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Improving the inventory management and valuation process
Case: The Switch Drive Systems

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ABSTRACT

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The goal of this study is to create a new inventory valuation process for The Switch Drive Systems and to improve its inventory management practices. In the matter of inventories the main problems in the case company are that it doesn't have consistent valuation methods throughout the company and that information received in ERP system isn't trustful. The research is qualitative case study. The empirical data is gathered through observing and unstructured interviews.

The research shows that material flow process and the inventory valuation must be divided and handled separately but they should interact with each other. The result is a new inventory valuation process which takes many factors of material process under the consideration in order to receive reliable value for inventories.

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Tutkimuksen tavoitteena on luoda uusi varaston arvostus prosessi The Switch Drive Systemsille, joka osaltaan parantaisi yrityksen varaston hallintaa. Suurimpina ongelmina case-yrityksen nykyisessä prosessissa on, että yrityksessä on käytössä useita eri menetelmiä varaston arvostamiseksi ja toiminnanohjausjärjestelmästä saatava varastoja koskeva tieto ei ole luotettavaa. Tutkimus on kvalitatiivinen case-tutkimus, jossa empiirinen aineisto on kerätty havainnoimalla ja strukturoimattomilla haastatteluilla.

Tutkimus osoittaa, että tutkimusongelman ratkaisemiseksi materiaaliprosessi ja varaston arvostus pitää käsitellä omina prosesseinaan, mutta niiden tulisi olla vuorovaikutuksessa toisiinsa nähden. Tutkimuksen tuloksena syntyy uusi varastona arvostus prosessi, jossa otetaan huomioon myös monia materiaaliprosessin tekijöitä, jotta varaston arvo saadaan määriteltävä luotettavasti.

PREFACE

Writing this thesis has been a long journey. This thesis took more than six months of my life but finally it's done and I'm proud of it. Sometimes working on the thesis felt endless and hopeless, sometimes I enjoyed the feeling of understanding and finding something new. But after all, this process has provided me a lot of knowledge and experience that will be fruitful in the future.

I'm very grateful to my supervisors, Professor Satu Pätäri and Professor Jaana Sandström for excellent guiding toward the goals of this study. I always received fast answers to my questions if anything puzzled me. Also I want to thank Pekka Hermunen who was supervising me on behalf of The Switch Drive Systems for all the time and energy he used to receive the results.

Special thanks I want to give to my wonderful "colleagues" Tuula, Terhi and Lauri for all the professional support they gave and trusting in me that I'm capable of finishing this thesis. Also I'm very thankful for the support and understanding of my family and friends. Without them I wouldn't have had the strength to complete my thesis nor my studies.

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LIST OF ABBREVIATIONS

ATO	Assembly-to-order
BOM	Bill of material
DTO	Design-to-order
ERP	Enterprise resource planning
ETO	Engineer to order
FP	Finished product
IAS	International accounting standards
IFRS	International financial reporting standards
JIT	Just-in-time
MTO	Make-to-order
MTS	Make-to-stock
POC	Percentage of completion
U.S.GAAP	U.S. generally accepted accounting principles
WIP	Work in process

1 INTRODUCTION

Inventories are essential for manufacturing companies because they generate sales and in return, profit for the business. Inventories are held to keep up records of purchases and to identify the cost of product which might be difficult sometimes if not impossible. The cost of the inventories is crucial because it has a significant influence on profit and that makes the choice of inventory valuation method very important. Ideally, the method should result in the best measure of company's income and financial condition. But the problem is that there is no one method that is suitable in every case, on the contrary the method is very case specific. (Ibarra, 2008, pp. 17-18) In other words, every corporation should build their own inventory valuation procedures in the respect of its special features to give the right picture of the financial situation.

The inventory research arose in the 1950's when both conceptual and mathematical models of inventories were formulated. The inventory research of 1950s-1970s corresponded to the assumptions of mainstream economic and business research. (Chikán, 2007, p. 55; 61) The inventory management known today has been developing since the mid-1970s (Loar, 1992, p. 70). Since the last decades, inventory management has gone through huge changes. The development of information and communication technology has a strong impact on the improvement of inventory management practices. (Riezebos, 2006, p. 667) Even though the importance of inventories to firms' efficiency and to wealth of a country is recognized, there is just a little research done about inventories (Chikán, 2007, p. 54).

Managing the material flow through the company's operations is important because every item going in or out or held in inventory influences on the financial performance of the company. The inventories of manufacturing

firms usually are divided in raw materials, work in process, and finished goods. (Ibarra, 2008, p. 17) The material flow affects directly to the levels of inventories which have been proved to affect the profit. The material flow goes through supply chain and that makes the supply chain management one of the core factors of material management. (Lieberman & Demeester, 1999, p. 24) Agarwal et al. (2006) determine the supply chain *“as a chain linking each element from customer and supplier through manufacturing and services so that flow of material, money and information can be effectively managed to meet business requirement”* (Agarwal, et al., 2006, p. 213).

1.1 Background of the research

Inventory valuation and the valuation methods have drawn a lot of attention by researchers (Alnestig & Segerstedt, 1996; Ampofo & Sellani, 2005; Chand & Patel, 2008; Ibarra, 2008; Krishnan & Lin, 2012). The scope has usually been on the comparison between costing methods first in first out (FIFO) and last in first out (LIFO), and on the financial statement norms, international financial reporting standards (IFRS) and U.S. generally accepted accounting principles (U.S.GAAP) in the matter of assessing the inventory value. But much of research hasn't been done, if any, about how the inventory management together with company specific inventory valuation methods affects the inventory value reported in financial statement. To figure out this connection the first step is to be sure that there aren't any distortions in the inventory management. The second step is to assess the value of the inventory correctly. Since the value is right, the influence on the profit and performance of the company can be studied.

There is notable research gap in the field of inventory research. There are no studies about the connections between well organized and controlled inventory management systems and inventory valuation methods. The aim of this study is to fill this gap by the case organization's part. This particu-

lar gap under the study isn't only undefined area in the research field in question. As Chikán (2007) argues, relatively small amount of researches has been done about inventories compared to other components of business activities. And this is not because everything is known already, vice versa, because very little is known (Chikán, 2007, p. 54).

The object of this research is to reveal the relation between the well managed material process and inventory valuation method chosen and their impact on correctly defined value of inventory. Because of the limitations in time and extent of the research, the influence of improved inventory valuation and management process on company's profit and performance is not in the scope of the study other than indirectly. Previous studies (Chen et al., 2005; Koumanakos, 2008; Loar, 1992; Porter et al., 1999; Vastag & Whybark, 2003) have been used to show this connection.

The Switch Drive Systems Ltd is used as a case company in this study. The Switch Drive Systems is part of The Switch Engineering consolidated corporation. The Switch was established in year 2006 when three companies merged. The company supplies permanent magnet generators and full-power converters for wind power and other renewable energy applications. The firm operates in Europe, USA and China, and has its production sites in Vaasa and Lappeenranta, Finland, and also in Luan, China. According to annual report of 2011 the revenue was 97 m €, total balance was 48 m € and the number of employees 176. The Switch draws its consolidated financial statement in accordance with IFRS standards. (www.theswitch.com)

The Switch Drive Systems uses model factory concept in its production. The model factory concept enables fast prototyping. Using the concept means that The Switch is in charge of the designing and manufacturing of the product but the production itself is mainly outsourced. Usually The Switch carries out testing and generator's assembling. The customership starts with a prototype which is designed in accordance with customer's

requirements. Since the prototype is finished and if the customership goes further, the zero-series is produced and after that mass production may take place. The Switch's way of operating follows the design-to-order (DTO) principle. The principle tells the point when the company needs to take action to respond to customer's order. In DTO customer's order penetrates the design phase and from that point the manufacturing starts. In other words the fulfillment of customer's needs begins always with designing the product according to customer's requirements. The case company has adapted the lean thinking in its production system. The lean ideology tries to minimize all "waste" in operations such as excess inventories, and operations are tried to make as flexible as possible to operate in supply chain.

Three principles of manufacturing mentioned above, model factory concept, DTO, and lean thinking, cause challenges in inventory valuation and inventory control in the case company. In the matter of inventories the underlying goal underneath all these three practices is zero inventories, which is practically impossible to achieve (Chikán, 2007, p. 54). The current inventory valuation process brings the additional challenges in valuing and controlling the inventories in the case company because the valuation method is totally different depending on the site it is performed and person in charge of the valuation. The current process doesn't have a process description in the case organization.

The challenges listed above bring on problems such as the reliable value of inventories is impossible to assess due to the variation of methods. The red line of this research is to find the way to unify the models and methods of inventory control and valuation despite of the site in which it is done to receive the reliable and correct value for inventory. The sub scope is to make the inventory control more efficiency. The share of inventories in The Switch's balance sheet is 11 m € which is 24 % from the total of balance sheet. The share is very remarkable and that's why inventory is very

important to be assessed rightly using the most usable procedures considering the special features of the company.

1.2 Definition, objectives and delimitations of the research

The Switch has deficiencies in the material flow management and in the inventory valuation process itself as it has been presented before. At the moment the information received from the inventories isn't trustworthy not to mention it's not that useful as it could be in decision making or in business control. In practice the problem is that there exists course of actions in the company that causes fluctuations of thousands of euros in the value of inventory. In addition, the balances of the material in enterprise resource planning (ERP) system might not hold true because of the defects in the processes and in the use of ERP system. One remarkable matter to be improved is the recognizing and handling the excess components that aren't used in a product that they are purchased for at the first place.

There are two main problems in the inventory valuation in the case company that needs to be solved to receive reliable and useful information out of the inventories. The first aspect is that inventory valuation processes in the company needs to be unified throughout the organisation. Among the other things, it needs to be considered which costs should be taken into account when calculating the value of stock and how obsolete is handled in inventory valuation process. And the other considerable aspect in finding the best valuation model to be implemented is managing the material flow because it is the chain of operations in a company that generate, need and consume the material to or from the inventory.

The inventory valuation process is distinguished into two parts in this research: inventory valuation and inventory management. To be able to attain the appointed goals of the research the inventory valuation and material flow management must communicate and interact with each other. In

other words those two processes can't be considered separately because they form the whole inventory process that must be improved. The division between these two unities is the red line throughout this research.

The aim of this study is to carry out research to improve the efficiency of the inventory system as a whole in the case company and try to find out the most suitable proposals on which the case company can base their process improvements. The main research question is:

How the inventory valuation process should be improved in the case company?

The supportive sub questions are:

What are the procedures of the inventory valuation methods and models that are the most suitable for the case company in the respect of its way of operating?

What is the significance of the inventory management in the case company?

The concrete objectives of this research process are to create one unified inventory process and draw a flowchart of that, and make the inventory management more efficient. These objectives are reached by creating consistent procedures throughout the case company. The new process should be built in the way that it reduces the number of manual loading phases in the process and that information is available directly from ERP system. The previous academic studies are aimed to use as a main source of the theory.

The delimitations of the research are a little bit volatile. The nature of inventories makes it hard to delimit because inventories affects nearly all functions in the company. When pursuing the objectives as issued, some

factors can be left outside of the scope such as the procedure of reclamation and spare part supply inventory, which have a little effectiveness on the levels of inventories. But when dealing with the material flow and trying to make improvements to inventories from that perspective it's quite hard to delimit what needs to be taken into consideration and what left outside of the scope. Throughout the research the focus is in inventory process improvement and all irrelevant factors and rare exceptions are dismissed. What comes to the valuation of inventories itself, the legislation and norms gives the limits within it needs to done. This research is primarily made to be applied in Finland's sites in Lappeenranta and Vaasa. If the new process is proved to be convenient and usable the process will be implemented in China also. The study is carried out from the perspective of financial administration.

1.3 Methodology

The research is case study and it is carried out by using the qualitative research method. The case study is an empirical research that investigates a contemporary phenomenon in real life context (Woodside, 2010, p. 1). Theory and empirical material is collected overlapped. The theory part is gathered by using the literature of accounting and inventory management. The main source of the literature is the previous academic researches that handle with the same issues of inventory valuation process and material flow management. In addition, Finland's accounting legislation has a big influence on the theory part. Databases, case company's own material and other relevant material will be used to build up the theory as well.

Gathering the empirical part requires the advanced understanding of the whole valuation process, the special features of the company and ERP system. The empirical part is collected through unstructured interviews and meetings, and by observing. In appendix 1 is shown all meetings this

research has required. The meetings were more like a discussion occasions. Altogether 16 meetings took place and a number of informal interviews. The observing participation of the researcher has been remarkable part of forming the results. The observation includes near look-ups to inventories with employees whose work includes the knowledge of inventories, such as sourcing and production. By participating and learning the current process of inventory valuation step by step and gaining the understanding of the company's way of operating has been crucial. The location of researcher is irrelevant in participant research (Brewerton & Millward, 2009, p. 97), so the intervention to operations of the case company by researcher doesn't have any effect to the results. The solution is based on the existing practices of the case organization and on findings from the theory.

Since the need for this study was realized the research process goes on as follows. In the first phase, the basic understanding of the issue is formed through several meetings and discussions with financial administration, production, sourcing, and ERP specialists in the case company. The goals of the research and the objectives of the inventory process improvements by the case company are set. In the second phase, the theory that supports the aims of the study is gathered up from previous researches, handbooks and Finnish national regulation about inventories. In the third phase, the solutions to issues that are emerged in the first phase are thought further and reflected to the theory. Based on the faults founded in the process, the issues are examined more and finally the suggestions to avoid them are formed.

1.4 The framework

In inventory valuation the important factor to know is how much material is held in the stock and on which price it is held with. In conclusion, the mate-

rial flow and inventory valuation methods chosen are the effective matters regarding this study. The framework is presented in figure 1.

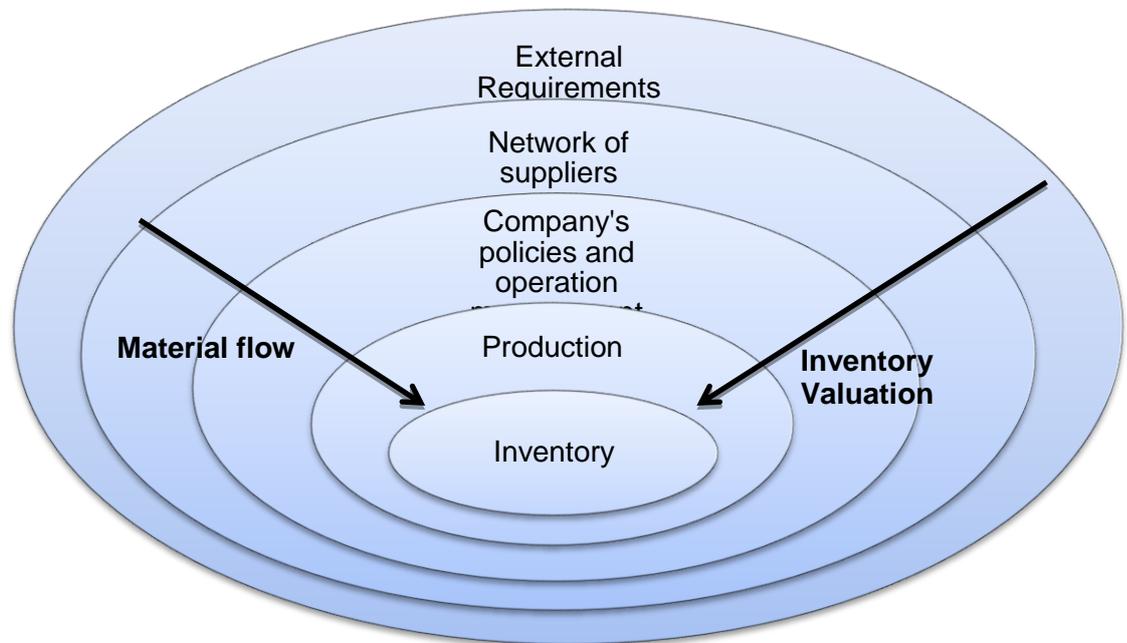


Figure1. The framework of the research.

The framework demonstrates how the material flow through supply chain together with external accounting requirements influences on the value and level of inventory which is in the core of all system. Starting from the core of the framework, the production consumes the material from the inventory and material is acquired to the inventory based on the needs of production. Company's policies and the way of operating affects to the levels of inventories held. For example, decisions to keep buffer or safety stocks affects increasingly in inventory levels. Network of suppliers determines how effectively the material is acquired to the inventory, in other words how effectively the supply chain works. The efficiency of supply chain network determines how much components must be stored in inventory or if the supply chain works well and the delivers of components takes place when they are really needed. The external requirements such as legislation and other accounting norms regulate the boundaries within the valuation of the inventory must be assessed.

1.5 The structure

In the first chapter the context of the thesis is introduced. The second chapter handles the behavior of inventories in accountancy. The chapter represents the regulations that companies operating in Finland must follow. Third chapter points out the significance of taking into account the company's way of operating when designing the inventory valuation process. The chapter reckons with the practical side of the inventories and shows the importance of material flow management. Chapter four presents the starting point and the methodology used in the research and also suggestion for the new inventory valuation process. The aim is to go deeply into the case company, its current inventory valuation process and the problems they are facing in inventories. After the detailed introduction to current situation the chapter presents the proposals for resolving the case company's problem regarding inventory valuation and management. The fifth chapter sums up the theory and results.

2 INVENTORIES IN ACCOUNTING LITERATURE

The external outlines are essential to understand when considering improving the inventory valuation process. The outlines are boundaries within the valuation must be executed. This chapter first presents the function of inventories in financial statement. Then the global harmonization work of financial statement is explained shortly because it has a huge contribution to Finnish accounting practices. Next the accounting regulation that must be obeyed in Finland is presented. And the last parts comprise typical frauds to fall in the inventory valuation.

2.1 Inventories in financial statement

Finnish Accounting Act states that inventories are goods that are held with the intention to sale or convert them into the finished product in order to be sold (Kirjanpitolaki 1336/1997). The inventories can be capitalized in financial statement if they are expected to generate profit for the company. In accountancy inventories are usually divided in raw material, work in process and finished goods. The acquisition prices of mentioned inventories form the book value of inventories. In addition to material costs, the value of inventories might also include the variable overheads that are occurred from acquiring the goods and the fixed costs related to them if they are essential compared to other costs of goods. Advanced payments are also included in inventory value if company hasn't received the goods yet. Advanced payment is presented in its own item in the financial statement, and so it's not recognized in the change in stock. (Yritystutkimus, 2011, p. 37)

The matching principle is one of the basic principles in accountancy. The calculation of the purchase cost of goods is one of the most important tasks of that principle because with existence of inventories in balance

sheet the cost of goods is matched against revenues and they are directed to the right accounting period. (Ahti, 1994, p. 60) It is very important to have the value of inventories right end of every financial period because the change in stock affects directly to the result of the financial period. In conclusion, when controlling the cost of inventories the taxable income is controlled. There isn't one correct way of determining the cost of inventories but the awareness of their existence and the understanding of the profitability concept is the greatest significance for helping the decision making (Grubbström, 1980, p. 260).

Inventories affect the financial ratios that are calculated from the the information received from financial statement. For example the current ratio is calculated by dividing current assets and financial assets by short-term liability. (Yritystutkimus, 2011, pp. 71-72) The financial ratios have many purposes of use. They can be used as a loan term when negotiating about the debt interests or they can be used in decision making related to the explanation and prediction of firm performance (Devine & Seaton, 1994/1995, p. 81).

There are two factors that affect the book value of inventory in a balance sheet and change in stock in income statement when closing the books. The first factor is the valuation method used to estimate the cost of the ending inventory, and the second factor is the model of determining the acquisition cost of inventories. There are three different kinds of sets of accounting standards that set the boundaries within the models and methods of inventory valuation needs to be carried into practice. The standards are IFRS, U.S.GAAP and each country's own nationally accepted standards. There are three globally known inventory cost valuation methods which are LIFO, FIFO and weighted average cost (Ibarra, 2008, p. 17). To estimate the cost of inventories IFRS allows FIFO or weighted average cost methods to be used and U.S. GAAP allows also LIFO method (Ampofo & Sellani, 2005, p. 224). The choice of different valuation methods not only affect assets on a balance sheet but they also result in differ-

ent cost of goods sold reported and have implications for tax planning (Krishnan & Lin, 2012, p. 52).

2.2 The value of inventory

Inventory valuation is very important in accountancy due to inventories are one of the largest items in balance sheet and they have direct effect on the profit. For example, if a net profit of a company is 10 and inventory value is 50, by over-stating its inventory value by 20 % company could double its profit. The effect of inaccurate measurement is very substantial for inventories. The three elements making up the cost of inventories are: direct costs of material and components, other direct costs that have incurred in acquiring the inventories such as labor and transport, and the third is overheads. (Most, 1967, pp. 39-41) Inventory is one component of the annual sales calculation. Any increase in closing inventory reduces the costs of sales and so it increases profit. (Pong & Mitchell, 2012, p. 173)

IFRS and U.S.GAAP have commonalities in inventory valuation requirements but they differ in initial and subsequent measurement, disclosure requirements, and tax impact (Krishnan & Lin, 2012, p. 51). In general, inventory is valued at the lower of cost or its net realizable value depending on the accounting principles in a jurisdiction the company operates. Inventory cost has been defined to include all costs incurred in bringing inventory to its present location and condition. (Ampofo & Sellani, 2005, p. 224)

Product costing models are used in inventory valuation as well as in pricing. Models of product costing should reflect the real situation of production and be as accurate as possible. The models are generally designed to meet financial accounting demands. Alnestig and Segerstedt (1996) have provided a research to answer what costing methods and models are used in ten Swedish manufacturing companies, if the full costing or variable

costing method is used. According to their research any sharp borders weren't found among the companies. The companies under the investigation tried to do their cost allocation as logical as possible and to meet the environmental requirements. In conclusion it is impossible to find one inventory costing method that would be suitable in all situations. (Alnestig & Segerstedt, 1996, pp. 441-442; 455-456))

2.3 Harmonization of financial statement procedures

In June 2002 the European Union Council of Ministers approved the so-called IAS Regulation, which obliges the Member States' publicly listed companies to draft the consolidated profit and loss accounts in accordance with International Accounting Standards (IAS) starting from the accounting year 2005. (TEM, 2012) The aim of IAS Regulation is to eliminate all accounting differences between EU countries taking into the account certain firms and certain types of financial statements. By making the IFRS standards mandatory for publicly traded firms two things are tried to achieve: First, that the information in consolidated financial statement is useful for outside investors and secondly, that the information could be used exclusively to make business and investment decision. (Sellhorn & Gornik-Tomaszewski, 2006, p. 188)

Accounting harmonization relates to the process of reduction of contradictory accounting practices and procedures to enhance international comparability of financial statements. Adopting IFRS standards is a necessary step to achieve this goal. Globalization and political pressure has driven an increasing number of countries all around the world to adopt IFRS standards or to allow selective use of IFRS. (Chand & Patel, 2008, p. 83) National economies have been opening up to international and global competition which need more open and borderless system to ensure transparency and comparably in financial matters (Pirinen, 2005, pp. 228-229).

Even though the intention of the harmonization is good, it has gained a lot of criticism. For Example the free culture theory has been attached to accounting harmonization. The theory criticize that harmonization assumes that all users of financial statement has the same needs in all countries and the economic transactions can be measured universally using the same procedures. The free culture theory states that on the contrary, accounting should be a product of the unique environment in which it operates. Rodrigues and Craig (2006) criticize that harmonizing accounting standards through the world is politically intricate, theoretically complex and operationally uncertain. (Rodrigues & Craig, 2007, p. 740)

Globalization has also affected to the accounting practices in Finland. The Finnish Accounting Act is based on the fourth and seventh European Committee (EC) company law Directives. And from the accounting year 2005 publicly limited companies are obligated to prepare the annual financial statement in accordance with IFRS as everywhere in EU's Member States. The IAS Regulation can also be adapted on accountable's own accord. (TEM, 2012)

2.4 Inventories in Finland's accounting regulation

According to Finnish legislation all corporations and foundations in Finland have a legal obligation to keep books if they run a business (Kirjanpitolaki 1336/1997, p. 1 §). The main purpose of the accountancy regulation is to secure that a financial statement gives *a right and sufficient picture of the return on the activities of the reporting entity and on its financial status*. Finnish accountancy regulation is compounded of Accounting Act and Accounting Ordinance, a number of decisions by the Ministry of Trade and Industry, and ordinance of the Accounting Board. (TEM, 2012)

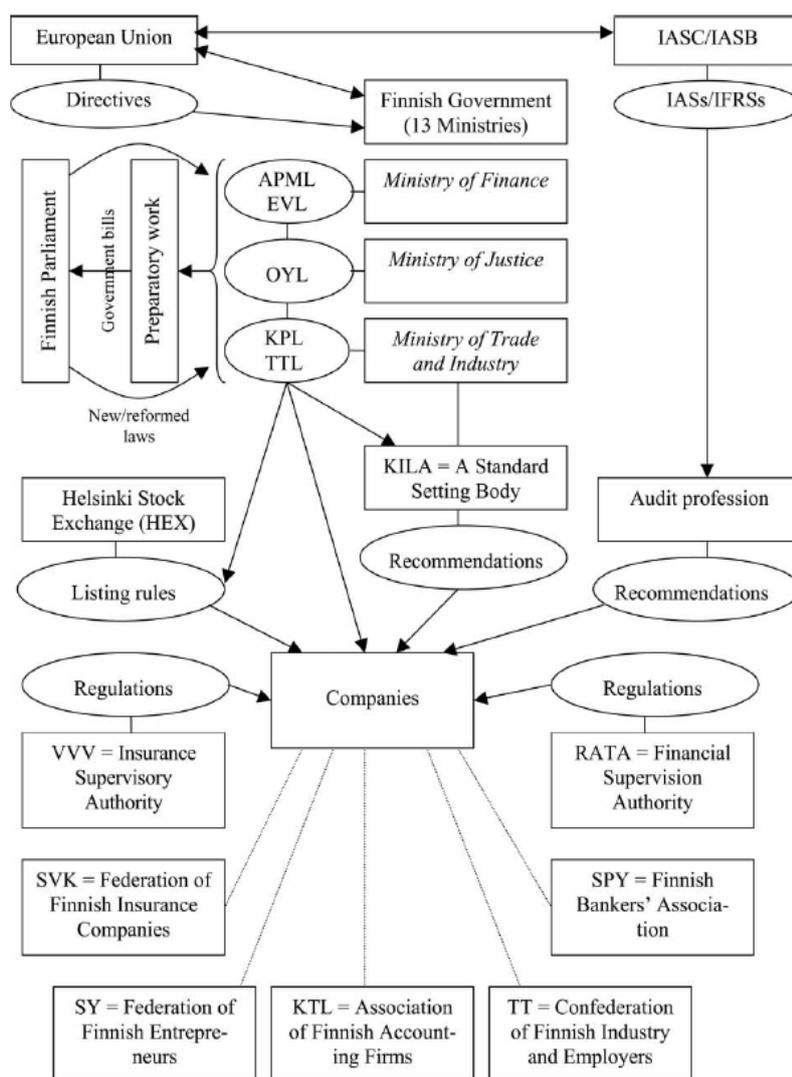


Figure 2. Finnish financial accounting regulation (Pirinen, 2005, p. 215).

In the figure 2 is presented the Finnish accounting regulation system. All parts effecting to it isn't dealt in this research, only those parts that have remarkable influence on inventory valuation practices: Finnish Accounting Act and Ordinance, European Union's Accounting Directives, IAS regulation, and the Finnish Accounting Board's general guidelines.

2.4.1 European Accounting Regulation

The main body of financial reporting requirements for companies in the EU consists of the fourth and seventh council directives. The fourth directive

coordinates the presentation and content of annual accounts and annual reports, the valuation methods used and their publication of the companies in Member States. The seventh directive coordinates the extent, the principles and the form of financial statements. (Haaramo & Rätty, 2009, p. 10) The European so called “Accounting Directives” give many options for Member States to choose which methods they want to adapt to their own national Accounting regulation. For example the directives provide optional layouts for balance sheets and profit and loss account from which Member States are free to choose. (Fourth Council Directive 78/660; Seventh Council directive 83/349)

The both Accounting Directives have become compulsory for Member States to adapt them in their own national legislation in the end of 1980's. Many amendments have been made to the directives since then. The main goals for fourth directive are to harmonize financial statement and to make the information more comparable among companies operating in the European Union. And as for the seventh directive, it governs about preparing the consolidated financial statement. (Haaramo & Rätty, 2009, pp. 10-11; 14) The fourth directive lays down the principles which govern the drawing up of financial statement. The objective of this directive is to present the true and fair view of assets and liabilities, financial situation and profit of the entity. (Fourth Council Directive 78/660)

The fourth directive lays down specific valuation rules which must be followed when valuing the inventories, for instance. Articles 35, 39 and 40 regulate the inventory valuation procedures. According to articles 35 and 39 the acquisition cost of current assets such as inventories are valued to the amount of direct costs. But there is an option included in the directive that member states may allow the overheads to be included in the cost of inventories. In practice the full costing principle is followed in the European Union nearly without exception. The article 35 also governs about the write-downs that they must occur immediately if the balance sheet value is reduced. And according to article 39 the valuation of current assets must

be done by following the lowest value principle. The article 40 permits FIFO or LIFO or similar methods to be used when calculating the purchase price or production cost of inventories. (Fourt Council Directive 78/660; Haaramo & Rätty, 2009, p. 13) Based on these two European Union's Accounting Directives the Finnish accounting legislation is formed.

2.4.2 Finnish Accounting Legislation

Accounting Act and Ordinance form Finnish accounting legislation that governs the contents of financial statements and the day-to-day bookkeeping (TEM, 2012). In the Accounting Act there is decreed about the general norms of accounting, balancing the books, and consolidated financial statement. In the seventh chapter of the Act is enacted that publicly listed companies must adopt IFRS standards approved by European Committee to prepare the annual financial statement. The Act also allows not publicly listed companies have the option to adopt IFRS standards voluntarily. In the matter of adopting the IFRS standards, there are just a few articles and clauses in the Accounting Act that accountable must obey. (Kirjanpitolaki 1336/1997)

In Accounting Ordinance is governed about the detailed format of income statement and balance sheet, sources and uses of funds statement, and notes to the account. In the fifth chapter of the Ordinance is regulated about application of the Ordinance when balancing the books in accordance with IFRS standards. When applying the IFRS standards just a few articles and clauses of Ordinance are valid. (Kirjanpitoasetus 1339/1997)

The Finnish Accounting Board gives general guidelines and opinions in the matter of accounting to applications sent by accountable or authority. The Board operates under the Ministry of Employment and the Economy. Its function is to give instruments and opinions to the application of the Accounting Act. The status of the Accounting Board is stated in the Act.

(TEM, 2012) The Board is accredited to grant exemptions from certain statutory provisions of the Accounting Act for a special reason. The condition for that kind of procedure is that it's not contradictory to European Committee's Directives. (Kirjanpitolaki 1336/1997) The good accounting practice is accepted in the Accounting Act and it states that if there is an issue that the Finnish legislation or the European Union's legislation doesn't provide a solution for, the solution can be drawn from the IFRS standards. (KILA 2008)

Finland's Accounting Board has given general guidelines, amongst other things, about including the fixed costs to the acquisition cost and about recording the revenues by the percentage of completion. These guidelines affect the inventory valuation practices. The aim of the first guideline mentioned is to guide how to apply the correct acquisition price valuation of an asset in accordance with the Accounting Act and Ordinance. The goal of the second guideline mentioned is to guide how to apply the method of percentage of completion in accordance with the valid Act and Ordinance. (KILA 2006; KILA 2008) Finland's Accountancy Board has given many published opinions as well but those are completely based on Finnish Accounting Act and Ordinance and in that aspect they are not applicable to use when the financial statements follows the IFRS standards.

2.4.3 International Financial Reporting Standards

There are three standards in IFRS norms that apply to inventory valuation methods in financial statements: International accounting standard (IAS) 2 *Inventories*, IAS 11 *Construction Contract*, and IAS 23 *Borrowing Costs*. The standards are presented below.

The aim of the IAS 2 *Inventories* is to determine the accounting treatment of inventories. In other words the objective is to recognize the cost of inventory as an asset and carry forward until the related revenues are real-

ized. IAS 2 applies to all inventories excluding few exceptions: work in progress arising under construction contracts (IAS 11), financial instruments, and biological assets related to agricultural activity and produce. The treatments of these exceptions are prescribed in the case specific standards. (IFRS 2009, p. 985)

IAS 2 defines inventories as assets that are: (IFRS 2009, p. 985)

- 1) Held for sale in the ordinary course of business
- 2) In the process of production for such sale, or
- 3) In the form of materials or supplies to be consumed in the production process or in the rendering of service.

IAS 2 states that inventories must be measured at the lower of cost and net realizable value. Net realizable value is based on the most reliable information available at the time estimates are made. The estimates must take into consideration the fluctuation of the cost of the inventory. IAS 2 also governs that the cost of inventories of items must be assigned by using the first-in, first-out (FIFO) or weighted average cost formula. (IFRS 2009, p. 986; 989)

According to IAS 2 the cost of inventories should comprise all costs of purchase, costs of conversion, and other costs if they are incurred in bringing the inventories to their present location and condition. The cost of purchase includes the purchase price, transportation, import duties and handling. Discounts, rebates and other similar items decreasing the value of inventories are deducted in determining the cost of inventories. The cost of conversion includes the direct production costs, such as labor and allocated costs of fixed and variable production overheads. The allocation of fixed overheads is based on the normal capacity of the production facilities. Variable production costs are allocated to each unit of production according to the actual use of the production facilities. Unallocated overheads are recognized as an expense in the period in which they are oc-

curred. Other costs are taken into account only if they are incurred in bringing the inventories to their present location and condition. For example, including non-production overheads such as designing for specific customers might be essential when determining the cost of inventory. In the contrary abnormal amounts of wasted materials or storage costs that aren't essential in the production process, administrative overheads that doesn't contribute to bringing inventories to their present location and condition, and selling costs aren't recognized as costs that can be included in the cost of inventories. (IFRS 2009, pp. 987-988)

The IAS 2 standard requires disclosure of the amount of any write-down of the inventories recognized as an expense in the period. Usually inventories are written down to its net realizable value. The practice of writing inventories down below its cost to the net realizable value must be applied because of the prudence principle that the cost of inventories doesn't exceed the real value. If the circumstances that caused write-downs no longer exist the value of inventory can be increased up to the level it was before but not over the original write-down. The write-downs are recognized as an expense in the period they have occurred and reversal write-down as a reduction in the amount of inventories recognized as an expense in the same period. When inventories are sold the carrying amount of them must be recognized as an expense in the same period in which the related revenue is recognized. (IFRS 2009, pp. 984; 989-990)

Second inventory standard is IAS 11 Construction Contract. Construction Contract refers to a long project, when the date of contract activity is commenced and the date the activity is completed falls into different accounting periods. The IAS 11 provides requirements how to allocate contract revenues and costs to the accounting periods in which work is performed. This standard must be applied in the financial statement of the contractor. (IFRS 2009, p. 1070) The Switch has projects that continue over a year and so they need to be handled as a Construction Contract.

Contract revenue comprises of the amount of revenue agreed in the contract and variations in contract work, claims and incentive payments. Contract costs comprise of direct costs of contract, overheads that can be allocated systematically to the contract, and other costs that have been specified in the contract. Contract revenues and costs are recognized as revenue and expense by the stage of completion of contract at the end of the reporting period when the outcome of the construction contract can be estimated reliably. An expected loss on the construction contract must be recognized as an expense immediately. Reliable estimates can be made after the contract has agreed on rights regarding the asset to be constructed, the consideration to be exchanged, and the manner and terms of payment. (IFRS 2009, pp. 1072-1074) In other words, the construction contract isn't set up as an asset to "inventories" in the balance sheet but recognized as an expense in income statement.

The stage of completion can be determined in many ways. The contractor can decide which method it uses that measures reliably the work performed. When the stage of completion is determined, only those costs are included which meet the costs of performed work. In the case when the outcome of contract cannot be estimated reliably revenue can only be recognized to the extent of costs incurred that are probably recoverable and costs are recognized as an expense in the period they are incurred. (IFRS 2009, pp. 1074-1076)

The core principle of the IAS 23 Borrowing Costs standard is that "*borrowing costs that are directly attributable to the acquisition, construction, or production of a qualifying asset form part of the cost of that asset*". And other borrowing costs apart from that must recognize as an expense. The standard doesn't apply if the asset can be measured at fair value or if the inventories are manufactured or produced in the large quantities. In this standard the borrowing costs comprise the interest costs and other costs that incur from the borrowing of funds, and asset is an asset that neces-

sarily takes a substantial long period of time to produce. (IFRS 2009, p. 1396)

Borrowing costs that are directly attributable to the acquisitions, construction or production of an asset must capitalize as a part of the cost of that asset. Borrowing costs can be capitalized when it's likely that they will result in income for entity and the costs can be measured reliably. The borrowing costs are costs that would have been avoided if the asset hasn't been produced. It may be difficult to recognize the direct connection between borrowings and the asset and determine the borrowings that would otherwise have been avoided especially when it comes to inventories. If the borrowings specified for the purpose of obtaining the asset are temporarily invested the possible investment incomes earned on the fund is deducted from the borrowing costs incurred in the same period. (IFRS 2009, pp. 1397-1398)

2.5 Typical frauds in inventory valuation

Inventory is the most common area for financial statement fraud. It is the easiest type of fraud to maintain from accounting period to other and it's the hardest to detect. (Wiersema, 2001, p. 34) Frauds are continuing problem in today's corporations and can be very costly. It is estimated that organization loses 7 % of its annual revenues to frauds. Since the publicity around the financial statement frauds, there has been an increased awareness of fraud schemes and more attention is paid to the prevention of frauds and improvements of organizational internal controls. Also a greater emphasis has been placed on the detection of material misstatements in financial statements. (Clayton & Ellison, 2011, p. 133)

Deficiencies in IT-system can lead to twisted financial statement. Inventory is one of the most common financial reporting problems in companies. The reasons are in issues of capitalization of expenditures for inventory, issues

associated with transactions affecting inventory, and issues with liabilities and payables because of cut-off failures in recording them and matching them to related revenue or inventory accounts. These issues can cause the incorrect value of inventory on financial statement. (Grant, et al., 2008, pp. 803; 821-822)

Capital tied up in the inventories is one of the areas for financial statement fraud. For example, if overhead is added to the value of work in process inventory, the asset can show an increase which may cause misleading financial statement. Anything that adds value to the work in process without real value is waste. There is no means to calculate the actual overhead to an order, so applying overhead to inventories can be quite arbitrary. This is one reason to try to keep the costs of inventories down. (Taylor, et al., 2004, pp. 20-21) IAS 2 requires inventory to be valued at full production cost. This accounting practice allows profitability to be boosted by the build-up of inventory through the carry forward of fixed production cost in inventory. (Pong & Mitchell, 2012, p. 174)

The valuation of inventories involves quantity and price. Determining the quantity of inventory on hand is often difficult. Material and components are constantly being bought and sold, transferred among locations and added during the manufacturing process. Determining the unit cost of inventory is problematic also. As a result, the inventory is a very complex account. (Wells, 2001, p. 33) Because the complexity of the inventories it's also easy target for unintentional errors that can occur in any element, including quantity, valuation, and costing (Wiersema, 2001, p. 34). According to Vahtera (1986) the probability to make mistakes in price and quantity of inventories is so high that it's not rational to try to achieve the exact value for inventory. The errors related to inventories usually occur from the faults in making inventory, incorrect accrual, or the neglect of stock accounting. The pricing is other factor that twists the value of inventory in financial statement. In pricing the minefield exists in faulty determination of

purchase price and acquisition costs, incorrect pricing and defective calculation of obsolescence. (Vahtera, 1986, pp. 108; 261-262)

3 INVENTORY MANAGEMENT LITERATURE

The inventory research arose in the 1950's when both conceptual and mathematical models of inventories were formulated. The inventory research of 1950s-1970s corresponded to the assumptions of mainstream economic and business research. (Chikán, 2007, p. 55; 61) The inventory management known today has been developing since the mid-70s. Before that the flow of materials was managed with excess inventories. In 1970s technology become increasingly available and affordable to track and measure inventories. The information flow throughout and between supply chain has helped companies to achieve better control over inventories both in internally and externally. Already, in the beginning of 90's managers realized and accepted the challenge and responsibility that is needed to properly approach the area of inventory control. (Loar, 1992, pp. 70-71) Since 1980s several developments in management such as just-in-time (JIT) and supply chain management are found considerable favor in practice but their implementation has proved challenging. These management systems specifically highlight inventory reduction and control as both beneficial and achievable. (Pong & Mitchell, 2012, p. 173)

Fawcett et al. (2010) determine the basic characteristics of inventories that they are considered to be an asset and held as buffers, and optimizing inventories is pursued by balancing associated costs. The perceptions of inventories changed in the 1980s when just-in-time inventory philosophy was introduced in which lean thinking has been attached to very tightly. Since then, researchers has consistently shown that by optimizing inventories via lean management the higher levels of asset utilization and customer satisfaction is achieved, which in turn leads to improved organizational growth, profitability and market share. (Fawcett, et al., 2010, pp. 510-511)

Since the last decades, inventory management has gone through huge changes. The development of information and communication technology has a strong impact on the improvement of inventory management practices. (Riezebos, 2006, p. 667) Inventories are very important to firms' efficiency and to wealth of a country, due to a lot of money are tied up in them. Even though the importance has been recognized, there is just a little research done about inventories compared to other components of business activities. (Chikán, 2007, pp. 54-55; 61)

The role of the inventories in business has changed over the decades. The traditional direction of economy and business research have diverged, leading to the need for new and better approaches to economic and business research but the field of inventory research hasn't followed this diversion and has been left behind of development. (Chikán, 2007, pp. 54-55; 61) Because of the development of the field of operations management research, new concepts have been added to the list of relevant inventory factors such as material requirements planning system (MRP), just-in-time (JIT) and ERP methods. Among these more management oriented concepts another emerging direction of the research assumes that demand and marketing environments play a central role in determining corporate inventories. (Koumanakos, 2008, p. 355)

In this chapter the connection between the operating models and inventory levels are demonstrated. Also other choices effecting to the levels of inventories are presented. First the importance of material management is displayed and how to control the inventories. Next the contribution of supply chain to the inventory management is presented.

3.1 Material management

Inventories are essential and unavoidable components of business and a critical supply chain resource (Chikán, 2007, p. 54; Fawcett, et al., 2010,

p. 510). Significant scope in improving the efficiency of the company is to improve the material management process in both the strategic and operational level (Śliwczyński & Koliński, 2012, p. 297). The core of the change in inventory research is that perception of the inventories has to move from passive to an active role in the company's strategy. Strategic decisions must focus on inventories and mutually, inventory policies must influence general strategy formulation and implementation through the company. Chikán (2007) lists three interconnected dimensions of the strategic importance of inventories for companies: inventories are contributors to value creation, they assure flexibility, and they are important indicators of macro and microeconomic phenomena. (Chikán, 2007, p. 58-59)

The complexity of the material flow process can cause difficulties in material management when focusing on too many different factors that influence on effective material management such as sourcing, warehousing, inventory management, and cash flow management. When taking the practical aspect of material flow into account there are often the lacks of adjusting the material flow process to the assumed strategy. Referring to the study of Śliwczyński and Koliński (2012) three most common consequences of insufficient analytical support in material management decisions are non-adequate level, allocation and structure of material inventories, non-adequate capacity and efficiency of transport and warehousing, and insufficient execution of material flow process. The same study states that the factors of material management efficiency that managers pays attention are inventory costs, material value along supply chain, standards costs in material process flow, and normative range of material management indicators. (Śliwczyński & Koliński, 2012, p. 297; 299)

Śliwczyński and Koliński list seven primary objectives for material management which are (Śliwczyński & Koliński, 2012, p. 298):

- 1) Efficient materials planning
- 2) Sourcing and purchasing

- 3) Good supplier relationship
- 4) Procurement and transport
- 5) Storing and inventory control
- 6) Financial management and controlling
- 7) Quality assurance

As it is seen in the list before, the material management is a lot more than just controlling the inventories, it's about controlling the whole material flow process but inventory management is one of the very important factors in it.

3.1.1 Inventory management

The theories of inventory management are very diverse from the practice. Even though the benefits of inventory management can be shown, the adaption of the theories into practice isn't always straightforward. Actually, despite of all theory available, the inventory management systems in use in companies are very primitives. (Niemi, et al., 2009, p. 160) One explanation for the poor adaption of the theories might be that companies learn through their business and trade contacts rather than through literature. And on the other hand, it is not easy to show the connection between inventory management and company's performance. (Vastag & Whybark, 2003, p. 115)

Regardless of the importance of inventory management universal evidence hasn't been found of the straight influence to profitability. Koumanakos (2008) studied Greek companies in three industrial sectors: food, textiles and chemicals. The purpose of the study was to find a linear relationship between inventory management and financial performance. The research resulted that the relationship exists only in the sector of chemicals. (Koumanakos, 2008, p. 355; 366) Loar (1992) carried out a research about the effects of the inventory level to the business in four

industries. Loar examined if the inventory level has any influence on the profitability of the companies operating in the industries under the study but couldn't find connection from the data. (Loar, 1992, p. 93) Chen et al. (2005) also investigated the financial impact of inventories but couldn't find the evidence of a significant impact (Chen, et al., 2005, p. 1024). Koumanakos (2008) Loas (1992) and Chen et al. (2005) aren't the only ones who have tried to find the connection between inventory management and company's financial performance but the results have appeared quite contradictory (Pong & Mitchell, 2012, p. 173).

Even though the lack of direct financial benefits, it is proved that adoption of the inventory management techniques has good influence in the use of other management techniques which might lead to better business performance and so on to better profitability. (Vastag & Whybark, 2003, pp. 115-116) It is claimed that the reduction of inventory by taking away the convenient supply and demand buffer puts pressure on internal operations improve. If improvements such as inventory reduction can be carried out successfully then they can have a positive influence on firm performance. Successful inventory control leads in situation that working capital investment needs are reduced and funds freed for alternative uses. (Pong & Mitchell, 2012, p. 174) It is also proved that improvements in productivity and inventory levels reduce a risk and help minimize the cost of manufacturing (Kros, et al., 2006, p. 224).

In order to improve the inventory management it is important to clarify how the different functions and organizational units are actually involved in inventory management decisions and how the procedures should be improved. This should be done because inventories are often functionally located between two or more units of a company. The different decision makers in different functions of a corporation value the costs and benefits of inventories in different ways. Furthermore, even contradictory objectives may be set to the management of inventories. (Korhonen & Pirttilä, 2003, pp. 195-196) One of the aims of inventory management is to control the

levels of inventories even though there are challenges associated with maintaining controls on inventory management performed by many people and in many locations (Mistry, 2005, p. 208).

3.1.2 Controlling the levels of inventories

The control of inventory is an essential matter in material management. In the inventory management theory the minimal inventory levels are tried to achieve with the certain external variables such as supply and delivery lead-times, supply and demand uncertainty, control of batch sizes and product variety. (de Leeuw, et al., 2011, pp. 436-437) But eventually there is very little empirical evidence which factors influence to inventory levels (Dubelaar, et al., 2001, p. 105).

De Leeuw et al. (2010) lists seven traditional factors that usually are used to explain the inventory levels in the inventory management literature: Lead-times, batch sizes, holding the “buffer” or “safety” stocks, seasonality, customer service levels to meet their demands, size of the company, and the variety of products. (de Leeuw, et al., 2011, p. 439) But Chen et al. (2005) argues that there are factors beside the traditional factors that influence the level of inventories such as the strategy of make-to-stock production or the fear of losing sales (Chen, et al., 2005, pp. 1018-1019). Also Lieberman and Demeester (1999) conclude that inventory levels aren't only dependent on traditional factors but also softer aspects such as the workforce effort and management style (Lieberman & Demeester, 1999, p. 472; 475).

To reduce inventory levels and eliminating buffers, management has to be able to identify where problems exist within a system (Loar, 1992, p. 71). In the literature it is misleadingly assumed that inventory locations are well determined and material transactions between the locations are well controlled and leaves a traceable trail. In some cases the materials aren't reg-

istered into any inventory control system and they need to be checked visually or spreadsheet applications are used. But such inventory records tend to be flawed because of the manual processes and inconsistency registration of materials and their movements. (Ala-Risku, et al., 2010, p. 253; 258) Alfaro and Rábade (2008) refer to American Production and Inventory Control Society (APICS) definition about traceability in their research as “the registering and tracking of parts, processes, and materials used in production”. There are costs involved in establishing and maintaining a traceability system but those can be just opportunity costs compared to the situation when faulty product is returned Traceability may improve the quality of products, among other things. (Alfaro & Rábade, 2009, pp. 104-105)

Enterprise should avoid the unnecessary storing because it ties-up capital and causes costs. One of the most important things is to follow the levels of inventories that they won't become excessive financial stress. (Ritvanen, et al., 2011, pp. 182-183) Too high inventories consume physical space, create a financial stress, and increase the possibility of spoilage, loss and damage. The high inventory levels also equals to sloppy and inefficient management, poor prediction, lacking scheduling and insufficient attention in process and procedures. (Koumanakos, 2008, p. 356) Raw materials show an immediate reduction in inventory levels. The reduction in work in process (WIP) inventories lowers the cost of inventory holding and related activities. The level of finished goods inventory should reduce because of improvements in process reliability and cycle times. (Kros, et al., 2006, p. 225) The possession of inventory has both pros and cons which are dependent on the individual firm. In general, inventory is a substantial business asset. (Pong & Mitchell, 2012, p. 174)

In some projects materials are tied up to a specific project task even though they could be interchangeable with the materials of some other project task. To provide flexible control of projects, materials must be monitored and controlled in many locations of the supply chain. The time pres-

sure might cause problems related to the quality and quantity of materials needs in the projects that requires overlapping design and production. The exact number and types of items needed in the project is not always known until the very late of the project. In addition, most projects face the design changes which should be adjusted in a controlled way. (Ala-Risku, et al., 2010, p. 253)

Chen et al. (2005) investigated how the inventory levels have changed in USA between 1981 and 2000. The research showed that a company that dealing efficiently with its suppliers has lower material inventories and a company that has efficient internal operation systems has lower work in progress inventories. The same research concluded that companies with abnormal high inventories have abnormal poor stock returns. As for companies with abnormal low inventories have normal stock returns while companies with a little bit lower than average inventories perform best in a long run. (Chen, et al., 2005, p. 1016) Lieberman and Demeester (1999) used data of 52 Japanese automotive companies. According to their findings, the reduction of inventory levels leads to productivity growth. They resulted that each 10% reduction in inventory led to an average gain of 1% in labor productivity which was measured as real value-added per employee. (Lieberman & Demeester, 1999, p. 473; 480)

3.2 Supply chain management

Inventories are complex systems that generate value to the company. And because the system's impact to cost structures and customer service levels, inventory systems merit particular attention that the system should be designed and managed strategically. Due to lean revolution the advanced inventory systems was revealed. That is, the inventory systems opened and it was realized that those systems reach outside the organization, throughout the supply chain. (Fawcett, et al., 2010, p. 526) Inventory hold-

ing comprises a significant cost in the supply chain which makes the supply chain management essential (de Leeuw, et al., 2011, p. 436).

Supply chain management is one of the most important factors for competitiveness (Rajesh, 2011, p. 619). It refers to the capability of managing the flow of materials and products from source to user (Wu, 2003, p. 1350). With the development of economy and information technology the competition between companies is entered into the "*competition between supply chains*" (Zhang, et al., 2012, p. 249). Agarwal et al. (2006) describe the supply chain "*as a chain linking each element from customer and supplier through manufacturing and services so that flow of material, money and information can be effectively managed to meet business requirement*" (Agarwal, et al., 2006, p. 213). As for Kaihara (2003) defines supply chain as "*a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers*" (Kaihara, 2003, p. 263) In short, the supply chain compiles of activities that controls and transform resources, materials and components into a finished product that is delivered to the end customer.

The need for supply chain management has increased because of the global trend that firms increasingly concentrate on their core competencies which results increased need of coordination in the supply chain (Rajesh, 2011, p. 620). Supply chain processes are becoming more and more strategic. The growing strategic significance of supply chain management has motivated the companies to understand the links between products, and the processes used to manufacture and to deliver them. (Stavrulaki & Davis, 2010, p. 127)

Stavrulaki and Davis (2010) designed a framework in their research to illustrate that the product characteristics affect to the type of the most lucrative manufacturing process used. For example manufacturing a product of

limited variety but in a high volume uses assembly line process instead of project process in the matter of effectiveness of process. (Stavrulaki & Davis, 2010, p. 129) Also Fisher (1997) separated products by their nature and introduced the framework to match supply chains with products. Fisher divided products into functional or innovative categories based on the level of demand uncertainty, profit margin, and product mix. Depending on the product classification, whether it falls into functional or innovative category, it defines if the supply chain should focus on operational efficiency in the case of functional product or on market responsiveness in the case of innovative product. (Fisher, 1997, p. 109) The goal in these frameworks, among many other frameworks similar to them, is to provide a better understanding of products and that the way of producing them varies so it's not rational to use same process and same supply chain to each product (Stavrulaki & Davis, 2010, p. 131).

The motivation of supply chain performance improvement is in the goal to match supply and demand (Mason-Jones, et al., 2000, p. 4061). Christopher et al. (2006) argues in their research that "supply chain competes, not companies" (Christopher, et al., 2006, p. 278). Successful supply chain model is proved to result in minimizing the inventories because the system builds a leaner supply chain and tighter information flows (Kros, et al., 2006, p. 225). Reducing or eliminating all non-value-added costs including excess inventories, is one of the primary goals in the effective management of a supply chain (Mistry, 2005, p. 194).

3.2.1 Just-in-Time

The Japanese Just-in-Time (JIT) system was developed in the 1950s and 1960s by Taiichi Ohno for Toyota. JIT is a production system with an explicit emphasis on removing the waste and unevenness from the supply chain. Amongst the other things, excess inventories are considered as a waste. JIT subsequently came in the West in the mid to late 1980s. (Pong

& Mitchell, 2012, p. 174; Stratton & Warburton, 2003, p. 184) Since the 1980s manufacturers have been exposed to the strong promotion of inventory control and reduction as a component of JIT and supply chain management. It is proved that these ideas have found extensive favor in practice although existing research studies have also shown that inventory control and reduction is challenging and its impact on performance appear mixed. (Pong & Mitchell, 2012, p. 173) But it is demonstrated that the implementation of JIT system can result in reduced inventory costs (Kros, et al., 2006, p. 227). The most extreme target is to reduce the level of inventories to zero but the “zero inventory” concept is impracticable (Chikán, 2007, p. 54).

JIT is a concept that covers almost all management activities related to manufacturing and focuses on all aspects of manufacturing products with a minimum waste. Many companies have a huge investment in inventory, and at the same time they must cope with unpredictable business environment. One way of realizing releasing resources is to apply JIT inventory system. Reducing or eliminating the costs allows the firm using JIT processes to not only improve profitability but also respond more quickly to changes in the firm’s supply chain. (Mistry, 2005, p. 194; Courtis, 1995, p. 46)

JIT-thinking revealed that controlling inventories requires inter-organizational coordination (Fawcett, et al., 2010, p. 511). JIT manufacturing also requires external controlling and that company has reliable suppliers and other partners. Through JIT system a company is believed to improve productivity and build a leaner manufacturing system to minimize inventories, which in turn reduces risks and minimizes the cost of manufacturing (Kros, et al., 2006, p. 224). Wu (2003) carried out a study which resulted that manufacturers who invest resources in implementing JIT in their factories will in general benefit by carrying smaller amounts of inbound, WIP and finished product inventory (Wu, 2003, p. 1370). For example the WIP inventories was once held as a buffer and considered es-

sential for maintaining the steady production flow. But the JIT production way of thinking has changed the role of WIP inventories to be detrimental in some cases. This perspective may reveal defects in the manufacturing process, forcing the company to eliminate sources of process variability. (Lieberman & Demeester, 1999, p. 468)

It is argued that implementing JIT decreases the value of inventory and the consequences of improved productivity, cost reduction and production combined with revenue growth will increase net income. Expected cost savings in inventory investment, storage, personnel expenses, and reducing waste is a major motivator underlying the introduction of JIT. The financial statement implications of JIT adoption are far more than just a decrease in inventory item. (Courtis, 1995, p. 47)

3.2.2 Lean and agile manufacturing

Lean manufacturing is based on the Toyota's system of production management, just like JIT manufacturing. Lean thinking owes a lot of the philosophy of JIT. It could be stated that lean thinking is an extension of JIT type of approach. (Rushton, et al., 2010, pp. 67-68) JIT delivery and low inventory are the heart of lean production (Wu, 2003, p. 1350). Lean manufacturing and lean thinking have provided the broad potential of the elimination of waste in improving business performance. The emphasis on waste elimination is closely connected to the reduction of inventories. And when the level of inventories is decreased the flaws are more likely to be revealed. (Stratton & Warburton, 2003, p. 184) In some literature the lean production refers the inventories as a waste and the focus of lean thinking is in the elimination of this waste (de Leeuw, et al., 2011, p. 438).

A lot of literature exists regarding the positive strategic impact of lean manufacturing on a company's competitiveness (Wu, 2003, p. 1351). Mistry (2005) studied efficiencies and cost savings that derived from im-

plementing lean manufacturing processes in electronic company. The company has sales revenues of approximately 100 million dollars. And by transiting into lean model the company saved ten thousand square feet in inventories which was savings of 183 thousand dollars. Improvements in inventory management were also identified as an important outcome. The interviewees in the study credited the improved inventory management to the fact that fewer material transactions occur, and hence there are fewer changes for errors. Interviewees also claim that improved process led to smoother transactions and increased efficiencies in material handling and in that way improved the inventory tracking. (Mistry, 2005, p. 198; 208)

Many companies have adapted the lean thinking approach with the aim to improve the efficiency of their business processes. But agile manufacturing approach has been raised as an alternative to leanness. (Mason-Jones, et al., 2000, p. 4061) Agility is the ability of an organization to respond rapidly to changes in volume and variety (Li, 2009, p. 62). The concept of agile manufacturing is the development of a company's strategic way of operating that allows the rapid responses to unpredictable changes in customer demand. The focus is on the need for company to work flexible together across the supply chain to meet the customer's requirements. (Rushton, et al., 2010, p. 68) Pearson et al. (2010) list four characteristics of business when agile approach is best suited: 1) short life cycle products, 2) high product variety in unpredictable demand, 3) small volumes and higher profit margins, and 4) competition based on differentiation. A lot of research has been done in the area of lean supply chain networks but relatively little amount of studies has been carried out in agile networks. (Pearson, et al., 2010, pp. 22-29)

To make the difference between these two concepts in brief: lean is having no waste or bulk and agile is quick in movements (Rushton, et al., 2010, p. 68). Lean is about doing more with less resource. Lean concept fits well where demand is relatively stable and predictable and the customer requirement for variety is low. Conversely, agile approach fits if the

demand is volatile and the variety is high. But in some circumstances leanness may be an element of agility. The previous studies show that the need for agility and leanness depends on the total supply chain strategy and the positioning of decoupling point. The decoupling point is the point which the customer's order penetrates the material flow stream. (Agarwal, et al., 2006, p. 212) The lead times of supply chain and the predictability of customer's demand effects the choice if the lean or agile supply chain is more suitable. This segmentation is presented in figure 3.

Supply lead time	Long	<u>LEAN</u> Plan and execute	<u>LEAGILE</u> Postponement
	Short	<u>LEAN</u> Continuous replenishment	<u>AGILE</u> Quick response
		Good	Poor
		Demand predictability	

Figure 3. Segmentation by demand and supply characteristics (Christopher, et al., 2006, p. 285).

Third aspect, leagile has risen to the side of lean and agile approaches. Leagile is combination of using lean and agile paradigms in one supply chain. (Agarwal, et al., 2006, p. 212) In leagile supply chain the lean and agile systems operate at the different points in a manufacturing supply chain. A key element of this proposed model is that the decoupling point separates the lean processes from the agile processes in the supply chain. The lean processes are in the upstream side of the point and agile processes in the downstream side. (Zhang, et al., 2012, p. 253)

3.2.3 Operating models

There are five classes of operating models through which manufacturing systems can be described: make-to-stock (MTS), assembly-to-order (ATO), make-to-order (MTO), engineer-to-order (ETO), and design-to-order (DTO). The distinction between these five strategies is the place of the decoupling point. (Porter, et al., 1999, p. 192) These operating models are part of operations management and that way part of inventory control. Depending on the company's operating model the logistical demands vary between long and short lead times. The chosen model also effects to need for warehousing for example if the products offered to customers are manufactured following the MTS or DTO. (Soman, et al., 2004, p. 223)

In MTS supply chain customer doesn't have any input into the final product and usually purchases the product from retailer. Groceries and books are such products. The ATO supply chain provides customer with a limited number of choices in the configuration of the final product. Customers can choose among standard components which they want to be assembled to the product. The MTO supply chain provides customers with the opportunity to have at least some part of the product customized uniquely to their specifications. The end customer doesn't have input into the overall design of the product. Examples of MTO products are pre-designed houses and custom made clothing. (Stavrulaki & Davis, 2010, pp. 134-138)

The ETO supply chain is usually regarded as a supply chain where the decoupling point is in the design stage, so each order from customers penetrates the design phase of a project. ETO supply chain usually associate with large, complex project environments. (Gosling & Naim, 2009, p. 741) But the determination of ETO production isn't that straightforward. Porter et al. (1999) introduced DTO supply chain to go next step further in customization. The distinction between these two classes is that ETO is defined as a standard product range with the opportunity of modifications and customizations. DTO is defined as a supply chain where every new

product needs design, engineering, and manufacturing based on each new customer order. (Porter, et al., 1999, p. 192)

DTO supply chain is usually controlled by designer or builder because they are usually in a direct contact with the end customer. In some cases the actual production is subcontracted out when the designer is the link between production and customer. Prediction is hard to be done in the matter of DTO supply chain due to the materials are either commodities already available in the market or they must be sourced individually based on the specific requirements of the product's design. The company pursuing the DTO supply chain customizes the product according to customer's needs and requirements but at the same time it tries to standardize components whenever possible. Typically DTO supply chain doesn't hold finished goods inventory. (Stavrulaki & Davis, 2010, pp. 140-141)

The complexity of the supply chain may vary from firm to firm and to industry to industry. Many manufacturing operations are designed to maximize throughput and lower costs without taking into the account the impact on inventory levels. There are many other factors in the organization that aren't usually compiled as a one process. There is need for a mechanism that integrates these functions together. And supply chain management is a strategy through which such a mechanism could be achieved. (Kaihara, 2003, p. 263)

		Make to Stock	Assemble to Order	Make to Order	Engineer to Order	Design to Order
Product Characteristics	Demand uncertainty, profit margin, product variety, order leadtime, labor skills	Low	—————→			High
	Product life cycle, forecasting, accuracy, volume	High	←————			Low

Manufacturing related characteristics	Production process	Continuous, large volume, assembly / batch	Assembly line, processes	Small batch, job shops	Job shops, projects
	Product design	Cost concious	Modular		Specialized
	Manufacturer has direct contact with end-user	Uncommon			Common
	Manufacturing processes focus	Efficiency	Customer contact point defines decoupling point, efficiency / flexibility focus		Flexibility
	Supply chain strategic capability	Lean	Leagility		Agility

Table 1. Comparison of supply chain characteristics (after Stavroulaki & Davis, 2010, p. 135).

Table 1 shows the linkage of production characteristic with supply chain and how the theories about lean and agile and the theories of operating models is connected. When revealing the relations between operational activities it might lead to the need to make accounting procedures more efficient and improve decision policies for the planning functions. One emphasis of this respect is on how a correct costing of materials, work in process and finished goods in inventory should be carried out in order to show the correct trade-off value. (Grubbström, 1980, pp. 259-260)

4 EMPIRICAL ANALYSIS

In this chapter the methodology and used data in the research is described first. Secondly the case company, The Switch Drive Systems is introduced as well as the starting position from which the new inventory process for the case company is formed. Next the new process is introduced as well as the implementation plan. End of the chapter the managerial implications, and validity and reliability of this research is pondered.

4.1 Acquiring and handling the empirical data

This research is an empirical study in which The Switch Drive Systems is used as a case company. The call for this research arose from the need of the case company to reshape its inventory valuation system. Previous studies of this topic haven't been carried out before so notable research gap exists and this research is academically justified. The case company was very committed to this research and provided all possible help to achieve the goals.

To acquire all necessary data about the case company, altogether sixteen meetings, dozens of e-mails, and several informal discussions took place. Meetings are listed in the appendix 1. In addition, very close look-ups to employees' functions operating around inventories and ERP system was essential in order to understand the whole field of inventories in the organization and to build the new process. All files and systems that are in use in the case organization were available to carry out this research. All meetings were recorded in order to make it easier to revise and ensure the content of the meetings. Because the meetings were unstructured the records aren't transcribed.

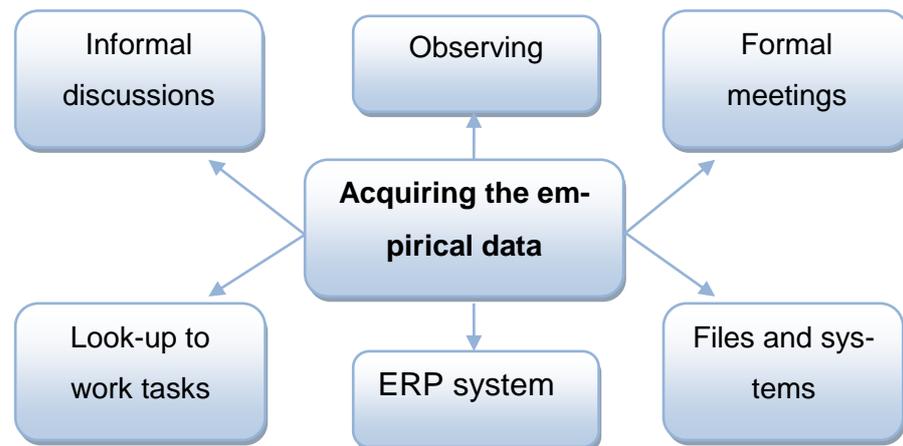


Figure 4. Acquiring the empirical data.

The research process started with meetings with operation controller, manager of administrative services, and model factory manager of The Switch Drive Systems to map the current valuation methods and problems in inventory and valuing it in general. After the general view over the issue was formed the second phase was to deepen the problem configuration by meeting the employees who had advanced understanding of the specific problematic of the topic. All functions affecting the inventory value was looked through and discussed such as purchasing, receiving, and production. After the detailed impression of the existing problem was gathered the third phase was to call the project group together and discuss about the solution. The project group consists of accounting, operations and business controllers, manager of administrative services, model factory manager and two project managers. The project group holds the status, knowledge and ability to make decisions regarding the inventory valuation process. In the third meeting of the project group the solution was sealed. The whole process went on by collecting the information and deepening the problem configuration.

4.2 Case: The Switch Drive Systems

The Switch Drive Systems is part of The Switch Engineering consolidated corporation. The Switch was established in year 2006 when three companies merged. The company supplies permanent magnet generators and full-power converters for wind power and other renewable energy applications. The firm operates in Europe, USA and China, and has its production sites in Vaasa and Lappeenranta, Finland, and also in Luan, China. According to annual report of 2011 the revenue was 97 m €, total balance was 48 m € and the number of employees 176. The Switch draws its consolidated financial statement in accordance with IFRS standards. (www.theswitch.com) This research is primarily made to be applied in Finland's sites in Lappeenranta and Vaasa. If the new process turns out to be convenient the process will be implemented in China also.

4.2.1 Operating models

The model factory concept is in use in the case company. The model factory concept means that before taking the product into mass production the prototype is always made before that and 0-series sometimes. The customership starts with a prototype which is designed in accordance with customer's requirements. The concept enables fast prototyping. Since the prototype is finished and if the customership goes further, the 0-series is produced, in which only one or two products are produced to know how much costs will fall into them and if customization is possible. After that the mass production may take place. In model factory concept the seller is in charge of the designing and manufacturing of the product but the production itself is mainly outsourced. The Switch outsources a lot of subcomponent assemblies but carries out testing and most of the generator's assembling.

The model factory concept is the way of setting up and managing an efficient and flexible supply chain. Lean manufacturing is one of the ideologies behind the concept. The Switch has adapted lean thinking in its production. Using the lean manufacturing ideology The Switch tries to improve its material and inventory management. The lean thinking has been in the company's policies for a little while and is still in the implementation and operations improvement phase.

The Switch uses design-to-order (DTO) and engineer-to-order (ETO) models in its operations. ETO is used more when producing converters because there are quite standard product range but with the opportunity of total modifications and customizations. As for DTO is used more when producing generators because usually they are almost completely new products that needs design, engineering, and manufacturing based on customer order. But as it is said in chapter 3.3.3 the distinction between these two operating models is very slight.

Production works through projects at The Switch and that's why project specific cost and inventory follow up is beneficial and almost necessary. The Switch doesn't hold safety stocks because they don't include in manufacturing policies of The Switch and buffer stocks are held only as commitments to suppliers to shorten longest lead times. All material is purchased directly to projects based on the actual need. Tools and other material that are used in many projects are acquired for the general usage so those costs aren't targeted to any specific project and are rarely entered into the stock accounting. Due to the project based operating policy The Switch desires that the change in stock in income statement would be recorded by projects.

The Switch always starts manufacturing when the sales order is received by opening a new project. In other words, the finished products aren't produced in advance to inventory. In theory this should lead to the situation that inventories only contains components and products that are going in

or are in production. But in practice this is an impossible situation to achieve because particularly when manufacturing the prototype the bill of materials (BOM) changes many times before the production is finished and so the leftover components remains in the stock.

4.2.2 Inventories in ERP system

The ERP system in use in the case company is called Nova provided by Visma. The current ERP system and the way of using it in the company create some limitations to the process of inventory valuation. But those limits can be bypassed using the system on other ways. The most important thing in order to do the valuation correctly is the discipline in using the ERP system.

ERP system contains stock accounting program. With stock accounting a company can maintain the basic and additional information of products and manage the stocks. Naturally, in ERP system the inventory is done in stock accounting program. Also the new items and product structures are created in stock accounting program. The item code is formed by using the code generator that is unconnected to ERP system. When creating the item all necessary and instructed details are entered on the information fields. Also the pricing data of the item is determined.

There are functions affecting stock balances in several programs in ERP system. They update stock balances so that the transactions can be traced. The stock balance in ERP system shows how many items there currently are in the stock by stock places. The ERP system also shows outward, inward, production, and production reserve balances. Outward and inward balances tell how many items are going in or out. The information for outward and inward balances is picked up from sales and purchase order programs. The production balance shows how many items are being manufactured, as for production reserve indicates how many

items is reserved for production. The information for these balances is picked up from production program when the product is transferred to work queue or the production run is done. The table 2 demonstrates which functions in which programs effects increasingly or decreasingly to the overall stock balances.

Program	Function	Description	Effect
Sales order	Accept delivery	Acceptance of delivery	-
	Cancel delivery	Cancelling the delivery	+
Purchase order	Accept delivery	Acceptance of arrival	+
	Cancel delivery	Cancelling of arrival	-
Production	Production run	Main products	+
		Structure parts	-
Stock accounting / Sales order	Stock transfer	To stock	+
		From stock	-

Table 2. Functions connected with stock balances.

Many reports about inventories are available in stock accounting program for example detailed report of stock entries. Also the detailed report of inventory balances is available by stock places. Inventory balance report can be printed out by using the previous purchase price or average price. The material costs of certain stock place are available through this printing function. ERP system uses the previous purchase price when printing the report of the cost of the BOM.

4.2.3 Inventory valuation process

The current valuation process differs depending on the site the inventory is valued. The division between generators and converters is very strong in the case organization and it carries even through inventory valuation. Cur-

rently there are two persons who do the valuation; other values converter's inventories and the other generator's. This division makes sense because the nature of the generators and converters are different. Most of the generators produced by The Switch are prototypes, as for converters are usually considered as mass production.

So far there have been two different kinds of valuation methods. The current situation of the inventory valuation is gathered in appendix 2. In the other of those methods the inventories have been divided in mass product projects and prototype projects. The inventories of mass products have been valued as follows. The material inventory hasn't been valued by projects but as a one material inventory. It has gotten its value from the inventory report of the stock places that holds the components for the mass projects that aren't in the production yet. The material costs aren't included in the WIP inventory for mass production projects but the WIP value for mass projects is the other direct costs that are caused by manufacturing. In general the components for mass products are valued as a material or finished products. The value for a finished product is calculated from the BOM of the product added with the other direct costs. In the case of prototype the value is calculated from the monthly income statement of the project. All direct costs are considered as a WIP and recognized as a value of project specific inventory. The value of finished product inventory is done with the same procedure. There isn't material inventory value for prototype projects in the first valuation method. The percentage of completion (POC) method is used to value the inventories of the projects that lasts more than a year.

In the other site's method the value is calculated by using the product calculuses and the information from the subcontractors' inventory reports. Subcontractors' inventory report files are uploaded and turned them into one file that contains all the components in stocks. By knowing the item code the components can be divided into finished products or material. Subcontractors don't hold any WIP inventories but all components hold be

subcontractors are material or finished goods. The value of material inventory is the real value of material in the stocks that isn't in production yet. The value of WIP inventory consists of the components on "the floor" at The Switch's production hall. The value of WIP is the real value of components that are considered as WIP. Any other costs than direct material costs aren't included in the values of material and WIP inventories. The value of finished products is calculated with calculus. In calculus the BOM of the product is considered as a cost of material. Costs of testing, finishing, packing, and shipping to customer are added to the value of finished product. The non-marketable components are taken into the account in both methods.

As it is seen in these two methods described above, the valuation itself doesn't differ that much from each other but the method how to carry the value out differs. The biggest difference in valuation is in calculating the value of WIP inventory if the other costs than material is taken into the account in the valuation or not. In the carrying method the difference is in the use of excel. Both methods exploit excel but the usage is heavier in the second method described. To decrease this manual work with excel is one of the goals of the new process. The new inventory valuation process will be built based on these existing methods.

4.2.4 Material process

When pondering the process that impact to the inventory value in the case company there are two processes that can be distinguished: material process and accounting valuation process. In the material process the physical stream of the items within the company is concerned and as for valuation process the book value of the items in material process is taken into account. The material process is shown and described below.

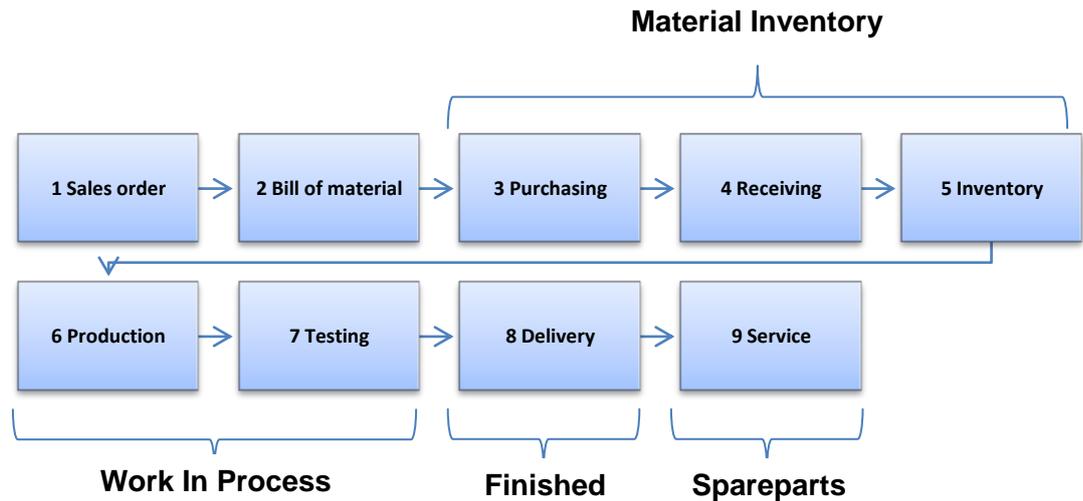


Figure 5. Material Process.

The material process starts from the need of the customer which generates sales order. This starts a process of designing the ordered product. Usually these products are based on earlier already designed components with some customization, so it's very rare when designing must start from the very beginning. Based on the mechanic and electric design the BOM is created. BOM consists of different levels. Level 1 is the finished product, level 2 is the main components the product consists of, and level 3 is the material that is needed to produce the components on level 2 and so on.

Purchaser makes most of the acquisitions based on the BOM. Purchasing is timed based on the knowledge organization has about the delivery times of components and on which stage of production the component is needed. In rare cases purchasing order can be done without the BOM because the subcontractors' work isn't included in BOM and neither are all material needed in production such as screws and wires. In addition, BOM is very likely to change over the project and changed components are turned into new one as a new revision or completely replaced.

When the material and components are ordered next step in material flow is receiving. It depends where the components are received if they are ordered for subcontractor's production or for assembly for the use of the case company's own production. If subcontractor receives the ordered

material and it doesn't have access to ERP system, it will send a docket to purchaser who mark item as a delivered in the ERP system. Just a few subcontractors have the access to ERP system to receive the components. If a component arrives at The Switch the person charge of receiving marks it as delivered. So the material can be in the subcontractor's inventory or case company's own stock which is called "the floor". All material and components that are in subcontractors' inventory is recognized as a material inventory and all components and material on "the floor" at the case company is recognized as a work in process.

Before production the components must transfer to the right stock, to subcontractor's or The Switch's own stock to be ready to be used in production. This requires inventory transfers. When doing the transfers in ERP one must be very careful that the transfer is made from correct storage place and transferred into the correct place. If mistake occurs while doing the transfers the stock balances will no longer hold the true.

Subcontractors manufacture most of the components of the case company's products and assembles them from the most part. The Switch Drive Systems test the products and assembles most of the generators before delivering them to the customer. But in some cases The Switch might do the production itself. The production uses the material from the stock and manufactures a new finished product. After the testing and finishing is done the product is ready to be delivered. Usually the product will be shipped within a few days but sometimes the contract of sale might be canceled before delivering for a reason or another. In that case the finished product is stored in the stock till the other customer will buy it or it will be reused in other project.

4.3 Premises for the improvements in the inventory valuation

Many problems exist in the current inventory valuation process but the fundamental issue is in the variation of valuation methods in the case company. The diverged valuation methods has led to the situation that there isn't consensus on the valuation procedures. For example there isn't agreement which costs should be included in the value of inventories. The reason for variation is in the division between generators and converters even though the difference between prototype and mass series is more distinct and the valuation should rather be divided between them. The overall manufacturing process counts more than the type of the product in this case.

The problem that twists the value of inventory is that all components aren't recorded in the stock accounting or components hold a wrong value. The flaws in balances are due to there isn't procedure to handle subcomponents. There are components produced by subcontractor that contains material that The Switch has purchase responsibility on because The Switch doesn't want to give the information to subcontractor. If the material used in such a subcomponent is recorded in the stock accounting the stock balances wouldn't decrease when accepting the arrival of the subcomponent. Some components might have wrong values because the purchasers or receivers haven't been careful enough. When creating the item the price for it must be given. And when receiving the arriving item previous purchase price shouldn't be updated.

The huge economic issue in current inventory process is the lack of the traceability of the items in stocks. The ERP system doesn't tie up the components for any specific project. When looking the inventory balances the ERP system only shows the overall amount of items in the stock but can't separate which items are reserved for projects not to mention for which specific project. In other words there's no information available which components are reserved for a project and which could be used freely in

other projects. This issue increases the value of inventories unintentionally. The increase of the value of inventory in the last four accounting period is demonstrated in the table 3.

	2011	2010	2009	2008
Stock	11 293	5 844	7 658	887
Total Assets	47 735	53 319	37 982	7 972
Stock / total assets	24 %	11 %	20 %	11 %
Revenue	97 317	134 527	3 427	6 347

Table 3. Stock, total assets and revenue in thousands euros 2008-2011 (Amadeus).

The numbers presented in the table 3 has fluctuated over the four years. But in the accounting year 2011 the stock has increased remarkably. Compared to the year 2010 the value of stock increased 94 % even though the total assets decreased by 10 %. In 2011 more assets were engaged in inventory than never before. This is wrong direction for financial development especially when it doesn't show in revenue.

4.4 Constructing the new inventory valuation process

In the beginning of this process the outlines for inventory valuation process were given: it needs to follow the effective regulation in Finland and it must be practicable, reliable and meet the internal requirements. The requirements for improving the material management were that it needs to be feasible and suitable in terms of special features of case company. Altogether four issues came up from the empirical data that needs to be solved to achieve reliable inventory valuation process. The issues are:

1. Different valuation practices depending on the site
2. Reliable information of real inventory balances and its value isn't available from ERP system
3. There's no information about which components are "free" for use that they aren't reserved for any particular project
4. The lacks in following the procedures of inventory write downs

All different kind of solutions in existing issue of inventory valuation has been pondered. The suggested process flow of inventory valuation for the case company is presents in the appendix 3 which has proved to be the only solution for the problem. Other suggestions have fallen through because an inventory value by projects isn't possible to get any other way. In order to receive the change in stock by projects the stock accounting is only possibility. In addition to stock accounting the purchase order program is only source to hold the knowledge of how much material has been purchased for a project. But all kinds of material and subcontracting are bought by using purchase orders, so the information about the project's components can't be distinguished reliably. In the respect of material management such a reports can't get out of the ERP system that told amount of the material acquired for the project and the amount of material consumed in project.

The suggested solution is based on the existing procedures in the company which are combined and modified to build up a new process. Any tremendous changes hasn't be made. The new valuation process is described in the next section. After that the procedures of how to achieve the aimed process is presented by dividing the suggestion in inventory management process and inventory valuation process.

The red line of the inventory valuation is to divide inventories into material, WIP and finished product (FP) inventories and value them separately. WIP inventory contains the material that is under the production at The Switch, FP inventory contains the products that are ready to be shipped to cus-

tomers, and material inventory is all material that isn't included in WIP or FP but is intended to be used in the production. The Switch demands that the value of inventories must be presented by projects because of its internal purposes. This is logical requirement because all operations are project based; customized projects are offered to customers, not just products.

The main features of the solution are to increase the number of stock places in the ERP system and to distinguish the prototype and mass projects from each other and value their inventories separately by different procedures. In practice, increasing the number of the stock places means that all projects have its own stock place in every physical storing place. All purchases, receivings, and production are made on those stock places addressed to the certain project. Until now there have been as many stock places as real physical stocks: one stock place in ERP system for one physical inventory. But now the principle change and it increases the number of stock places in ERP system exponentially. The idea of stock places is demonstrated in figure 6.

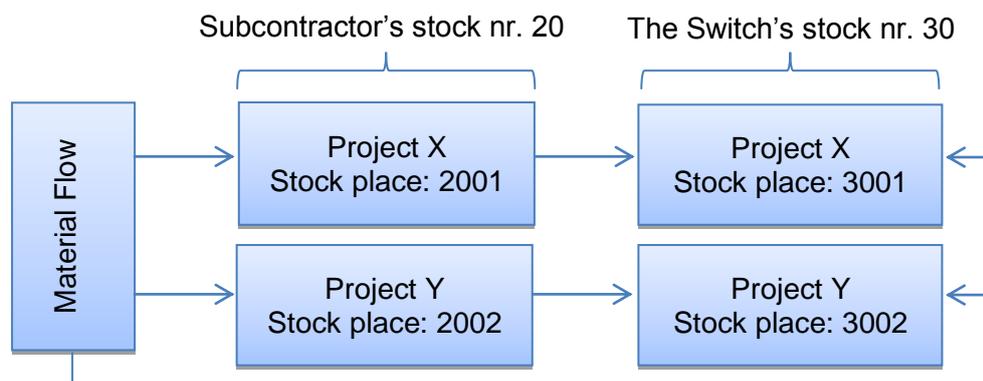


Figure 6. The principal of increasing the number of stock places.

Every project has its own stock place in the each storage at the subcontractors and at The Switch. This project based stock place numbering is called as "stock place chain" in this research. The stock places are numbered consistently that it is easy to follow which stock places holds the material of certain project. The stock places use four digits numbers. The

first two digits tell the physical stock place and two latter digits refer to project number. It depends on the resources of inventory keeper outside of The Switch if it arranges the material it holds behalf of The Switch by the stock places that are used at The Switch's ERP system. The only exigency for subcontractors is to arrange inventories in the way that inventory can be done every month and it can be reported to The Switch. Of course it is desirable to receive the project specific inventory lists in order to pursue more reliable inventory management but in some cases it is impossible for subcontractor to do so or it would be too expensive compared to benefits.

The intention behind increasing the number of stock places is to make the inventory valuation by projects easier and more reliable. Also the project specific stock numbering improves the inventory management and provides reliable information about the material used in the projects. Using the virtual stock places is the only way to manage the inventories because the ERP system in use doesn't provide any other practice to do that when taking the case company's special features in the way of operating into account. In other words the current way of using the ERP system doesn't support case company's project based way of operating. The whole production process and supply chain are very complicated and that's why following the material flow is essential for knowing the quantity of material and where it is placed. The ERP system in use at The Switch is built more like for those companies whose production is more stable and more predictable when it comes to inventories.

Other reason for taking more stock places in use is that the ERP system doesn't earmark the material for certain projects that it has been purchased for. Item index shows how much there are material in the stock, how many pieces are coming in or going out and how many items are reserved for production. But there is no information available for which project the items have been purchased at the first place. The current way of using the ERP system doesn't support the inventory management but establishing the project specific stock place system allows better material

follow-up. This procedure improves the material management because all items purchased for certain project are placed on certain stock place which contains only components and other materials for only this one project so the material is earmarked in that way. The mapping of stock places is shown in appendix 4.

The inventory valuation is part of monthly reporting and is done in every month. First of all, the cut-off period when all changes to inventories is forbidden must be clearly determined and informed to people who may have access or interest to do changes. The cut-off day is the first working day of a month. When the cut-off takes place the comparison between subcontractors' and ERP system's inventory balance can be made. Every month subcontractors deliver an inventory report of the material and components that they have on behalf of The Switch. These inventory files are available for the case company's usage. After matching the inventories the deviation report of the inventory balances can be run. The report shows if there are differences between balances received from subcontractors' files and the balances received from the ERP system. If deviations occur it must be traced which has caused them. When the faults are found the corrections can be made. This matching must be done properly to reach the correct quantities of the items in inventories that the real value of the material in inventories can be calculated.

Since the inventory balances are fixed the inventories are divided into two categories: prototype and mass production. 0-series are considered case by case if they belong to prototype or mass series classification. The division is done because prototypes and mass series are valued with different procedure. Prototype gets its value from monthly project report and mass series from what there really are in the stock for the project. If the estimated length of a project is more than one year POC method is used. Only prototype projects can last more than a year. The IAS 11 deals particularly with POC method.

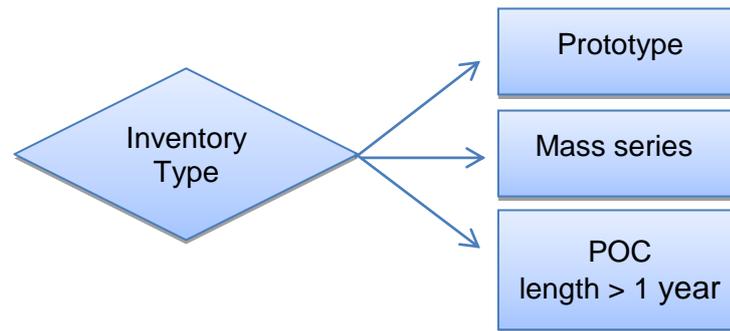


Figure 7. The division of inventories for valuation.

In the figure 7 the three classes is shown in which inventories are divided. The class the project falls in rules how its inventory value is calculated. When it comes to prototype project, the monthly income statement of prototype project is printed out and the direct costs presented on project's monthly income statement are added up; materials and supplies, subcontracting, variable personnel costs, and fixed personnel costs. The sum of direct costs incurred during the month in question is recorded as a change in stock to income statement. The costs are added to the previous month's inventory value of the project and this equals to the value of work in process for prototype project in balance sheet. The value of finished product is calculated with same means. The product is considered as finished when it is ready to be delivered. Proto projects don't hold material inventories but all are valued as WIP or FP. The inventory voucher is created and transferred to accounting.

The prototype project is valued by using the POC-method if the project lasts over a year. In this case, the project is valued as in IAS 11 *Construction Contracts* stands. Revenues and costs of long project are recognized as revenue and expense by the stage of completion of the project at the end of the month. In other words the inventory value of over-a-year project isn't set up as an asset in the balance sheet. In the case company the percentage of completion is calculated by dividing the realized costs by estimated costs. IAS 11 is presented better in the chapter 2.4.3.

The inventory values for mass projects are calculated by using the information about the quantity of the material that is in the stock. To value the mass project's material inventory the inventory reports of stock places that holds the material of the project in question are printed out by using the average purchase price. The total of this report shows the value of the material in those inventories and it is the value of material inventory of the project. Mass projects' WIP inventories are valued with the same principle than material inventories: the quantity of items multiplied by the average purchase price. In the current situation the WIP inventory for mass projects is calculated only when drawing the financial statement not when doing the monthly reporting because the turnover of the current mass products is very fast. This situation may change in the future but then it needs to be considered again. It doesn't make a change if the value is in material inventory or in WIP inventory because the valuation method is same so the value is same. In addition, the monthly reporting is done only for internal purposes and the information about how much money is tied up in WIP inventory isn't needed in monthly basis. The value of finished mass product is calculated by adding sales freight, testing, and packing costs to the value of BOM of the product. After the valuation the voucher for accounting is created.

To value proto projects and mass projects with different methods is consistent because the cost structure for the projects is different. A large share of the total costs in proto project consists of other costs than material. For example, designing and testing causes a lot of costs for proto projects. In that point of view the project specific income statement which shows all direct costs of the project is the most reliable source of information for valuing the inventory. On the contrary, in mass production project the share of other costs than material is very small so the cost of direct material costs is sufficient.

IAS 2 governs that the cost of inventories should comprise of all costs of purchase, cost of conversion, and other costs if they are incurred in bring-

ing the inventories to their present location and condition. But in this case the other direct costs than material of mass product is considered to be unsubstantial when comparing them to the whole cost structure, that other costs than material doesn't need to be taken into account when valuing the inventories of mass projects. In the contrary, valuing the prototype project's inventories all direct costs is included in the value because the share is so remarkable. Overheads isn't included in either one of inventory type because it would require advanced calculation systems and till the end the share of overheads is estimated to be unsubstantial compared to the other costs. The same reason applies to IAS 23 that the borrowing costs aren't taken into account in valuation.

4.5 Implementing the inventory valuation process

As it is illustrated before, the inventory valuation process and inventory management are tightly connected in order to receive reliable inventory value. Both processes must work fluently without any complications. Being a result of that, one of the most important factor receiving the correct and reliable value for inventory is that all materials that are held by enterprise with the intention to use them in production or other way to used to generate profit are recognized in the inventory and the value of the material, semi-finished or finished product is known reliably.

In the suggested solution the biggest change will be the increased amount of the stock places. This is the factor that causes most of the adjustments that need to be done to be able to put the suggestion into action. To control the numerous stock places one of the most important factor is to inform all employees working in the functions that might affect the value and balances of inventories. And to make the suggestion feasible it also requires that subcontractors are committed to new process in the matter of inventories. Subcontractors have to use the item codes given by The

Switch in order to make the monthly inventory work and also they need to consider arranging the storing by the stock places.

4.5.1 Material Process

Material process is essential in a matter of managing inventories and pursuing the correct balances of inventories. Material process shows entire material flow in the organization: why the material is acquired, which operation uses it and when material is consumed out. It is described below how The Switch Drive Systems should arrange its functions and operations that impact to the inventory management to receive the correct value of the material that is in the possession of the company.

The idealistic material process, seen in figure 8, begins always with sales order. When company is received the sales order the project is opened. When opening the project the cost center is given for the project. The cost center is formed from five numbers. The first number tells if the product is generator or converter, second number stands for which field of the renewable energy the project is produced for and the third number tells if the product is prototype or mass series. With 0-series the project opener uses one's own consideration if the product falls better into the form of prototype or mass series but usually the nature of 0-series is closer to prototypes. And the last two numbers forms the function which causes the cost. The stock place on which the project will be finished is determined and also the stock place chain on which the material for the project is stored and purchased is determined in the phase of opening the project. The project openers are in charge of keeping up the records to know which stock place chains are available and which are in use. The aim is to "recycle" the stock place chains.

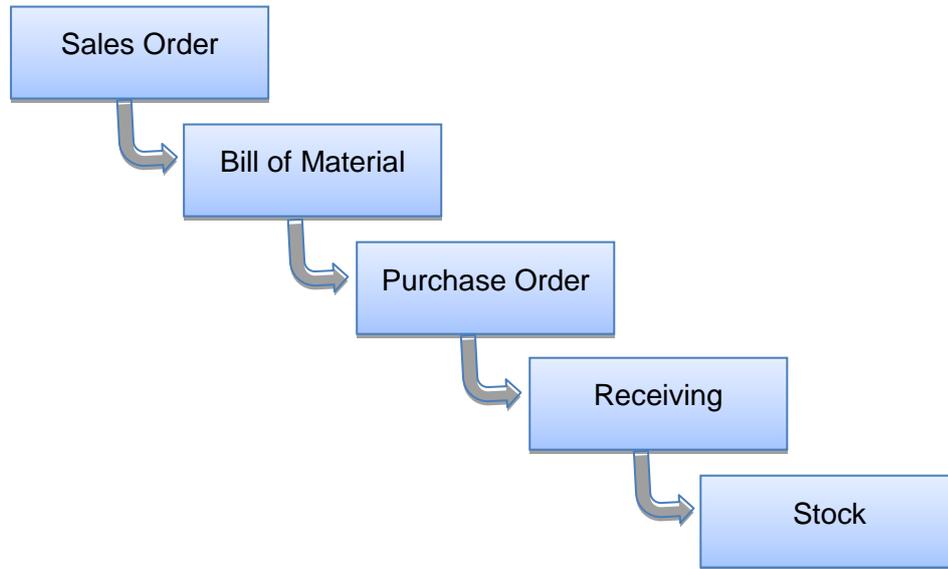


Figure 8. Idealistic Material Process.

Since the sales order is received and recorded in the system BOM for the products that customer ordered is designed. BOM consists of many levels creating the structure of the product. The BOM could be described as a recipe of the product. The first level is the finished product, the second level is the subcomponents the product is assembled and the lower levels include all components and material needed in subcomponents. Whether the purchase responsibility is on The Switch or on the subcontractors it is determined on the BOM by marking components and material active or passive. This is important for purchasers that they know what to acquire. And when calculating the value for finished products the components that are marked as passive aren't included in the calculation of the price of the product.

The third step in material process is to acquire the material needed in the production. Before purchasing, the item codes for all components must be created by using the code generator. Most of the purchase orders are made based on the BOM but purchase commands can come from other source as well, for instance from production manager or testing. The general principal is that all acquisitions are made through purchase orders so

that all material is registered in the system. Even though all purchases must be recognized in the ERP system all material doesn't need to be included in the inventory value. For the cases like that there is a tipping codes and row code three in use. The tipping code is usually used if the job performance such as calibration is bought. The row code three comes to a question if a component isn't wanted to be included in the balance of the inventory. But cases when using row code three are very rare. There are instructions for purchaser which material and components should be recorded in the ERP system and stock accounting, and how to use the code generator.

In receiving phase three things must be checked carefully: the number of items received, if the stock place in purchase order is the same as it is received in, and that the stock place is consistent to a project number. Purchaser marks the stock place in the purchase order but mistakes might occur. Double checking of the stock place number when receiving is important in order to get the inventory balances right. When recording the receivings to the ERP system there are many options about what shall be updated and what shall not. The option "don't update previous purchase price" must be checked because it would twist the average price of the item in the case when just a few items has been purchased for a prototype project and there could be volume discount available. Because the previous purchase price isn't updated automatically purchasers must update the prices manually. When purchaser calls for offers and if there is differences between mass price and unit price the mass price must be used as previous purchase price and updated it to the ERP system. If the mass price is not available the lowest price must be used as a previous purchase price. Previous purchase price is used when pricing the products or estimating the costs and the average purchase price is used in valuation of inventory.

To move the items from an inventory place to another the inventory transfer occurs. Inventory transfers are made in ERP system. When making the

transfers the covering letter must be printed out to have a better control what has been transferred and where and if it has reached the destination. The covering letters must be printed out even if the transfer occurs within the same physical stock but between the projects. That way it is easier to keep on track with the transfers in a case if there are any deviations in inventory balances in the end of month. To have all transfers on the paper it is easier to check out if it's because some item is transferred from or into wrong stock place. The information about transfer orders from or to a project must reach the accounting that accountant can post an adjusting entry to project costs. This procedure is very important in order to get correct project costs.

By following these models of operations the items in inventory ends up in the right stock place with the right value which results in correct inventory value in financial statement. The biggest change from the perspective of inventory management is that when the project is delivered the stock places the material of the project was hold in are emptied. In practice, for all projects are purchased material that hasn't been used in production for a reason or another. In current process, this excess material tends to be remained in inventory without any consideration of its purpose of use in the future. So the material left on stock places is recognized and the purpose of use in the future is considered by the technical account manager. The excess material is transferred to "free stock" to wait for next project in the value of average purchase price or to obsolete inventory if it is assumed that the item doesn't generate value for the company in the future.

4.5.2 Inventory Valuation Process

The inventory valuation process presented in appendix 3 generates the right value for inventories if the material process has been done correctly and the inventory balances stack up. But there are many things in valuation process that must be agreed on. First of all the inventory valuation is

done on the first working day of a month. It must be decided who is charge of matching the balances of inventories, runs the deviation report and makes corrections and also who calculates the value for inventories and inventory change and prepares the accounting vouchers for accounting.

In the suggested process, to know how to divide the inventories into material, WIP and FP inventories the determinations of the inventories must be made clearly. Material inventory consist of material that are intended to use in mass production but the production hasn't been started yet. Work in process inventory for mass production includes all materials that are in the started production. In the started production is considered products that are under the production at The Switch's production halls. As for prototype, all started projects are considered as work in process. Finished products are products that are completed and ready to be shipped to customer. The projects that lasts over a year isn't even included in the value of inventories because its revenues and costs are recognized as revenue and expense by the stage of completion of the project in accordance with IAS 11.

The problem with components that The Switch has purchase responsibility on and which are delivered to subcontractors for manufacturing the sub-components will be solved by doing "production planning" order. BOM is created for the subcomponent which includes all components that are used to produce it and the subcontractor's work. The order is made for subcontractor about a product that includes the component The Switch has purchase responsibility. When receiving this "production planning" component the production run for it is done at the same time. In that case the subcomponent is finished, it consumes the purchase responsibility component from the stock place it was recorded, and the inventory balance is increased by one finished sub-component and decreased by the components that it consumed. In addition, when doing the production run the value of the component is calculated based on its BOM. This same procedure must be followed even when changing the revision of a compo-

ment. This practice enables that the component is recognized in the inventory with its real value.

Once the project is completed the stock places it used, must empty out of the extra materials that wasn't used in the project. By doing that The Switch tries to get better control over its inventories. The inventories tend to increase due to current inventory operations. The reason is that excess components aren't possible to recognize in ERP system. By recognizing and considering the usage of extra material, The Switch tries to achieve remarkable savings compared to current situation.

4.6 Managerial implications

The findings of this research are useful in two ways, academically and practically. First of all, any previous studies don't exist that handle the topic under this study as a whole. At the best this study opens the discussion around the inventory management influencing on the inventory valuation and by that way to the profit and performance of a company. The literature overview on inventory management and accounting lay down good foundation for the future researches and point out some factors that need to be taken into the consideration in assessing the value of inventories.

The practical side of the findings is that results can be used with few modifications for the other company's purpose as well. This study offers good framework for the other manufacturing companies that considers reshaping its inventory valuation processes. Obviously, case specific factors and matters need to be taken into consideration but the factors affecting the inventory processes are presented in this study. Many corporations can draw the conclusions of what are the best procedures for it based on the suggested process founded in this study.

4.7 Validity and reliability

In the qualitative study, the research is valid if it represents accurately those features of the phenomena that it is intended to describe, explain or theorize (Long & Johnson, 2000, p. 31). There are four criteria that define a valid case study: significance to public or theoretical interest; completeness that the whole case is communicated; consideration of alternative perspectives by drawing the work of other researchers; sufficient evidence is provided to enable the reader to make one's own judgments. (Brewerton & Millward, 2009, p. 56)

Validity can be divided in internal and external validity. The internal validity exists in the research in which the relation between theoretical and conceptual definitions is logical. In other words internal validity requires that conclusions, concepts and assumptions are consistent. External validity indicates the relation between conclusions and empirical evidence. Estimating the validity of qualitative research is mainly revising the researcher. The internal validity can be revised by reasoning because it mostly reflects the academic capability of the researcher. And as for revising the external validity is also related to researcher as well. It can be said that research contains external validity if the researcher has drawn right conclusions from the observed situation or the situation is described just like it is. (Grönfors, 1982, p. 174)

To point out the reliability is part of estimating the validity. The acquired data has reliability when it doesn't include any contradictions. The data can have reliability without having validity but no other way around. There are four categories in which the estimating of reliability can be divided: consistency, an accuracy and objectivity of the phenomenon, and continuity of the phenomenon. (Grönfors, 1982, p. 175)

This research can be stated valid because all the factors mentioned above fulfills. First of all the study meets the four criteria listed by Brewerton and

Millward (2009): the research is significant, the whole case is described thoroughly, previous researches are used to verify the results, and sufficient evidence to draw the solution is provided. The research holds the internal and external validity as well. Study is reliable also due to contradictions are eliminated. Results and conclusions are logical with the theory and problem configuration.

5 DISCUSSION AND CONCLUSIONS

Inventory valuation is obligatory part of the financial statement. It has direct impact on the balance sheet and income statement and that way to the profit. These are few reasons why inventory valuation is essential to be done right by using the methods that are most suitable to illustrate the financial situation of a company. The allowable methods depend on the financial statement norms the company uses in drawing up the financial statement. Inventory management is directly linked to inventory valuation because it determines the levels of inventories and the values of the items in inventory. It has substantial impact on the profitability and the firm's performance.

The call for this research arose from the need of the case company to reshape its inventory valuation system and improve its inventory management. There exist many problems in the current processes that affect to the reliable and usefulness of the received information about inventories which affects both the inventory management and valuation. In the first chapter the adjustments for the research was made and the main research question was formed as follows:

How the inventory valuation process should be improved in the case company?

The process flow chart of the new valuation process is shown in appendix 3. The empirical data that was used to form the results is gathered by observing and using the unstructured interviews. The result is formed by using the current procedures by editing and mixing them. The result is organized in the respect of the special features of the case company in which the most distinct is the prototyping manufacturing, so called model factory concept.

The new process upgrades the reliability of the information received from the inventories. This is due to all items that are owned by The Switch and are intended to use in production are recognized in the stock accounting. In addition, the items hold correct value. The reliable inventory knowledge improves the inventory valuation process and inventory management. The knowledge is straightly used in the valuation of material inventory and mass projects' WIP inventory. What it comes to improvement of inventory management the knowledge of what there really are in the stocks and for which project it's purchased for or if the material is in free use are huge amendments to material management. The most important development in the inventory management process is to recognize the leftover components and have the consideration over them of their use in the future.

Even though the improvements are significant and advantageous they don't require that many changes to the current way of operating because the new process is formed based on the present procedures of the case company. Some procedures have been reshaped and some is sharpened. Also the instructions are stricter. The biggest change is that there exists a process as a whole that needs to be obeyed. The change in the number of stock places is the major reason why employees needs to be trained because it's essential that they understand the importance of the stock places and that the stock places hold material of the correct project. From this point of view the special attention must be paid to stock transfers, if the transfer occurs between right stock places or if the information must be sent to accounting. The other factor that needs special attention is acquiring the material if it's necessary and is done to the right stock place.

In order to get reliable and useful inventory valuation process there are two processes that need to be handled separately: material flow process and inventory valuation process. Material process includes all functions in the organization that acquires moves and consumes material to or from the inventory. Valuation process is the process that determines the value of inventories. Valuation procedures form the process. These two pro-

cesses are very close to each other and they should interact with each other. Material process uses the information from valuation process in purpose of purchasing and pricing. Inventory valuation process uses the information from material process about the inventory balances and values of items. Based on the division of the processes two sub questions were set. The first one was:

What are the procedures of the inventory valuation methods and models that are the most suitable for the case company in the respect of its way of operating?

About inventory valuation and executing it has been governed in EU's legislation and Finnish national legislation. EU's legislation gives the boundaries within the valuation must be executed in Member States. Finnish legislation bases on the EU's directives. Public companies have to draw its financial statement in accordance with IFRS standards. Other accountables in Finland can use IFRS standard in its own accord. The Switch Drive Systems prepares its financial statement in accordance with IFRS voluntarily. The Switch has operations and customers all around the world. Drawing up the financial statement by using IFRS norms is beneficial for the case company because IFRS enables the international comparison for suppliers, customers and creditors. IFRS norms have a specific standard, IAS 2, for valuating inventories. The objective of IAS 2 is to prescribe the accounting treatment for inventories. There are two other standards IAS 11 and IAS 23 that deals partly with inventory valuation.

According to IAS 2 all costs of purchase, conversion and other costs should be included in the value of inventory. In the new valuation process that standard isn't fully applied. The other costs of mass products apart from material costs are completely excluded from the value of material and WIP inventories. The share of other costs compared to material costs is minor so those costs are considered to be not important to be included in the value of inventory. But in prototypes the other direct costs such as la-

bor costs and testing is notable so they are taken into account in inventory value. The overheads such as property maintenance are considered to be minor cost compared to material costs of products so they are excluded of the valuation even though legislation and IFRS enables including them in the value of inventory. IAS 11 Construction contract has been fully adapted to the new procedures of inventory valuation. Adding the borrowing costs to the value of inventory as it is allowed in IAS 23 wasn't considered significant in the case company. Borrowings aren't used that way in the case organization that the expenses could have been separated for individual products in inventory and anyway, the cost would be so minor.

The valuation methods has been put together to be as logical as possible to meet The Switch's external and internal environmental requirements. The suggested inventory valuation method is resulted to be the simplest as possible but still give the correct value in the boundaries of regulation. The information of inventories isn't directly used in pricing or product costing in the case company so there aren't that heavy external requirement for the valuation process what it comes to adding other costs than material to the value of inventory. Even though, most of the costs are dropped from the valuation the process obeys the prudence principle.

The other sub question was:

What is the significance of the inventory management in the case company?

In the case company the ideal material process starts with sales order. The BOM must be designed for the ordered products. Based on the BOM purchasers make the purchase orders. The material arrives and is stored in the stocks. This material that is in a possession of The Switch and has purpose to generate profit for the company needs to be capitalized as inventory in balance sheet. To get the correct value all items that are re-

garded as inventory needs to be recognized in the stock accounting and those items needs to hold a correct value.

The current problems in the case company concerning the material management is that material acquired for a subcomponent hasn't recognized in the inventory and the control and instructions of updating prices of the items has had deficiencies. But from now on the BOM is created for individual subcomponents. So when receiving them the production run is made and it consumes the material from the inventory that has been attached to the subcomponent and produces one item. The instructions of keeping up the correct price for items are sharpen. Also the instructions of using codes in ERP system that doesn't update the stock balances are sharpen.

The current inventory management is quite advanced in some parts. For example The Switch uses lean manufacturing in its operations. This improves the inventory management in its own part. But according to this study the agile manufacturing would be more suitable for the case company because the demand is low and the variety and volatile is high. Hence, leanness may be the element of agility. The supply chain management is on the good level as well. The list of suppliers is long and the knowledge of lead times and such important information is very good.

Even though the previous studies' shows mixed results about the improved inventory management influence to performance it can be rationally argued that in this case the improvement in inventory management increases the financial performance. This is fact because currently so much money is wasted in components that aren't ever going to be used because they get lost in the stocks due to they aren't earmarked any way. Also by recognizing all items in inventory with right value improves the financial forecasting. But it can't be rationally concluded that inventory management improves the performance. In some way it will because good inventory management releases the resources from keeping up the inventories to

other functions but it can't be concluded how effectively this improvement will show in the case organization.

Considering the amount of time given for the researcher to build up a new inventory valuation process the suggested process is the best solution undoubtedly. Each minor factor that is raised from the empirical data is taken into account and solutions are searched interactively with the representatives of the case company. Due to the delimitation that excluded exceptions from the research might still occur and it's not necessary that for those occasions the answer is found in the new process. In addition, the understanding and knowledge of the current issue of researcher can be challenged. There can be issues that haven't come up when collecting the empirical data or there could be unsaid things in the case organization that are assumed to researcher to understand. Also it can be considered which way the solution would have formed if changes had been arbitraries and operations were changeable. In conclusion, this suggestion might not be watertight but regarding to given delimitations this is the best practice.

Two topics arose for the further study suggestions. The first is examining how the new inventory valuation process and improved inventory management affects the profitability and performance in the case company. This would be the logical continuation for this research to examine how these changes really affected the case organization. This could be studied by using the comparison of financial data such as inventory value and change in stock. Also interviews could be practicable about how the improvements in inventory management have affected the development of the production.

The second research suggestion is to find how to optimize the inventory value of the case company. By studying the inventory levels and finding the optimal inventory level the significant improvements in profitability and performance could be assumed to notice. Optimizing inventories could bring up the deficiencies of the current production systems and to chal-

challenge the project based manufacturing; is it the most beneficial way of operating to acquire material for the actual need of the production or could there be other balance.

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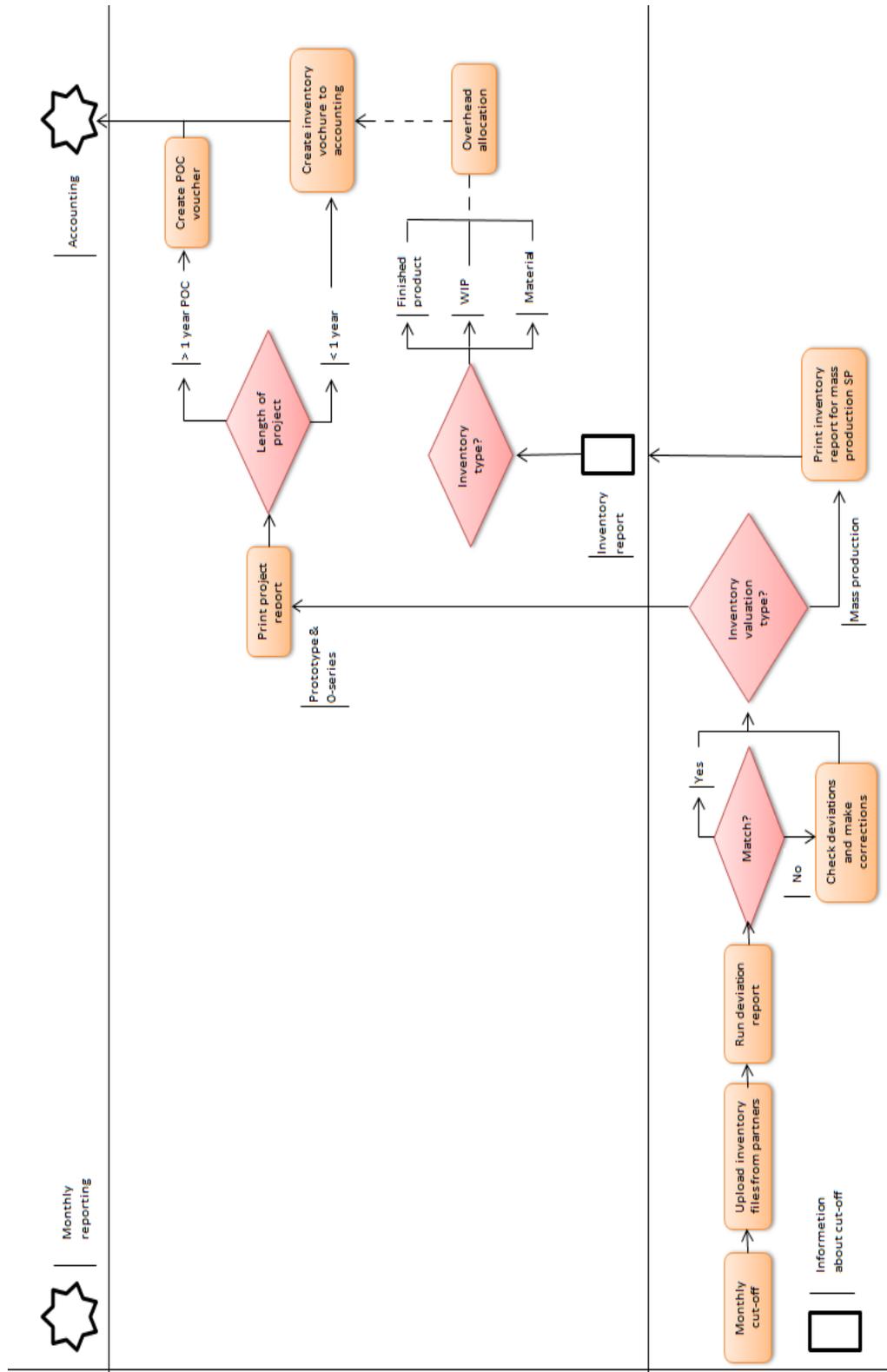
Appendix 1. Collecting the empirical data

Date	Attendees	The agenda of a meeting
31.5.2012	Manager of administrative services, Operations controller	Agree on the goals of the research
4.6.2012	Manager of administrative services, Model factory manager	Plotting the need for new inventory valuation process
6.6.2012	Operations manager	Current inventory valuation process
7.6.2012	Accounting controller	Case company's external requirement
4.10.2012	Accounting controller, Operations controller, Business controller, Manager of administrative services, Project manager	1st meeting of "project group": the current process, it's weaknesses, requirements for new process, possibilities for new process
18.10.2012	Manufacturing manager, Purchaser	Pitfalls of the procedures of new intended process
29.10.2012	Project Managers	The possibilities in ERP system in use
29.10.2012	Purchaser	The purchasing process in Vaasa
29.10.2012	Senior sourcing manager, Model factory manager, Development engineer, Logistic engineer, Purchaser	The production and material management process in Vaasa
31.10.2012	Accounting controller, Operations controller, Business controller, Manager of administrative services, Project manager, Model factory manager	2 nd meeting of "project group": taking the planning of new process further – resulting nearly completed new inventory valuation process
8.11.2012	Operations controller	Discussing about some details
27.11.2012	Operations controller, Manager of administrative services, Manufacturing manager, Purchaser	Discussing about some details
13.12.2012	Accounting controller, Operations controller	Going through the intended process
14.12.2012	Operations controller, Project managers	Planning the testing of the process
17.12.2012	Project managers	Testing the intended process
18.12.2012	Accounting controller, Operations controller, Business controller, Manager of administrative services, Project manager, Model factory manager	3 rd meeting of "project group": making the decision of beginning the implementation of the new process

Appendix 2. Starting position

	Method 2	Method 1	External outlines
Baseline	<ul style="list-style-type: none"> All purchases made directly to projects Inventory bookkeeping of subcontractors in excel, only one has a rights to Nova -> little possibility to control faults in inventories Fast inventory turnover 	<ul style="list-style-type: none"> Inventories comprises indirect labor Valued by acquisition price Changes in inventories from monthly profit and loss account -> adding to previous months sum 	<ul style="list-style-type: none"> Legislation IFRS Sound accounting procedures and other principles FIFO method is used in all inventories
Raw materials	<ul style="list-style-type: none"> "Kanban", has a huge value -> all projects use this stock but expenses are divided between two projects Valued by average price 	<ul style="list-style-type: none"> Includes materials for mass products Purchased without project number! 	<ul style="list-style-type: none"> Inventory must be recorded at the lower of cost and net realizable value (the estimated selling price, less the estimated costs of completion and selling expenses)
Work in progress (processes)	<p>WIP:</p> <ul style="list-style-type: none"> Valued by average price Quantities of inventory from subcontractors' excels Average price*quantity=project value <p>POC(percentage of completion):</p> <ul style="list-style-type: none"> Method is used for over 1 year projects in which the revenues and expenses of long-term contracts are recognized yearly as a percentage of the work completed during that year (defined in IFRS) 	<p>WIP, prototype:</p> <ul style="list-style-type: none"> The value of process followed in excel -> monthly profit and loss account by processes, costs added in excel <p>WIP, mass production:</p> <ul style="list-style-type: none"> Costs that are directed to project (labor) can be followed monthly and material costs when project is completed -> costs are run with structure Fast inventory turnover 	<ul style="list-style-type: none"> Inventory must be recorded at the lower of cost or net realizable value The cost of work in progress comprises design costs, raw materials, direct labor, other direct costs and related production overheads (annual report 2011)
Finished products	<ul style="list-style-type: none"> Calculated with calculus which contains direct material, freight, testing, etc. 	<ul style="list-style-type: none"> According to prudence principle, finished products must value to the lowest possible value, estimated selling price or manufacturing cost 	<ul style="list-style-type: none"> The cost of finished goods comprises design costs, raw materials, direct labor, other direct costs and related production overheads
Waste	<ul style="list-style-type: none"> CFO's permission is needed if shutdowns occurs 	<ul style="list-style-type: none"> Stock 80 Obsolete in use 	
Problems	<ul style="list-style-type: none"> System doesn't support project follow-up How to deal with non-marketable material Too much manual work in the current process Information received from Nova can't be trusted 		

Appendix 3. Inventory valuation process flowchart.



Appendix 4. The table of stock places.

Stock places	Nr.	Finished products	"Free" stock	Proto / 0-series	Mass 1	Mass 2	Mass 3
Subcontractor 1	20	20	20.01	20.02	20.03	20.04	20.05
Production 1	21	21	21.01	21.02	21.03	21.04	21.05
Subcontractor 2	22		22.01	22.02	22.03	22.04	22.05
Subcontractor 3	23		23.01	23.02	23.03	23.04	23.05
Subcontractor 4	25		25.01	25.02	25.03	25.04	25.05
Subcontractor 5	26		26.01	26.02	26.03	26.04	26.05
Subcontractor 6	27		27.01	27.02	27.03	27.04	27.05
Production 2	51	51	51.01	51.02	51.03	51.04	51.05
Subcontractor 7	52	52	52.01	52.02	52.03	52.04	52.05
Subcontractor 8	64		64.01	64.02	64.03	64.04	64.05
Subcontractor 9	70		70.01	70.02	70.03	70.04	70.05
Subcontractor 10	72		72.01	72.02	72.03	72.04	72.05
Subcontractor 11	75		75.01	75.02	75.03	75.04	75.05
Abroad	xx		xx.01	xx.02	xx03	xx.04	xx.05
Spare Parts	100						
Direct Delivery	150						
Obsolete 1	49						
Obsolete 2	80						