to reorder point	15		Delta+1 is the minimal quantity to be ordered in order to get the inventory level back to the desired level as defined by the reorder point.
Lead demand	12		
Holding cost per unit (per lead tir	€ 12.50		
<b>EOQ with volume discount</b>	16		

## Inventory calculations Smart Pie 4

A	B	C	D	E	F	G	H	I	J
<b>Assumptions</b>	<b>Past Sales</b>			<b>Forecasted Sales</b>					
	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07			
	0	5	3	6	12	18			
	-12	-7	-9		12				
	Lead time (months):		1						
	Service level:		0.9						
<b>Calculations</b>				<b>Formulas</b>			<b>Comments</b>		
	Lead time demand:		12		SUM(H4:J4)		Summing the forecasts		
	Standard Deviation:		2.516611		STDEV(E5:G5)		Deviation in the past sales		
	Service factor:		1.281552		NORMSINV(D7)		Inverse of the normal distribution		
	Lead time factor:		1		SQRT(D6)		Square root of lead-time to forecast ratio		
	Safety stock:		3.225167		D10*D11*D12		Combining factors		
<b>Reorder point:</b>		15.22517		D9+D13		Lead time demand + safety stock			