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Cost analysis for a special product
Case: Stora Enso Oyj

Thesis 2018

Tiivistelmä

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Yrityksen tarkoituksena on tuottaa asiakkailleen lisäarvoa sekä toimia taloudellisesti ja tehokkaasti tuottaakseen omistajilleen rahaa. Taloudellisen tilanteen seuraamiseksi ja päätösten tekemiseksi tarvitaan kustannuslaskentaa ja tarkemmin vielä yksittäisen tuotteen kustannusten ja kannattavuuden seuraamista.

Tämän työn tarkoituksen oli analysoida tuotteen X kustannusrakenne ja kannattavuus, kun kyseessä oli uusi erikoistuote Stora Ensolla. Tuotteen perusmateriaali valmistettiin Suomessa ja sen jalostaminen tapahtui Ruotsissa. Näiden eri tehtaiden kustannusten kohdentamisen ja ajureiden mahdolliset eroavaisuudet toimintolaskentapohjaiseen laskentasysteemiin dataa siirrettäessä käytiin systemaattisesti läpi haastatteluin, data-analyysin ja prosessimallintamisen avulla. Kustannusrakenne ja kannattavuusdata analysoitiin toimintolaskentapohjaisesta systeemistä otetuilla arvoilla. Tuotteen X kokonaiskustannuksia ja kustannusrakennetta verrattiin yhtiön sisäisellä simulaatiomallilla laskettuihin kustannuksiin.

Tutkimuksen perusteella löydettiin kustannusajureissa eroa, jonka muutoksen tutkimista suositeltiin. Myös kuukausittain tehtävän siirtodatan manuaalisen työn välttämistä systeemin kehittämisellä tarkasteltiin välttämään virheitä. Kustannusanalyysin tuloksena saatiin lisätietoa kokonaiskustannuksiin eniten vaikuttavista tekijöistä, siten millä toimilla tuotteen X kokonaiskustannusta voisi pienentää. Simulaatiomallin ja toimintolaskentaan perustuvan tuotteen X kustannusten vertailu vahvisti, että kahdella eri menetelmällä lasketut tuotteen X kokonaiskustannuksilla ei ole merkittävää eroa.

Työn tuloksia voidaan hyödyntää tuotteen kustannusten ja kannattavuuden seurannassa, tuotehallinnassa sekä tuotetta koskevien päätösten tekemisessä. Työn kehitystuloksia voidaan myös hyödyntää uuden liiketoiminnan kehittämisessä.

Asiasanat: tuotelaskenta, kustannuslaskenta, toimintolaskenta

Abstract

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The target of the thesis was the cost and profitability analyses of the new packaging material product X produced in the forest industry, at Stora Enso. More closely the other target of the thesis was to investigate allocation methods and drivers used in the activity-based costing. Further, the results of the cost analysis were evaluated and compared with the simulation model of the product cost calculation (mill method). The results and conclusions of the study was needed in product management decisions.

Allocation methods and drivers of activity-based costing were systematically investigated by interviewing specialists, by data analysis and by process modelling. Cost and profitability analyses was made by collecting data from the ABC system and handling it in Excel. In order to confirm the results of the analyses the Excel-based simulation model was used to compare the cost structures of the product X.

As a result of this thesis some driver and allocation issues were discovered and their inspection and development were recommended. Based on the findings the development of the system for more automatic systems would prevent monthly manual work in the transfer data from mill systems to the ABC system. These changes would be small in the whole context of the ABC system and the input for that has to be evaluated. Data analyses showed the most effective costs to the total production costs. According to that knowledge the production process can be developed to be more profitable. The final result of this thesis was that the simulation model and ABC returned the total costs for the product X on the same level and no remarkable difference in the costs could be found. The results of the thesis can be utilized in the cost and profitability follow up of the product X, in the product management and decision making.

Keywords: product costing, costing, activity-based costing

Abbreviations

ABC	Activity-Based Costing
ABM	Activity-Based Management
EBITDA	Earnings before Interests, Taxes, Depreciation and Amortization
EBIT	Earnings before Interests, Taxes = operating profit
ERP	Enterprise Resource Planning
SAP R/3	System Application & Products in Data Processing Release 3

Content

1 Introduction

1.1 Background

The aim of a company is to produce products or services in order to add value for a customer. Besides customer value the organization needs to operate effectively and profitably in order to add economic value for owners. For reaching the best possible organizational aim, the management accounting and furthermore cost calculations are needed for the decision making of the company. More closely product cost calculations for an individual product are an essential information source for the basis of the pricing. Correctly calculated production costs benefits the profitable pricing of the product and furthermore the profitability of the whole company. (Pellinen 2003, p.11.)

For my thesis I got a real product cost calculation case concerning Stora Enso's packaging material manufacturing process and business. I work for Stora Enso and wanted to write my thesis inside the company, especially about the area of management accounting. Stora Enso is a global company in the forest industry field. As Stora Enso's product portfolio is wide, it is very important to follow-up the product profitability of an individual product to advance the right management decision making. The product manager in the field of food service packaging materials is the owner of the products and they need to be aware of the cost structures of the products in their area. The cost data is used for the basis of pricing, product mix decisions and reasonable cost structure follow-up.

The topic of this thesis is important to the company as cost calculation methods have to be checked, analyzed and compared in order to get more information for the product manager as well as to develop methods for some new products whose production processes are more complex. Furthermore, the found development actions of calculation processes can be utilized in the development of new businesses.

As this study handles special cases at the certain company only a few earlier studies can be found. Theoretical frames will be constructed from the writings of the general management costing. For the background of the empirical part, the main concepts are explained and handled on a basic level.

1.2 Case company

Stora Enso is a global company in the field of the forest industry and its manufacturing started in the18th century from Sweden (Stora Kopparbergs Bergslag) and from Finland (Enso-Gutzeit Oy). However, roots of the Stora company are as far as in the 13th century in Sweden. Nowadays the head office is situated in Helsinki, Finland. Stora Enso is publicly listed in Helsinki (STEAV, STERV) and Stockholm (STE A, STE R) stock exchange. Some 26 000 employees in more than 30 countries work for Stora Enso. There are 6 700 employees in Finland and 5 100 in Sweden. Sales in 2017 were 10.0 billion EUR, with an operational EBIT of 1 004 million EUR. Europe is an important area as it is the main sales area (74%) and location for personnel (76%). Stora Enso provides renewable solutions in packaging (consumer board (28% of EBIT) and packaging solutions (17% of EBIT)), biomaterials (26%), wood products (11%), paper (13%) and other (5%). (Stora Enso 2018.)

The Consumer Board division offers fiber-based packaging solutions using renewable and recyclable natural materials. The value chain starts from the forest and continues via pulp and paperboard production to converting processes. Food and beverage packaging is an end-use area where the barrier (plastic) coated paperboard is widely used. For example, on the food service market the materials for disposable cups and trays are recyclable plastic coated paperboard. (Stora Enso 2018.)

This research handles cost calculations concerning barrier coated paperboard. Barrier coating is needed in packaging materials to maintain the quality of the packed food. Barrier coated paperboard is produced in two stages. First, paperboard is made in the paperboard machine. Secondly, barrier coating is added to the surface of paperboard in the coating process. The paperboard grades covered in this work are produced in Imatra Mills, Finland. The barrier coating process is realised in Imatra Mills, Finland or in Forshaga Mill, Sweden, Figure 1.

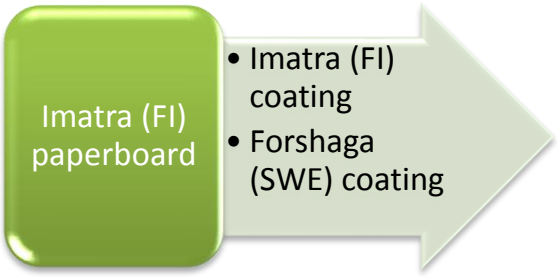

Figure 1. Paperboard production locations concerning the thesis

In Stora Enso, SAP R/3 enterprise resource planning system and different production systems (depending on the mill site) are used for collecting production and cost data: Seitti in Imatra mills and Paperline in Forshaga mill.

The product costs and profitability are reported in the Sting system, which is based on an activity-based approach. In Sting actual costs during a month are assigned to cost objects such as paperboard products, Figure 2.

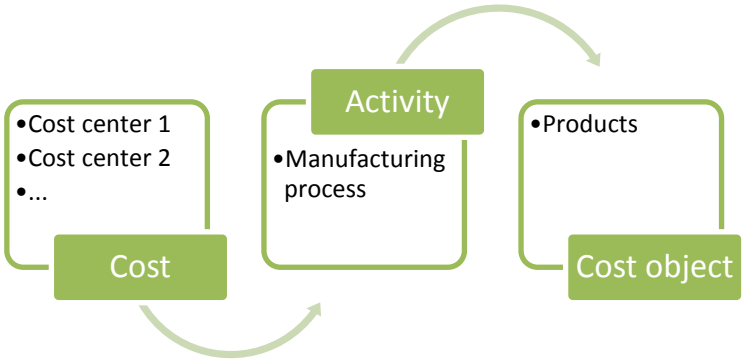

Figure 2. Basics of the Sting product profitability system (Stora Enso internal report 2010)

1.3 Target and limitations

The main topic of the thesis is the cost and profitability analysis of the packaging material product produced in the forest industry, at Stora Enso. Especially, the target of the thesis is to investigate if any or which development actions are needed to the cost and profitability follow up system Sting and/or to data transferred to Sting in order to confirm the valid cost and profitability data for profitability follow-up. Further, more closely the target of the thesis is to clarify real costs (cost analysis) for one special product from year 2016. The origin of the basic cost data, its allocating principles and reporting systems in one manufacturing

case will be systematically clarified. The case is a special new product grade of Forshaga mill as shown in Figure 1 earlier. The product manager needs the analyzed and reliable cost data for a few special products.

Three subtasks have arisen in the pre-study. The first task is to clarify the origin, routes and allocation methods of the cost data transferred from the different mill systems into the profitability data follow-up system, Sting. The second task is to analyze the cost and profitability data found in the Sting system. Finally, the Sting-data is compared to the results from the simulation model of the product cost calculation.

The main research question is

- Which development actions are needed in the cost calculation and profitability system (Sting) in the case of a new special product X?

The other research questions are

- What differences are there in the cost and profitability calculations in two different process cases?
- What is the cost structure and profitability of a new special product X?
- What differences are there between the Sting data and the data from the cost calculation simulation model for the product X?

The purpose of the first question is to find out the need for the development of the cost calculation or allocation methods. The origin of the cost data will be clarified for one chosen special product X. It is assumed that the Sting system is the main follow up system in the company and no new models will be developed. Due to the history the mill data systems are different in Imatra and Forshaga mills and the comparison of the systems clarifies the research in the beginning. In addition, cost allocation methods will be compared to find out possible differences and their effects on product calculation results.

As for profitability the product manager's point of view limits the topic to the product cost calculations and product profitability utilized eg. in product pricing. The cost data of the two mills for the chosen case product X was selected to be under inspection. The product manager has a special interest in the profitability data of

two special barrier products. Both cases are studied, but only one is chosen to be reported in this thesis. This data is compared to the profitability data of more basic products whose cost structure has been known for a longer time period. The Excel-based cost simulation model (mill method) is used to evaluate the Sting system data and their product cost data is compared.

1.4 Research method

The research method for this study is a case study where an empirical inquiry investigates a phenomenon within its real-life context. This approach was chosen for the study since this research focuses on one problem in a specific environment which is one company and the results of the study cannot be generalized to other environments. The case study answers questions ‘how’ and ‘why’ and it is used for surveying, describing and explaining. This case-study is actually a practice-based study where both the observation of situation and development are combined for understanding the research problem. (Laitinen 1998, p. 28.) This research is descriptive and it describes the problem itself and factors affecting it. Descriptive research is typically a case-study when the problem is described in a very detailed way. (Kananen 2014, p. 38.)

At the beginning of this thesis the qualitative method gives results because the emphasis is on the understanding of cost and profitability calculations. In the qualitative method observations and measurements are in natural settings. Thus the research is inductive, starting from practices and moving towards theoretical view. Since unexpected matters are targeted to appear from the material, it is examined multilaterally. In the qualitative method the object of the study is chosen appropriately not randomly. In addition, the research plan might change flexibly during the qualitative research depending on the findings during the process. The research plan, questions and methods can be changed during the research project. (Hirsjärvi 1997, p. 160.)

In the first part of the clarification work the existing written materials were used as well as new materials collected by interviews and observations. To open interviews it will be chosen system and cost calculation specialists from the Stora Enso organization, typically controllers and system specialists. They have the

deepest knowledge in the studied area and the challenge is to get right information via interviews. In the second subtask the data analysis of the cost and profitability data from the Sting system is made and compared to the simulation model data. After this work the development actions are proposed.

1.5 Structure of the study

At first, the introduction gives the basic information about the thesis, and target, limitations, research questions as well as research methods are presented. The beginning of the theoretical part includes the vocabulary terms of the cost calculation and profitability area. Further cost calculation, activity-based costing method and profitability are discussed in order to explain the experimental part of the study, Figure 3.

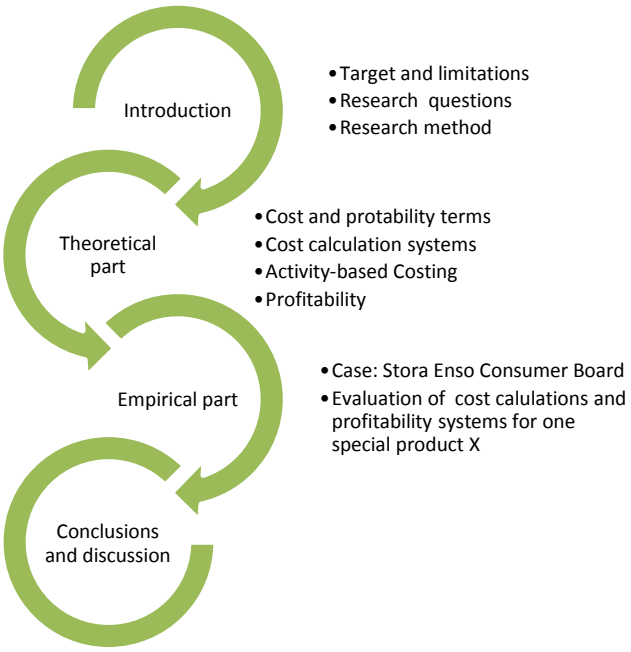

Figure 3. Structure of thesis

2 Management accounting and cost terms

One definition of accounting describes it as the process of identifying, measuring and communicating economic information to permit informed judgments and decisions by users of the information. So, accounting provides information assisting decision-makers of a company to make good decisions and plans according to

objectives of the organization as well as to control activities of the organization. Users of accounting information can be internal parties within the organization and then the function is called management accounting. Whereas sharing the information to external parties outside the organization, it is called financial accounting. (Drury 2004, pp. 5-7.)

Management accounting assists in planning, organizing and controlling of the company. Management accounting contains for example costing, economical steering (eg. budgeting, follow-up), investment calculations and strategic management accounting. Calculations are needed to support in the strategic decision-making for searching for alternatives e.g. pricing of a product or investments. To support the objectives of the company targeted calculations e.g. budgeting is needed. By control and performance calculations the company observes and analyzes its functions compared to plans. Further it compares actual and planned outcomes and responds with corrective actions. (Järvenpää 2010, pp. 20-22.)

2.1 Cost terms

The company management and people in the finance department need to be familiar with the basic cost terms and concepts to talk in the same language and understand each other. The management needs to understand the shared information for the planning, controlling and decision -making. (Morse 1991, p. 27.)

“Cost is the monetary measure of resources expended to attain an objective such as making a good or delivering a service” expresses Kinney (2009, p. 24.)

Drury (2010, p. 30) defines a cost object to be any activity for which a separate measurement of costs is desired. For example, the cost of a product, the cost of operating a particular department or anything for which it is wanted to measure the cost of resources used are cost objects.

Cost terms mainly used are variable and fixed costs as well as direct and indirect costs, which are clarified in the next chapters. The cost term product costs are related to making products that directly generate revenues for an entity. They are recorded as expenses which are matched against sales for calculating profit. They are included in inventory valuation for finished or partly completed goods.

Product cost is also known as product unit cost. Period costs are related to business functions other than production such as selling, distribution and administration. (Kinney 2009, p. 29; Drury 2004, p. 32.)

2.2 Variable and fixed costs

When costs are divided according to their variability on the production amount, they are variable or fixed costs. Total variable costs are directly related to the level of production, in other words costs increase when the production amount increases and accordingly decreases when the production amount decreases, Figure 4. These are typically material, energy and operative labor costs. Total fixed costs remain constant over the change of the production amount. These are typically depreciation of the buildings, supervisors' salaries or interests due to financing. In addition, semi-variable costs are those in which part of the cost is variable and part is fixed, typically electricity or water costs. When total costs are divided by the production amount, they are unit costs. (Järvenpää 2010, p. 55 and Drury 2004, p. 34.)

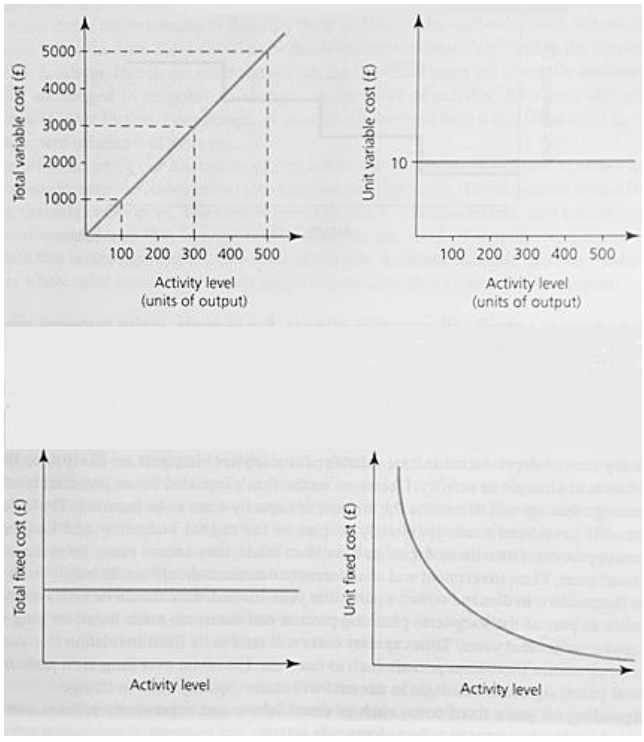

Figure 4. The effect of production level (activity level) on variable and fixed costs, total and unit cost separately (Drury 2004, p. 35)

Further, when the production has high variable costs the effect of the production level on profitability is moderate. In case of low variable costs the production level has a remarkable effect on profitability. (Ikäheimo 2016, p. 125.)

2.3 Direct and indirect costs

Traditional cost accounting systems accumulate product costs as in the table below (Drury 2004, p. 31)

Direct materials	xx
Direct labor	xx
Prime cost	xx
Manufacturing overhead	xx
Total manufacturing cost	xx

Direct costs are specifically and economically traceable directly to the cost objects (a product or service). Raw material costs or operative salaries are typically direct costs. Indirect costs, for example the rent of a factory (especially when many products are manufactured in the same factory), cannot be identified specifically and economically to an individual cost object. However, they are essential costs for the function of the company. (Järvenpää 2010, pp. 58-59.) These costs together are prime costs for a product. In addition, direct expenses, like the cost of hiring a machine for producing a specific product, are included in prime costs. (Drury 2004, p. 31.)

Overhead is any factory or production cost that is indirect for manufacturing a product, thus it does not include direct costs. Overhead costs can be variable or fixed depending on behavior in changes in production volume. For example variable overhead includes the costs of indirect material and indirect labor paid on an hourly basis. Fixed overhead includes for example factory insurance and license fees. Overhead costs include quality costs as an important component. (Kinney 2009, p. 36.)

3 Costing

Costing is the system of the computing cost of the production or of running a business, by allocating expenditure to various stages of the production or to different operations of a firm. (Drury 2004, p. 31.) In the next chapters accounting systems, product costing and especially product costing in the paperboard industry are discussed. Especially results of two Master of Science Theses (Lipsanen and Piili) have been referred in this chapter to increase costing aspect towards the costing in Stora Enso Imatra. This research covers especially the paper industry as well as continues the earlier theses, which makes the theoretical view of this work deeper and use of these references relevant.

3.1 Accounting systems for different production types

“An accounting system is a formal mechanism for gathering, organizing and communicating information about an organization’s activities.” (Bhimani et al. 2012, p. 5.) The accounting system should provide such information that supports the management in the strategic targets of the company. When the strategy changes the accounting system has to change, too, in order to ensure essential and reliable information. So the flexibility of the system is the basis for the system development. (Laitinen 2003, p. 28.)

An accounting system needs to adapt to the manufacturing environment where the company has the production process. There is not only one suitable accounting system for every production process. Therefore, the suitable accounting models are developed for the different nature of operational principles. The length of the production series is the main disjunctive aspect in the separation of different production types to the order based or series based production, product line type (assembly) or continuous production (process). This separation and thus clarification of the manufacturing environment affects significantly in the development and adaptation of the accounting systems. (Fogelholm and Karjalainen 2001, p. 57.)

According to Fogelholm and Karjalainen (2001, p. 66) one accounting model is not enough and different accounting systems are suitable for different manufac-

turing environments. One example is a process industry for example a paper production process. There high direct costs are typical for production and therefore accuracy demand of the accounting system especially concerning material and energy costs is important.

The diverse production process needs a diverse accounting model. If the accounting model is too simple for a more complex process the usefulness and reliability of the model is poor. The complexity should be considered for example when production batches are different, the composition, dimension or production lots of products are different or when the products consume organizational resources in different portions. Typically, the consumption and cost standards based on the earlier actualized material consumption data are utilized in the accounting models. The preferable and exact model standards are based on the actual process data. Thus, indirect costs are assigned accurately to different cost objects. (Fogelholm and Karjalainen 2001, pp. 42-56.)

When the initial data and the accounting model are precise and individual precise information about profitability for decision-making will be obtained. These sophisticated systems are expensive to operate but accordingly they have the low cost of errors. One more difference between the simple and sophisticated accounting systems is the mode of the cost allocation. Naturally, when more accuracy is wanted more careful cause and effect cost allocation is used instead of arbitrary cost allocation. For example activity-based costing has been developed after the diversity in the organizational functions had risen. (Drury 2004, p. 60.)

3.2 Product costing

Product costing is a process in which the manufacturing costs are assigned to inventories as they are converted from raw materials to finished goods. (Morse 1991, 31) Direct costs are allocated straight to the product, but indirect costs need to be directed by using cause an effect cost allocation reliably. From management accounting point of view costs are assigned to the products for internal profit measurement (Drury 2004, p. 59.)

For right and reasonable management decision-making the accuracy of the product costs is important. Then it is possible to separate the products and product

segments that are profitable. Poor product profitability leads to evaluation if more inputs (marketing, pricing decisions, production efficiency improvements) are made or is it reasonable to leave the product out from the production. (Fogelholm and Karjalainen 2001, p. 57.)

3.3 Product costing in the paperboard industry

Requirements for the accounting system in the paperboard industry are high due to complexity of the production process and high number of different end-products. The high accuracy of the accounting models produces information which is useful for profitability follow-up and pricing. Pricing decisions for an individual product are important because it is an opportunity to affect the profitability of individual production runs. The reliable accounting system is needed to ensure competitiveness of the paperboard industry. (Lipsanen 2007, pp. 32-38.)

In the paperboard industry, the cost allocation is made by using production tons or production time. For example, personnel, machine, depreciation and administrative costs can be allocated by using production time. (Lipsanen 2007, p. 39.) According to Piili (2009, p. 43) production time is the most important individual variable which affects the paperboard product cost because fixed costs are allocated based on it.

Lipsanen (2007, p. 89) studied the product costing at Stora Enso Imatra Mills in his master's thesis. At that time the present costing system had not been established. His results showed some individual needs for a cost system by mill management, accounting, production and sales departments. Those needs were among others clearer follow-up for variable costs, reliable product and customer profitability analyses, possibility to react to defects as soon as possible, optimization of product portfolio, possibility to optimization and simplification of budgeting.

Figure 5 shows the general cost structure of the product in the pulp and paper industry. It shows that 40% of costs are coming from materials. The other costs include transportation and storage as the highest cost group (13%).

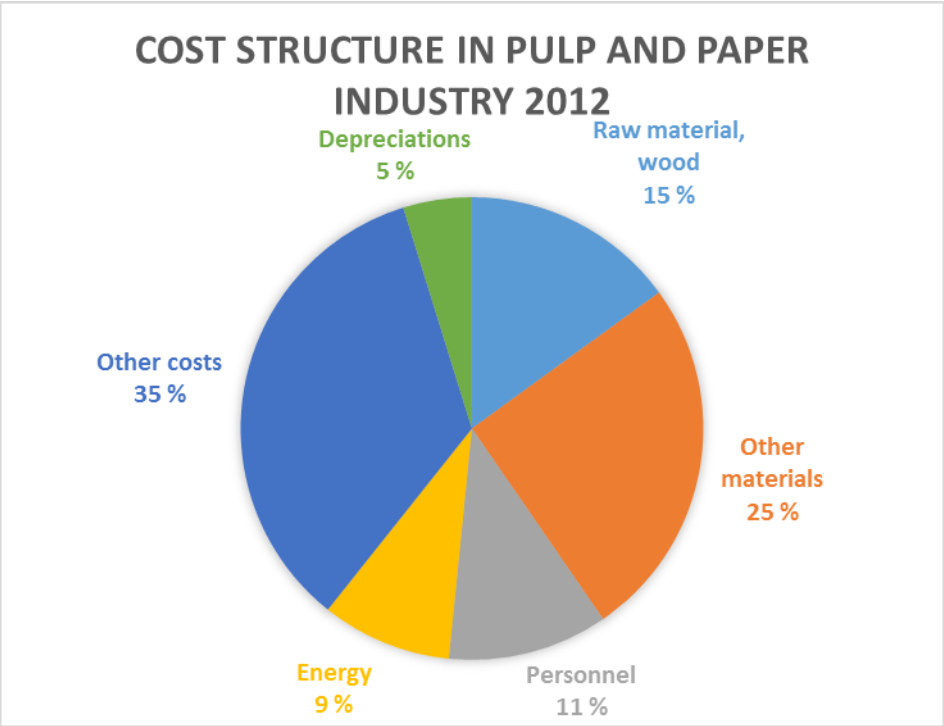

Figure 5. Cost structure in the pulp and paper industry in Finland in 2012 (Metla 2014)

In Figure 6 the pulp and paper mill activities are shown to give the general view of the paperboard making process which is the key process for product cost calculations in this study. The main process functions and support functions affecting individual product costs are indicated in Figure 6. The part process of the whole paperboard production process concerning especially the thesis is converting. Costs of all other part processes are taken from the cost calculation system, and cost allocations of the converting process are investigated more deeply.

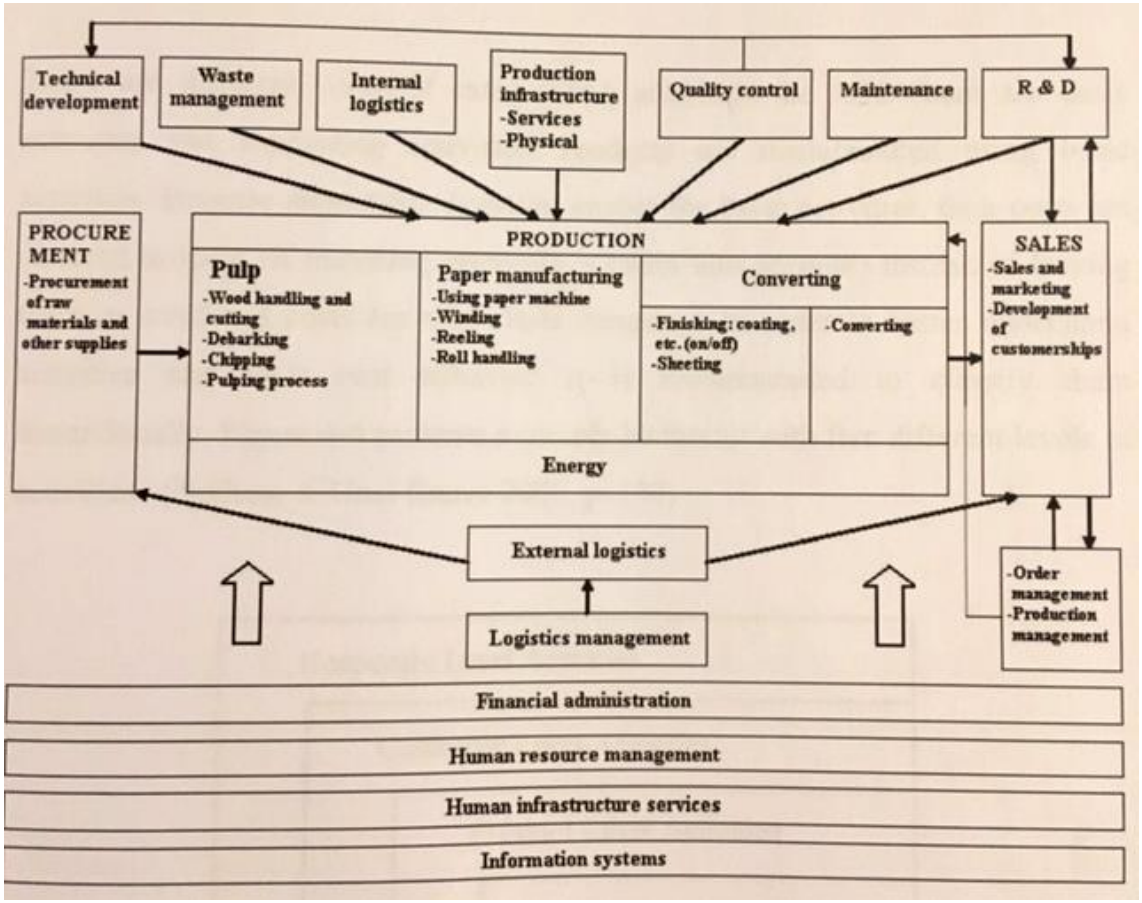

Figure 6. Activities in a pulp and paper mill (Piili 2009, p. 24.)

3.4 Cost allocation

As Drury (210, p. 58) defines “a cost allocation is the process of assigning costs when a direct measure doesn’t exist for the quantity of resources consumed by a particular cost object. The basis used to allocate costs to cost objects is called an allocation base or cost driver.” When the allocation bases are clear and costs can be divided into direct and indirect cost, they can be allocated to cost objects through a cause-and-effect allocation method. For example manufacturing, transport and marketing costs are allocated to the product through a cause and effect allocation method. If the marketing actions of the product are 20% of the total marketing activity, 20% of the total marketing costs are allocated to this particular product. (Järvenpää 2010, p. 61.) Another example from a clear cost driver in the manufacturing process is a production volume, which has an absolute cause-and-effect relationship to a cost. Manufacturing overhead costs are allocated within a period through the use of cost drivers to products. (Kinney 2009, p. 28&37.)

In the activity-based costing (ABC) system the cause and effect allocation method is used for indirect costs. Figure 7 clarifies the assignment of direct and indirect costs. The cost allocation method of this work is the ABC system and the figure clarifies the basic cost allocation for the work. ABC is explained more closely in the next chapter.

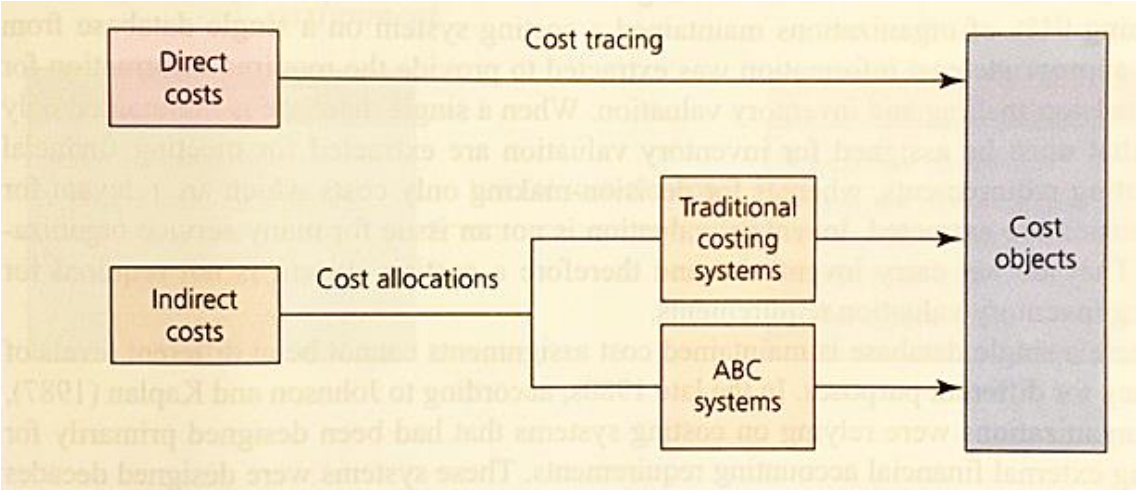

Figure 7. Cost allocations and cost tracing (Drury 2004, p. 59)

If the cause and effect principle can be used accurately, precise and reliable cost information is produced for profitability analysis and decision-making. Sometimes it is not reasonable and economical to allocate all costs precisely. If some costs have been left outside allocation and they are relevant costs, it decreases the quality of decision-making. (Ikäheimo 2016, p. 128.)

3.5 Activity-based costing

Activity-Based Costing (ABC) is a system how to assign indirect costs to cost objects. According to Järvenpää (2010, p. 128) this costing method follows the cause and effect -principle very well in the allocation of overheads. Basically, the company has resources which are used by activities. The focus of ABC is to attach costs to products based on activities conducted to produce, distribute and support products, e.g. research and development, sourcing, marketing, sales etc. Direct costs are allocated straight to products whereas indirect costs are accumulated from different organizational levels into cost pools and further costs are

assigned to products by using multiple cost drivers, Figure 8. At first a cost driver is used to assign costs to activity center cost pools, for example number of machine hours or number of setups. An activity center cost pool is any segment of the production for which the separate cost reporting is wanted. An activity driver measures the demand of activities, i.e. resources consumed by products, for example processing time per unit or number of setup hours. (Kinney 2009, pp. 111-113.)

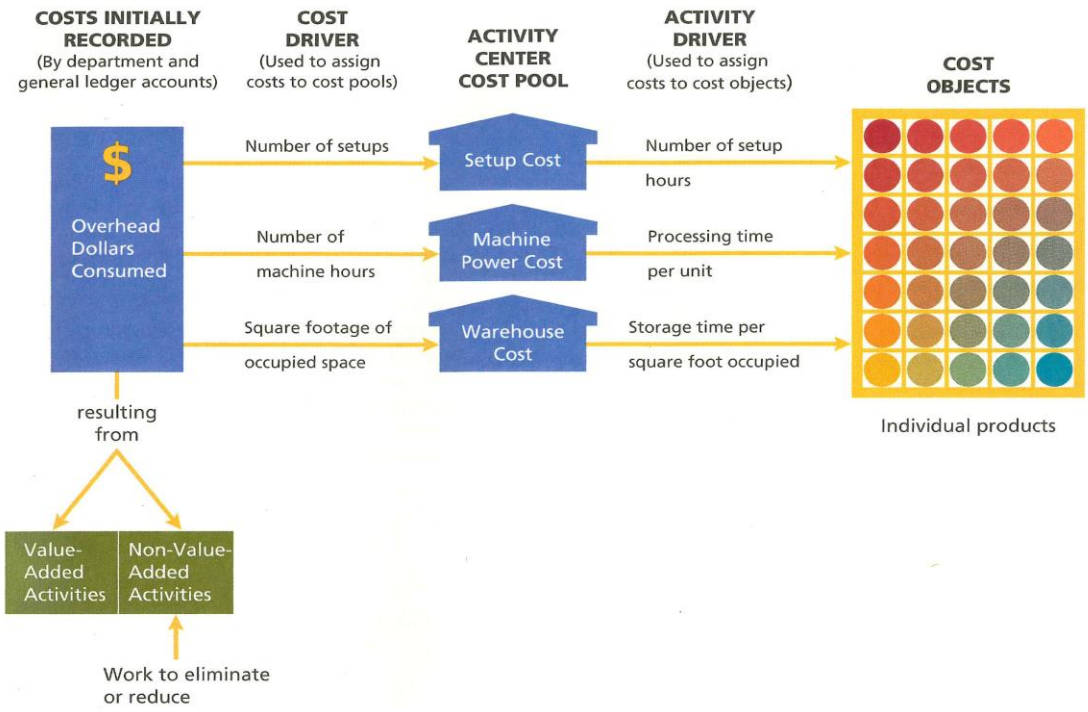

Figure 8. Tracing costs in an activity-based costing system (Kinney 2009, p. 113)

In the ABC -system both volume-based and non-volume based cost drivers are used. The traditional process costing or job-order costing methods use only volume-based cost drivers (units of output, direct labor and machine hours) which means that the consumption of overhead resources is directly related to units produced. Then high volume products get more indirect costs than they have consumed. This generates the distorted result as many non-volume-based cost drivers (for example number of process setups) affect the total cost of the cost

object. The ABC system takes better into consideration the varying of indirect costs in proportion with other changes than volume. This is one important reason for more accurate and reliable cost information generated by ABC compared to traditional methods. (Drury 2004, p. 395 & Järvenpää 2010, pp. 129-131.)

Some products may create more overhead costs than others. This may vary due to wide product variety or product/process complexity. For example some product may need a high-technology machinery or expensive distribution. If only few overhead pools are used, overhead related to specific products will spread over all products resulting higher costs for products that are not responsible for the increased overhead. (Kinney 2009, p. 117.)

Activity-based costing suits well for the organizations where the product variety is wide, there are customized products and/or production is demanding and complex. Thus, when the portion of overheads is high in the organization and it is beneficial to assign them to different cost objects, ABC is beneficial. It is noticed that activity-based costing supports very well for example profitability evaluations and pricing decisions in the company. (Järvenpää 2010, pp. 131-132.)

4 Profitability

4.1 Profitability of the company

It is important to make detailed planning for future operations in the company. Only profitability leads to future activities otherwise it leads to bankruptcy. For continuity of the company its revenues from the selling products or services should be higher than its expenses due to the purchasing of raw materials. So, profitability is the company's ability to get profits. Increasing profitability should be a continuous development action in the organization. (Eklund 2011, p. 63.)

The simplest measure of profitability is the result of the company. An overall result is the result when all costs have been subtracted from revenues. A business result is revenues minus the costs of business (variable and fixed costs and depreciations, no interests and taxes). EBITDA (earnings before interests, taxes, de-

preciation and amortization) express the result without interests, taxes, depreciation and amortization, thus revenues minus variable and fixed costs. EBIT is the same as operating profit, earnings before interest and taxes. (Eklund 2011, p. 64.)

The cost calculation data is needed in order to follow-up profitability of the production. After data acquisition decisions are needed in the company. The next four points show possibilities to increase profitability by increasing revenues (Eklund 2011, pp. 70-75)

1. increasing the quantity of sold products (e.g. enhanced marketing and segmentation)
    - increasing revenues have to be higher than enhanced marketing costs
    - decreasing prices: increasing revenues due to higher quantity of sold products have to be higher than lost revenues due to decreased prices
2. increasing prices of products
    - if quantity of sold products remains
3. decreasing both variable and fixed costs
    - re-engineering of the business processes
4. changing product mix
    - finish the production of the non-profitable products

4.2 Product and customer profitability

Product profitability is one of the basic elements of the profitability of the whole company. For decision-making concerning product selection (product portfolio) or product pricing, well calculated and analyzed cost information is needed. Accordingly, in customer segmentation and taking care of customer relationship, customer profitability is essential information for the development of operations. Reliable and analyzed cost data and behavior of costs improve possibilities to continuous development plans and actions. Right costs for a product are calculated if the calculation system has been developed to meet the company's de-

mands. In addition, carefully used cause and effect allocation to a product, accrual and assessment handling affect the accuracy of cost data. (Järvenpää 2010, p. 148.)

For improving the long-term profitability of the company, product, product group and/or customer profitability have to be monitored and decisions concerning unprofitable products have to be made. According to precise cost data the investments in and marketing actions to the most profitable products are possible. (Fogelholm & Karjalainen 2001, p. 43.) The pricing decision is influenced by the cost of the product and therefore well prepared cost information is important for the right and reasonable pricing as well. (Drury 2004, p. 411.)

5 Product costing, case: Product X Stora Enso Oyj

In the next chapters the empirical part of the thesis is discussed. The main task of the empirical research was the cost and profitability calculations of the packaging material product X produced at Stora Enso Forshaga mill. Before that process the material has had the converting phase where the base paperboard material was produced at Imatra mills and further transported to Forshaga mill in Sweden.

The product manager needs the cost and profitability data in their daily work for follow-up, product portfolio management, decision making and price advising for sales. That was the main reason for investigating product costing for the chosen new product X.

The target of the thesis was particularly to investigate if any or which development actions are needed to the cost and profitability follow up-system Sting. In addition, actions needed for data transferred to Sting in order to confirm the valid cost and profitability data for the profitability follow-up of the product X. The cost and profitability analysis in year 2016 for the product X were examined and the data was compared with the data calculated with the simulation model used normally by the mill. The empirical part was started by composing the product cost modelling images for the paperboard and barrier coating manufacturing processes.

Because this study is the case study for the private company, the exact results cannot be shown in this thesis. The results in this empirical part are partly coded and partly left out. However, the main conclusions have been presented.

5.1 Systems in calculations

This chapter presents the data systems of Stora Enso, i.e. how data is collected and transferred for the product calculations.

The SAP R/3 system (Application & Products in Data Prosessing Release 3) is an enterprise resource planning (ERP) system in whole global Stora Enso. It is used in every mill and different modules of the program are in use locally. Typically all units use SAP, e.g. in handling of accounts payable, allocating costs for cost centers, managing of inventory and capital assets, payroll and a part of the management accounting. For the product cost calculations costs are taken from the SAP system. Also, product recipes used in costing are administrated in SAP Workflow.

Different production systems depending on the mill site are used for collecting production data, e.g. production time and produced amount: Seitti in Imatra mills and Paperline in Forshaga mill.

Fenix is the sales system which contains e.g. product prices and revenues needed for profitability evaluations.

Product costs and profitability are calculated with the ABM tool by Norwegian company SAS and reported in the Sting system. ABM (activity-based management) is based on the activity-based approach of costing. Sting is a reporting tool used in the mode of Excel Pivot table. In Sting actual costs during the month are assigned at first to activities and then to the cost objects such as paperboard products, Figure 9. Data is transferred monthly from SAP (contains cost centers), Fenix and mill production systems. Calculations are cost accountings afterwards and there is a possibility to follow-up costs and profitability on a monthly, quarterly or yearly basis for example for individual products, product groups, customers, business segments or mills. The management of the company gets the cost reports from Sting.

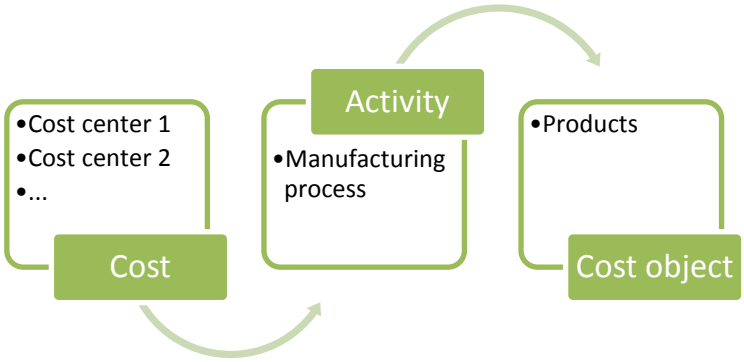

Figure 9. Basic of Sting product profitability system (Stora Enso internal report 2010)

The Excel-based simulation model for the comparison of the Sting-based product cost calculation was used. The simulation model was used to compare and evaluate the reliability of the product cost structure got from Sting. It is the mill method and typically used to evaluate product costs for a new product. It calculates variable and fixed costs (containing depreciations). The model contains the basic data values like raw material amounts and prices, production amount, production time, set-up time etc. The basic actual production data (production time and amounts) for simulation was obtained from Forhaga's mill system Paperline.

6 Cost analysis

This main chapter of the empirical part explains the costing for the product X. The research design and data collection methods are presented together with the results of process modelling, data analysis and data comparison.

The empirical study explains research design, shows the process model of Sting activity-based costing as well as the results of the cost and profitability analysis and finally expresses the comparison of cost calculation between the Excel-based simulation model and Sting values. At the end of the study, conclusions and further actions are presented.

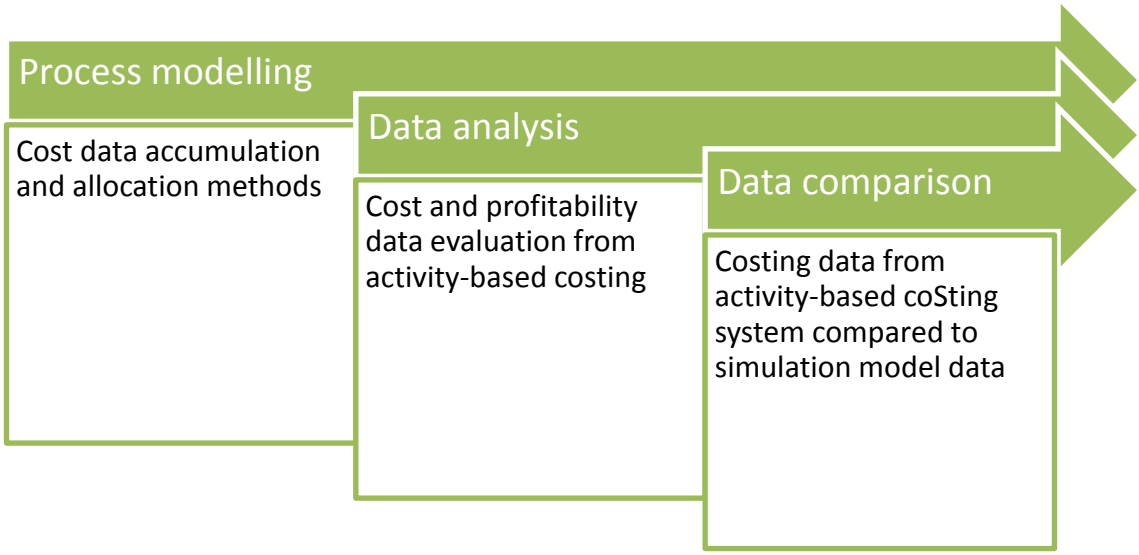

Figure 10. Components of research design

In the pre-study three subtasks for this study arose, Figure 10. The first task was to clarify the origin, routes and allocation methods of the cost data from the different mill systems into the profitability data follow-up system, Sting. The second task was to analyze the cost and profitability data composed in the Sting system. Finally, the Sting data was compared to the results from the simulation model of the product cost calculation.

As it was shown in the Introduction chapter in Figure 1 (Page 8) the cost calculation and profitability models were studied for one special product manufactured in two stages. At first the paperboard is manufactured in Imatra mills in Finland and the extrusion coating (converting) is made in Forshaga mill, in Sweden. And like Figure 6 (Page 19) shows the pulp manufacturing is the first operation before the paperboard manufacturing in the whole process of the paperboard manufacturing value chain. All these three main stages are included in the cost calculations.

As the result of the study the evaluation of the development actions needed in the cost allocation methods is discovered. In addition, the product cost and product profitability calculations and their structures are presented. The comparison of the product costing to the simulation model costing shows the evaluation of Sting data reliability.

6.1 Data collection

Data for this study was collected by open interviews, document analysis, process modelling and data analyses.

Firstly, in data collection open interviews of specialists in Stora Enso were conducted both in order to get the general view of the study's field and to reveal details in the product costing. Open interviews were given in different meetings, on the phone and by e-mail to both specialists and controllers in Imatra, Finland and in Forshaga in Sweden. The first introductory meeting was held at Forshaga mill in October 2016. The target of the meeting was to introduce the topic, the background and the target of the work for production manager, controllers and production supporter of the mill working with manufacturing, cost calculations and reporting of the special chosen product X.

An open interview according to the beforehand prepared framework was held with the Sting system application specialist in October 2016. Further questions for him were asked by e-mail and on the phone. Other interviews were conducted by e-mail in order to get the data in a written form as it was easier to prepare the structured questions, evaluate answers carefully and ask further questions based on the earlier answers. These questions were sent to mill controllers to Forshaga mill, Sweden and to Imatra mills, Finland, as well as to the production supporter in Forshaga mill. They answered to the questions by e-mail or by phone.

The document analysis concentrated on the internal documents (internal Power Point presentations and other internal documents as well as previous e-mails) concerning activity-based costing and the Sting system.

Secondly, for searching development actions to cost allocation methods in the Sting system the process model of cost assigning was constructed and two different mill practices (Imatra and Forshaga) were compared. The target of the comparison was to reveal possible differences in cost assigning in order to find possible development actions for drivers or practices.

The Sting cost and profitability evaluation system is a data system utilizing Pivot tables in the Microsoft Excel program. The basic data is coming monthly to Sting

from the SAP R/3 enterprise resource planning program and different mill systems. Data is prepared by mill controls and typically transferred automatically between systems. If any changes in transferred data are needed the mill controller and system application specialist together make the changes manually.

Cost and profitability data for an individual product was taken by utilizing the logic used in the Excel Pivot table. Choosing right attributes for the wanted product under inspection should be done carefully, as there are a certain logic in the system and very many options from where to choose attributes. Costs were taken out in the unit eur/ton monthly, quarterly or yearly basis.

Finally, a simulation model was utilized in the data handling. It is a tailor made Excel-based model for the evaluation of product costs especially for a new product which is planned to manufacture at Forshaga mill. The simulation model contains much data which can be accurately gathered for an individual chosen product, Table 1. However, it contains also some rougher values which are known and calculated based on the long experience. Values for the modelling were received from the Paperline mill production system and mill production support person. The calculation is Excel-based and the product calculation is compared with the Sting data with the chosen special product X.

Costs gathered for a product	**Properties and costs known**
Raw material cost /ton	Raw material waste-%
Raw material consumption/ton	Machine efficiency-%
Packaging material	Fixed costs euros/hour
Electricity	
Production time	

Table 1. The main variables in the simulation model

6.2 Process modelling

The process model of the product costing was created in order to show how costs and revenues are handled as well as which drivers are affecting the cost allocations in Imatra compared to Forshaga. The next step was to gather the data from specialists for the evaluation of cost allocation methods for the product X.

According to the process modelling the main data sources for product calculations (cost and profit) and the main activities and cost allocation methods according to the activity-based approach were presented. The cost object is a product which is a paperboard grade in the paperboard manufacturing model and a paperboard grade with one barrier coating grade in the coating process.

Costs are accumulated in SAP to cost and profit centers. Revenues are accumulated in the Fenix sales system. Production data comes from the mill systems. According to the ABC method costs are assigned to the cost groups using different drivers. Further, the raw material cost assigned to the products is made according to the product recipe (in SAP), which expresses which raw materials and how much they are used in the production.

As for the barrier coating process of the special product X; all raw material costs of the particular barrier coating (polymer) grade are accumulated to the groups in SAP according to the special SAP numbers. Then the barrier coating cost is assigned to the particular end product by using drivers.

The main difference between drivers used for production data from Imatra and Forshaga is that it is possible to take the detailed driver data for an individual product from the mill system Seitti in Imatra whereas in Forshaga the driver is different.

6.3 Factors affecting cost and profitability data in Sting

The main task of this work was to evaluate which development actions are needed in the data handling and transferring from the mill systems and SAP to the cost calculation and profitability system (Sting) in the case of one new special product X. In this chapter the main issues are handled.

Costs and profitability data is monitored and reported in the Sting ABC-based system because it includes all fixed and variable costs as well as revenues through whole production and value chain assigned to products or customers according different drivers. Data has been already handled into the form that management and decision makers can easily compare, e.g. product profitability in different time periods. In Sting cost cube it is possible to take only production

costs where inventory does not affect. Cost data comes from cost centers of SAP, recipes from SAP or an external file prepared by a controller and sales from Fenix.

Fixed costs and depreciations

The first target of this thesis was to evaluate cost assigning methods especially related to the fixed costs and depreciations of Forshaga production. In addition the comparison to the Imatra mills was made. Imatra mills and Forshaga mill are using different driver for assigning fixed costs and depreciations to a product. By interviewing specialists it was discovered that the difference in the mill data systems between Imatra mills and Forshaga mill is affecting the handling of the data before it is transferred monthly to the Sting system. It includes typically some manual work and also the controller needs to be very careful with the product codes in the transfer files so that the information is transferred correctly. That is careful work as there are many different products produced monthly and especially yearly. In addition there are special product codes randomly used for different trial products. So, the human mistakes are possible.

The corrective action for assigning fixed costs and depreciations for a product more reliably is that Forshaga mill investigates if they could take the actual production time into use in Sting. The investigation how to minimize the manual work would be valuable as well in order to prevent human mistakes and hard precise work within a monthly period break that is time consuming. This needs a larger process optimization. According to the literature these types of problems concerning measurement accuracy are typical in the ABC costing method. In addition, the pros and cons evaluation might be worth making, i.e. how precisely the costs are presented and how much effort would be used (Järvenpää 2010, p. 128.)

Grade change times are included in the run time. According to the matching principle the product gets its own grade change time (fixed) costs. According to the activity-based costing principle: the slower produced product gets more costs in relation to the product which is produced with higher speed due to the principle how much machine capacity is used by the product. This has not very strong

effect on the total costs as the share of Forshaga fixed costs in the total cost structure of the product X is quite low whereas the material costs dominate. However, basically the fixed cost should be allocated with the production time as a driver, which results more reasonable fixed cost values.

Raw materials and waste / assigning

For one month the consumption of the polymer A raw material is accumulated according to the original group in SAP and further the whole consumption has been split according to the product recipes. However, the cost of polymer A waste is split proportionally on every product using the same polymer A. The product with actual low waste in the production might get higher material costs in the end. In the short production run as the waste is split on only a small volume, the cost/ton for polymer A becomes high, which makes the actual usage of raw material/ton much higher compared with the usage in the recipe.

When having a web break on the machine not related to the product being produced, the product gets extra costs. This can be manually corrected, but taking working time and manual corrections can lead to errors.

These problems are known and are typically based on the ABC costing method. It has to be evaluated what the reasonable time to use for manual corrections or system development is in order to get as exact results as possible. In relation to raw material costs the precision of the allocation is important because the share of raw material costs is high.

Raw materials and accrual handling / periorization

Monthly transferred data for Sting calculations can be affected by the change of a period. When the cost of the raw material is not reported in the same month as the finished product there will be higher production cost / ton in that month for a product. So it leads to the fact that manufacturing costs in the Sting system might be changing in monthly observation. It is agreed that longer period observations are preferred and no reasonable corrective actions are needed for this problem.

6.4 Cost and profitability analysis

The product Manager needs the cost and profitability data in their daily work for follow-up, product portfolio management, decision making and price advising for sales. Cost and profitability data was analyzed in this work on the basis of Sting data for a product X. Excel Pivot property was used and the costs and profitability from the different viewpoints of the production (total manufacturing chain or only Forshaga production) or different time periods (quarterly in year 2016 and the whole year 2016) were collected.

So, the effect of different manufacturing processes (pulp making, paperboard production and converting process in Forshaga) on costs were clarified. The converting process has the big share in the costs. More detailed the raw material costs dominate the product X. Like Figure 5 in page 18 generally shows, in the cost structure of the paper industry, raw materials dominate. More closely the raw material costs can be split so that polymer A material costs dominate the raw material costs of the product X, Figure 11. In the figure the periorization difference when costs were not evenly split in two consecutive months (the third and forth from the left) can be seen. This was discussed in the previous chapter. So, the illustration should be preferably presented in the larger timeline.

Figures of profitability analyses are not shown and commented because of the sensitivity of the company's information.

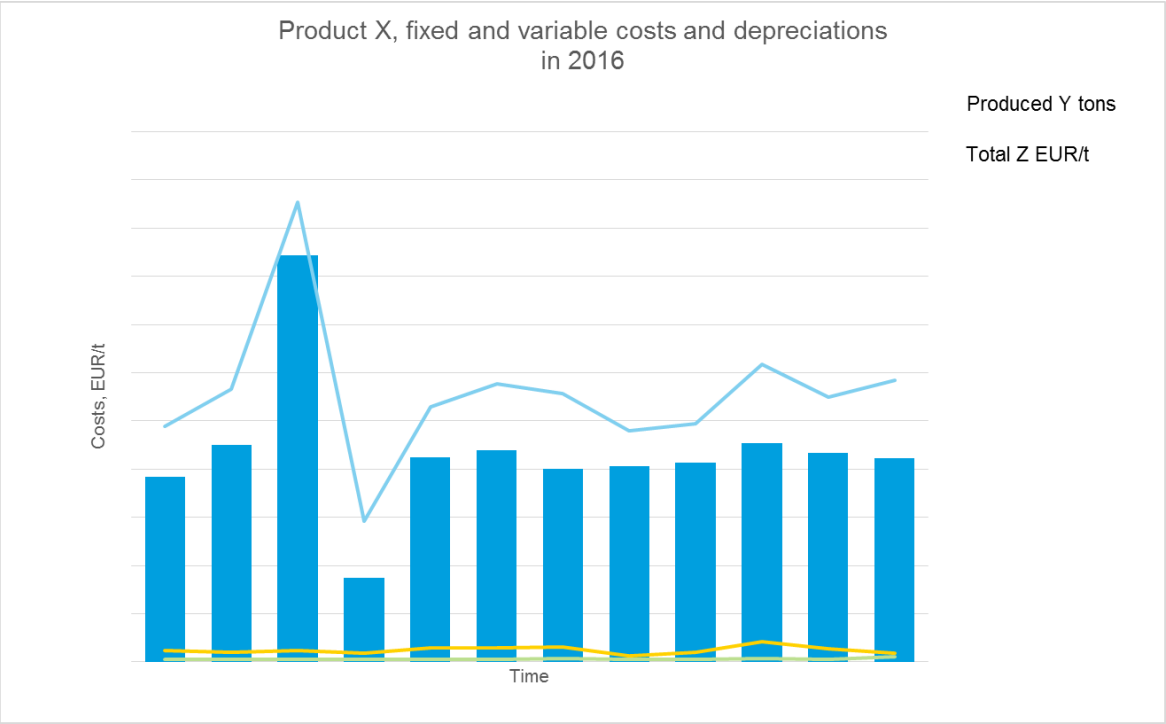

Figure 11. Costs of a product X

The pictures of the next data analyses were composed in this thesis for the company's internal use:

Production costs

- the cost structure of the selected extrusion coated special products (the share of variable and fixed costs)
- the share of pulp and board manufacturing and extrusion coating processes
- the effect of different product grammages of the same product
- the cost development during four previous years
- changes in fixed costs during year 2016
- the cost structure between Imatra (paperboard manufacturing) and Forshaga (extrusion coating process)
- the comparison of the cost structure of the selected product X to more basic product grade

Profitability

- which activities are affecting profitability (EBITA) and how much
- profitability development during four previous years
- the effect of different product grammages of the same product

One of the main results from the cost analyses was the realization of the share of raw material costs in the extrusion coating process in Forshaga and further the importance of the raw material efficiency in the production as well as the well negotiated raw material purchase prices.

6.5 Cost comparison between the activity-based system and simulation model

The Excel-based simulation model was used to make sure and compare the costs for product X presented in the Sting system. The actual converting production times and amounts got from the mill system Paperline were used, which gave the clear reliability to the simulation. In addition raw material prices are precisely known together with the used actual raw material grammages (including the waste).

As the result of the simulation the diagrammes presented in Figure 12 were drawn.

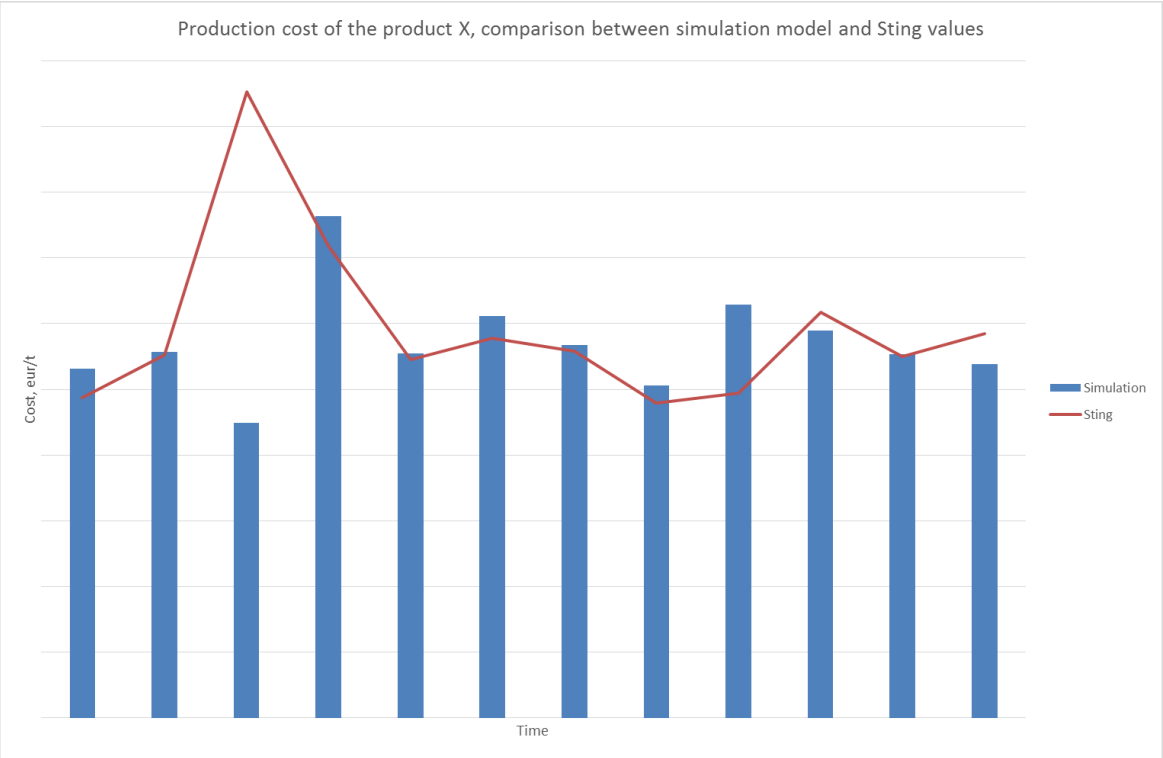

Figure 12. The comparison of costs for the product X calculated by the ABC-based method and simulation model

The comparison of Sting cost values and values from the simulation model showed only 1-9% difference monthly in the total costs. Thus the reliability of the Sting costs was shown to be on the same level as that from the simulation. These two methods had different allocation methods for fixed costs and finally the total costs showed the same acceptable cost level. For the company's internal use more detailed cost comparison was made, too. These results showed also acceptable comparison results and gave good confirmation information for the cost structure of the product X.

7 Conclusions

For the right and reasonable decision making of the management e.g. product pricing, product portfolio etc. the correct mill, product group and product cost information is very important to follow-up.

In the thesis the main research question was: Which development actions are needed in the ABC-based cost calculation and profitability system (Sting) in the case of one new special product X in Stora Enso Consumer Board. According to the research, firstly, it is reasonable to continue the development actions with the existing Sting system and not to develop any other 'side systems' for the costing of the product X.

The further development action in the cost assigning for the product X is the usage of time as a driver allocating fixed costs. It is affecting strongly the validity of fixed cost data and further the total costs structure of the product.

During the study it was also decided together with the product management and controlling that only longer period (at least quarterly or preferably yearly) cost data will be followed up. This is due to the accruals during the monthly breaks and data transferred to the costing system.

There is some manual work, monthly follow-ups and updates during the costing process. Manual work may lead to mistakes easier than the developed systems. However, the monthly transferred data and the Sting system itself are under the evaluation and development actions all the time and corrections are made continuously when noticed. It is typical for the ABC system that by the continuous system tuning it is possible to obtain more accurate costing results.

The second research question was: What is the cost structure and profitability of the new special product X. As a result of cost analyses it was found out that raw material costs dominated. Further, the cost structure can be affected by barrier coating production efficiency and well managed raw material pricing negotiations.

The third research question was: What differences are there between the Sting data and the data from the cost calculation simulation model. It was possible to conclude that there were only small variation between total costs of the product X when calculated with two different methods. That result proved the total polymer coating costs to be on the right level in the ABC system.

As an overall result of the work more information for the utilization by product management and barrier coating production development was collected and analyzed. Furthermore, the found development actions of calculation processes can be utilized in the development of new businesses.

The reliability of the study was affected by many aspects. The first issue was choosing right system specialists or controllers from the large organization to interviews so that the best possible information was collected. Secondly, the most important factor was that I as a researcher has understood the problem, made right questions and understood answers correctly and made relevant additional questions in order to get solution description that was wide enough.

In the second subtask the results collected and calculated from the Sting system are possible to contain systematic errors (wrong costs) or by mistake wrong costs not belonging to the particular product. The system was an Excel-based Pivot table, where activities, products etc. whose costs were included in the calculations were manually chosen. In manual work it is possible to make many mistakes.

The third subtask contained the comparison between costs calculated with the Excel-based simulation model (mill method) and Sting costing. The original data for the simulation was got from the mill system and it is reliable. However, the constant values in the calculation model may contain some evaluation mistakes.

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