

Jani Korhonen

**DEFINING DESIRABLE CHARACTER-
ISTICS FOR PRODUCTS TO INCLUDE IN
SHOULD-COST ANALYSIS AND ITS
BENEFITS FOR CASE COMPANY**

Qualitative Research on Benefits of Should-cost
Analysis for Industrial Company

Master of Science Thesis
Faculty of Management and Business
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April 2024

ABSTRACT

Jani Korhonen: Defining desirable characteristics for products to include in Should-cost Analysis and its benefits for case company: Qualitative Research on Benefits of Should-cost Analysis for Industrial Company
Master of Science Thesis
Tampere University
Master's Degree Programme in Industrial Engineering and Management
April 2024

This thesis is aiming to find answers on what are the benefits of Should-cost Analysis (SCA) and what would be the desirable set of characteristics for purchased products that would determine the products to be included in the SCA process in the case company.

Literature review for this research is selected to be serving the understanding related to purchasing related decision making and cost estimation by introducing sourcing strategic decision making and cost estimating techniques. Those are then tied to the case company's goals for the SCA implementation as a summary prior to the empirical section. Actual data is collected from interviewees that are having different views on procurement based on their work experience and current role in the case company.

Case company's procurement professionals believe to the potential of SCA on making procurement processes more efficient. Those benefits include better negotiation power in price negotiations, cost savings through increased understanding of the costs of a product, and overall competence increase related to procurement professionals increased understanding on product cost structure. When comparing these findings from interviews to the literature, it is evident that SCA deployment has great potential to increase company's cost efficiency related to product costs from the implementation of SCA process.

Most desirable products for the SCA implementation in the case company are the products that it has Intellectual Property Rights (IPR) to. Simple design was mentioned in the interviews constantly, when defining desirability of products to be chosen to SCA process. According to interviews, mechanical and machined components are examples of those products. Also, high costs and high value of the product was one key driver that would make SCA implementation possibly successful according to the interview results.

Suggestion for first steps based on this research is that case company should implement SCA in two different scopes: first scope (short-term) for products that have already identified issues in their cost structure and the second scope (long-term, immediately) is for more broader implementation of SCA. During the first phase for first scope implementation, planning and conceiving of the second phase should be conducted. Process for implementing SCA supporting daily operation of purchasing and sourcing departments should be developed and opportunities for SCA, for product and process efficiency improvements, should be studied in broader scope. Also, case company should study the possibility of screening products regularly (every 6 months for example) to keep updated for changing prices and situations in the supply market.

Keywords: Should-cost Analysis, cost estimation, cost modelling, cooperative cost reduction, interorganizational cost management

The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

TIIVISTELMÄ

Jani Korhonen: Toivottavien ominaisuuksien määrittäminen tuotteille, joille käyttöön otetaan Should-cost Analyysi menetelmä sekä sen hyödyt case-yrityksessä: Laadullinen tutkimus Should-cost Analyysin hyödyistä teollisessa yrityksessä
Diplomityö
Tampereen yliopisto
Tuotantotalouden diplomi-insinöörin tutkinto-ohjelma
Huhtikuu 2024

Tämän diplomityön tavoitteena on löytää Should-cost Analyysin (SCA) hyödyt tilaajayritykselle sekä sen ostoportfolion tuotteille ominaisuuksia, jotka tekevät SCA:n niihin soveltamisesta haluttavaa.

Työn kirjallisuuskatsaus on rakennettu palvelemaan ostettavien tuotteiden hankintaan sekä niiden kustannusten arviointiin liittyvää ymmärrystä esittelemällä hankinnan strategiseen päätöksentekoon liittyvää teoriaa sekä kustannusten arviointimenetelmiä. Nämä kokonaisuudet on myös sidottu tilaajayrityksen tavoitteisiin liittyen SCA:n käyttöönottoon yrityksen hankinnassa. Varsinainen data kerätään haastattelujen kautta eri tilaajayrityksessä työskenteleviltä henkilöiltä, joilla on näkemystä ja työkokemusta hankintaan liittyvistä tehtävistä.

Tilaajayrityksen hankinnan ammattilaisilla on haastattelujen perusteella luotto SCA:n potentiaaliin hankinnan prosessien kehittämisessä tehokkaammiksi. Neuvotteluvoiman kasvu hintaneuvotteluissa toimittajien kanssa, kustannussäästöpotentiaalin huomaaminen kustannustietoisuuden lisääntymisen kautta, sekä yleinen ymmärrys tuotteiden kustannuksiin liittyen niiden kustannusrakenteen läpinäkyvyyden parantumisen kautta nähtiin merkittävinä hyötyinä, joita SCA voi tuoda tilaajayrityksen hankintaprosesseihin. Kun näitä haastateltavien mainitsemia hyötyjä verrataan kirjallisuudessa esiintyvään kustannusten arvioinnin hyötyihin, on mahdollista uskoa, että SCA:lla on mahdollista parantaa yrityksen kustannustehokkuutta tuotekustannuksiin liittyen.

Suotuisimpina tuotteina SCA:n implementoinnissa haastateltavat näkivät tuotteet, joihin yrityksellä on immateriaalioikeudet. Yksinkertainen tuoterakenne ja ominaisuudet nähtiin myös yhtenä SCA:n soveltamista helpottavana tekijänä. Näihin tuotteisiin lukeutuvat haastattelujen perusteella mekaaniset ja koneistetut, kohtuullisen pienikokoiset tuotteet, joihin liittyy jo tunnistettuja kustannushaasteita. Myös korkeat kustannukset ja tuotteen korkea arvo olivat tuotteeseen liittyviä tekijöitä, jotka haastateltavien mukaan nostavat SCA:n soveltamisen haluttavuutta.

Seuraavat askeleet kohti SCA:n käyttöönottoa voidaan jakaa kahteen eri aikahorisonttiin tilaajayrityksen tapauksessa: lyhyen aikahorisontin (välittömästi) SCA:n soveltaminen suositellaan aloitettavaksi tuotteille, joilla on jo tunnistettuja haasteita kustannusrakenteissa sekä niiden design on yksinkertainen; yhtäaikaaisesti lyhyen kanssa suunnitelma ja konsepti SCA:n käyttöönotolle laajemmalla tuoteskaalalla sen päivittäistä hyödyntämistä ajatellen. Laajempaa SCA:n käyttöönottoa varten yrityksen tulisi suunnitella SCA:n hyödyntämistä tasaisin väliajoin (esimerkiksi kuuden kuukauden välein), jotta markkinoilla tapahtuvat hinnannuutokset voidaan havaita ajoissa.

Avainsanat: Should-cost Analyysi, kustannusten arviointi, kustannusten mallintaminen, yhteinen kustannusten pienentäminen, organisaatioiden välinen kustannusten hallinta

Tämän julkaisun alkuperäisyys on tarkastettu Turnitin OriginalityCheck –ohjelmalla.

PREFACE

With completing this thesis one era comes to an end for me. First, learning new things around cost estimation and SCA was interesting journey, and I had many insightful conversations with people that have huge amount of knowledge on doing business in global markets. And then secondly, when reflecting the whole journey called studying, it has given keys to me to pursue my aspirations workwise, without forgetting the broad network of likeminded people. All the sweating in the library or at home with the study appointments have not gone to waste.

Now it is time to thank everyone involved on making this thesis possible, it would have not been possible without the support of my direct manager as well as the support of the head of the SCA at the case company. Results would not have emerged to the paper without the inputs from the interviewees and of course the form of this thesis would not be this structured without the valuable support from Tuomas Korhonen and Leo Mulari from Tampere University. Also, the push and support at home during difficult times made this possible.

Tampere, 27.4.2024

Jani Korhonen

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1. INTRODUCTION

During the last three to four years people's lives have been facing major difficulties caused by different international health and geopolitical crises. That has had an affection also to businesses by the weakened availability of materials, increased costs and general uncertainty floating over different industries. For businesses these crises have been adding pressure towards several different kind of functions and procurement has been one of those functions. For example Knight et al. (2022) stated point brought up by Carney and Mazzucato that was related on procurement and business functions shift from economical thinking towards focus on value. They (Knight et al., 2022) said business as usual is not going to be efficient in the future anymore. This health crisis (Covid-19) revealed the systematic issues that had been lying under the radar before and for example the availability issues on semiconductors has been one initiator to the need of change (Knight et al., 2022). The Ukrainian crisis started at 2022 and has highlighted these issues and the demand for a change is increasing. These crises have been affecting to the case company too and it has been resulting in a need for updating its processes to secure the availability of supplies with acceptable pricing. For the context of this research, there lies a need for development of procurement processes in the case company, that will manage the costs of supplies in more standardized manner and securing the availability of supplies in collaboration with suppliers. One part of the process improvement and knowing the costs of supplies is Should-cost Analysis (SCA).

1.1 Background And Should-cost Analysis Introduction

Procurement professionals are constantly trying to find new ways for securing the supply of purchased materials with the focus on the availability and pricing of those materials. In the case company procurement role is to be a part of securing the production flow by making sure that materials purchased from the suppliers are in the production line when needed and with acceptable costs. The case company is a multinational, publicly listed industrial machinery producer that has a global presence. It offers products that are produced in-house as Configure-to-Order (CTO) and Engineer-to-Order (ETO) products. Therefore, every product is produced based on actual customer needs.

The goals in procurement scope are to find cost reductions throughout supply chain and to make the supply chain processes to function as efficiently and optimized as possible.

It is done by continuous process development and standardization throughout the organization. In the case company development of procurement processes and strategic & operational procurement are divided to its own functions, which means that dedicated team is nominated to maintain the processes centrally and operations are managed by teams nominated to each business line separately.

At this point is going to be introduced the term Should-cost Analysis (SCA). It has been reported to be used already in 1970's for the purposes of USA military and this military report (US Army, 1972) also states that SCA has been in successful use in a nation-wide consumer goods chain. It was taken in use when there was public criticism around increased costs in military operations and was aimed to reduce those costs by having a new approach on cost estimation. Identifying of uneconomical and inefficient practices and processes was the goal for SCA. This is made possible by professionals that are going to review and analyse the costs of contractor's or supplier's "...engineering and manufacturing operations, accounting procedures, cost estimating systems, purchasing procedures, make-or-buy decisions, organizational structure, and any other elements of cost and management control required for contract performance". (US Army, 1972, pp. 715–7) Hiller (2012) agrees US Army report with the aim of SCA and agrees that while SCA is a cost estimation tool, its purpose is not to produce accurate prices for products but a price range, best estimate and more sophisticated arguments for price negotiations with suppliers.

In practice the process could be described as a digital twin to the production process of the selected product. This way it would be possible to make righteous estimates for the costs of the product and increase transparency between different functions that are involved in the process of screening a suitable supplier, designing the product, or developing the selected process for the cost estimation purposes. Producing a product with the support of software which can model the whole manufacturing process of the selected product and give best in class pricing to it. Best in class pricing considers all cost drivers for the product because of manufacturing processes like labour rate, machine hours, set up times, material costs, manufacturing techniques, manufacturing overheads, and so on.

There are different relative terms for SCA used in the literature on the field of procurement. SCA can be seen as external cost model, that Sower & Sower (2015, p. 65) describes to be referred as "industrial cost models", "projected cost models", or "Should-cost models". Terms "Should-cost Analysis" and "Should-cost model" do not offer many scientific articles from the scientific databases as "Elsevier" or "Scopus". Therefore, it is important to set specifications for the external cost model to be used in the case company

so that relevant literature can be found. Case company's incentive is to implement SCA in a way that it would be possible to check correct costing for selected products in for example three-year periods. Before the actual SCA process can be implemented, road map for the ramp-up or development phase must be made. In the road map there should be determined the need for the process, selection criteria for the products included in the process, measurement practices, ways of working, and collaboration plans with relevant stakeholders to be established. This all must be done to ensure that the process does not perform in a vacuum but follows case company's strategic direction to produce the best results possible.

1.2 Research Scope and Questions

In the case company there is no SCA in use now. However, there is an increasing interest towards it because it can give a significant support towards cost reductions, more efficient purchasing and engineering processes, and better collaboration between the case company (buyer) and suppliers. Conducting of the SCA requires resources and it is not profitable to run for each purchased product. The need for this research is raised by the case company and the theoretical contribution is not aimed for a new problem identification. This research is going towards answering the research questions as qualitative research, the data is collected from interviews and the goal is to frame the benefits of deploying SCA and determine the desired characteristics for the products to be included in to the SCA process.

The scope for the research is to map the benefits of deploying SCA process to support the case company's procurement processes. The scope includes existing materials that are going to be included in the first scope of implementing SCA processes for the operations of the case company. Existing materials in this research mean in the context of the case company tangible products like bearings or cubicles and services are left outside of the scope. When discussing desirability, benefits, and challenges of SCA, also products in their design phase will be brought into the discussion. It is important to identify stages of products life cycle that SCA has the most potential to be supporting procurement needs. By identifying the benefits of SCA, requirements for collaboration between stakeholders internally and externally, and the requirements for SCA operations it is possible to start strategy creation for the SCA deployment.

For clarity, already launched products will be included to the short-term plans to take on the process more urgently, and products in design phase will be included to the process in the long-term plans when the more urgent cases have been solved and collaboration between all relevant stakeholders has been planned and piloted.

Cost estimation tools like SCA and Value Analysis and Value Engineering (VAVE) can have a great affection to the costs of a product in an early design phase (Bodendorf et al., 2022) and it is necessary to include those kind of situations in the scope of this thesis, too. Also, VAVE activities have already been conducted in the case company and it would be important to review its relationship to the SCA process in this research.

With the scope of the research specified it is possible to introduce the research questions. As being qualitative research, the data for results is going to be collected from interviews with key stakeholders to the case company's procurement development function. For SCA being a new process for the case company it would be interesting to find out the opinions from interviewees on the benefits and reasons behind deploying SCA to the procurement of case company. After specifying the beneficial elements of SCA, more deeper insights related to it are easier to give to the subject of the research. Like mentioned, it is not feasible to conduct the SCA for all purchased materials because of the needed resources for successful SCA outcomes. It is important to specify decision making criteria which are used to determine the material specifications (quantity, spend, design, supplier, etc.) of the chosen materials. By the reasons stated, the research questions can be formed as:

RQ 1: What are the benefits and challenges of deploying an SCA process?

RQ 2: What are the key characteristics for the purchased products that define the desirability of SCA?

These questions are aimed to be answered mainly by the material that is collected from the qualitative case study. Literature review will be working as a support to the qualitative case study and creating background on cost management. Product offering of the case company is broad and the products sold to customers are complex assemblies that can consist of hundreds of components. Therefore, the scope in this research is steered from the product level to the component level. That way we can differentiate materials included in the product to get visibility to the cost structure of the product for the case company to be able to compare costs from calculations to the ones presented by supplier. However, data from product costs in the case company's purchase portfolio is not going to be presented. Still, for example cost issues can be raised from product management on a product level and it is SCA professionals' task to find the components that has the biggest impact or issues in costing.

1.3 Structure of The Theory

Theoretical part is starting with presenting the assumptions and decisions affecting the formation of the sourcing and purchasing strategy. Strategy formation is presented with using Kraljic's (1983) Purchase Portfolio Matrix (PPM) as a basis for the structure and suitable strategies for the portfolio quadrants. Second part of the research is presenting literature review on Interorganizational Cost Management (IOCM) which is building the structure for the joint efforts on cost management and information sharing between buyer and supplier. Third part is consisting of Cost Estimation related approaches including the Should-cost Analysis (SCA), Value Analysis and Value Engineering (VAVE), Activity Based Costing (ABC), and the introduction to Internal and External Cost Modelling and in what kind of issues those models are made to solve. In the figure 1 can be seen the idea of how these three major parts of the theoretical part are connected with each other.

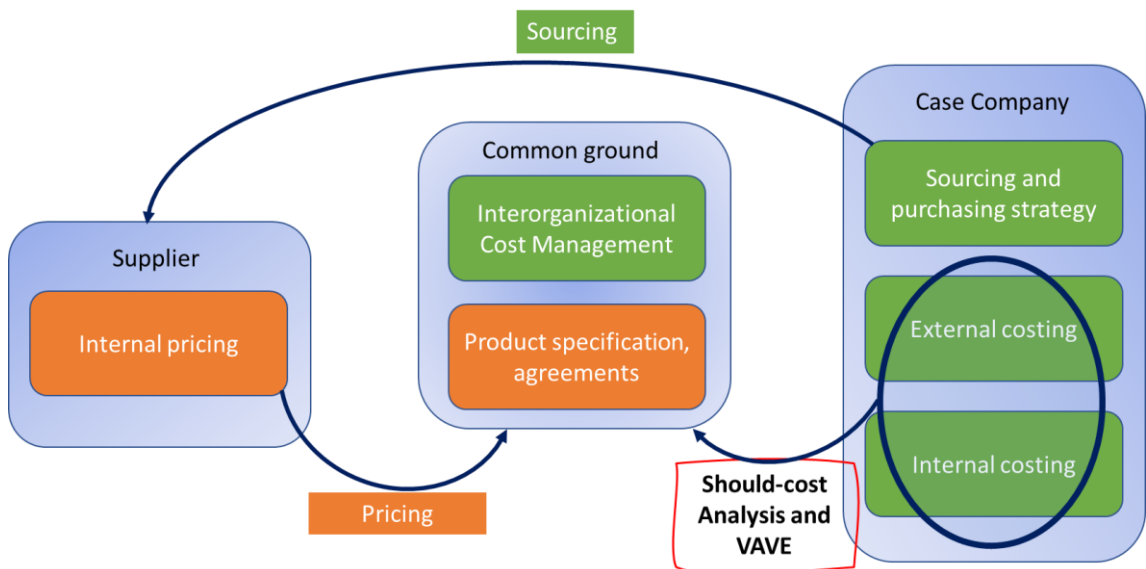


Figure 1. Rationale behind the structure of this research. Components highlighted with green colour are included in theory, orange ones are not.

As the figure 1 shows, there are two “actors” and “domain” forming the theoretical part of this research: Supplier related pricing; common ground, which includes introduction to IOCM, product specification and agreement related to the purchases of the supplier products; and Case Company related Sourcing and Purchasing strategy building, external and internal costing. The sourcing process (simplified in the next example) is initiated when there is a need for buying a product from the supplier markets identified in the case company. According to the need and aligned with company’s business strategy sourcing and purchasing strategies are formed to guide the sourcing process for the suppliers. Selected suppliers will give their price for the materials according to the Request for Quotation (RFQ) send by the case company. The case company will analyse quotes

from the suppliers based on their knowledge on the cost structure of the products which will act as a fact base for the price negotiations between supplier and the case company. The analysis of the cost structure of materials offered by supplier is done by the help of external cost modelling e.g., SCA in the context of this research. Based on this simplified process of sourcing in the case company will the material to be included in the theoretical part be chosen. The supplier box and pricing are highlighted with orange colour presenting the fact that this research is going to be focused on to the common ground and Case Company related factors leaving the supplier internal actions to a minimal attention. Also, the product specification and agreements are out of the literature reviews scope.

Most attention is going to be given to the SCA and VAVE activities and what are the requirements and needs for those to be supporting procurement processes of the case company. The fact that there is no exhaustive amount of research literature available on SCA activities directly is going to require focus to be broader when building knowledge around SCA and costing practises.

After the literature review, there will be short summary from the literature review for highlighting the importance and relevance of the found material for this research. It is going to be more discussive in its nature and it is going to be answering more on the case company's needs, before diving into presenting the findings from the interviews.

2. PURCHASING AND SOURCING STRATEGY

This chapter includes discussions related to purchasing and sourcing strategy, and product and supplier segmentation. When considering purchasing strategy, it might be very challenging to construct one global purchasing strategy for the company. Therefore, it is reasonable to create diverse strategies and tactics for different type of purchases and suppliers. Meaning for the purchasing strategy is to create executable and controllable plans for purchasing function. (Hesping and Schiele, 2015) For example also Kraljic (1983) and Olsen & Ellram (1997) are highlighting these differentiated strategies for different purchases and suppliers.

As a process level, SCA and other cost modelling methods should be tied to the company's business strategy, which is then followed by its sourcing strategy. Before going deeper into the sourcing and purchasing strategy, strategic sourcing is going to be introduced in next chapter. After that strategies for procurement activities relevant in the context of this research are going to be introduced.

2.1 Strategic Sourcing

Term "Sourcing" is by one definition by Giunipero et al. (2019) a process which has a goal to align corporate strategy with its needs with organizational buying and it is done by managing its supply base by transactional and strategic interactions. It can be called also as procurement, buying or purchasing (Giunipero et al., 2019). Giunipero et al. (2019) also stated that based on the literature considering sourcing, it can be divided into two different types: strategic/relational sourcing and transactional/tactical sourcing. Strategic sourcing's goal is to improve organizations cost efficiency by the analysis of purchasing expenditures and when it is done properly, it might eventually lead to competitive advantage (Giunipero et al., 2019). According to Kotula et al. (2015) strategic sourcing can also be a tool for risk mitigation. For example, strategic, sourcing related decisions play significant role on preparing for the risk of natural disaster or political instability (Kotula et al., 2015).

Eltantawy and Giunipero (2013) are building their knowledge around strategic sourcing on several scholars in their research's literature review. Strategic sourcing can be seen supporting make-or-buy decisions and whether in-house production is going to be source for competitive advantage as said by Eltantawy and Giunipero (2013) according to Walker, or defining if the organization possesses the resources or technology to produce

products in-house as Baier et al., Freeman and Cavinato, Venkatesan, and Welch and Nayak has stated. (Eltantawy and Giunipero, 2013) In general, strategic sourcing is requiring purchasing or sourcing strategy to be aligned with organization's competitive strategy and that requires strategic orientation from the procurement function (Apte et al., 2011). Next chapter is going to present ways to form and implement these strategies in practice.

2.2 Purchase Portfolio Model

The use of portfolio models has its limitations that are good to acknowledge when planning on deploying one of those. Olsen & Ellram (1997) state that when using portfolio models on building strategies to different groups, it is possible that those strategies are formed to be independent strategies that are not exactly supporting each other and might not be in line with strategies above.

Kraljic purchasing portfolio matrix is developed by Peter Kraljic and introduced in Harvard Business Review in 1983. Although, there has been other purchasing portfolio models developed after Kraljic (1983), it has been the most used purchasing portfolio model and can be seen as a foundation for companies purchasing strategy (Gelderman and Van Weele, 2003; Hespington and Schiele, 2016; Olsen and Ellram, 1997). In the figure 8 is presented the process towards purchasing strategy creation. Kraljic's (1983) process has four steps: product classification, supply market analysis, strategic positioning, and strategy implementation plans. Those steps steer the company on creating supply strategy that considers company's own strengths and power over suppliers on market. Next this four-step approach on supply strategy building will be introduced.

Kraljic's matrix consists of four different procurement focuses that classifies the items company is procuring: strategic items, bottleneck items, leverage items, and noncritical items, which is closely related to the classification of products as the first step on creating purchase portfolio matrix. (Kraljic, 1983) In the figure 2 is presented general process for creating supply strategy for an organization.

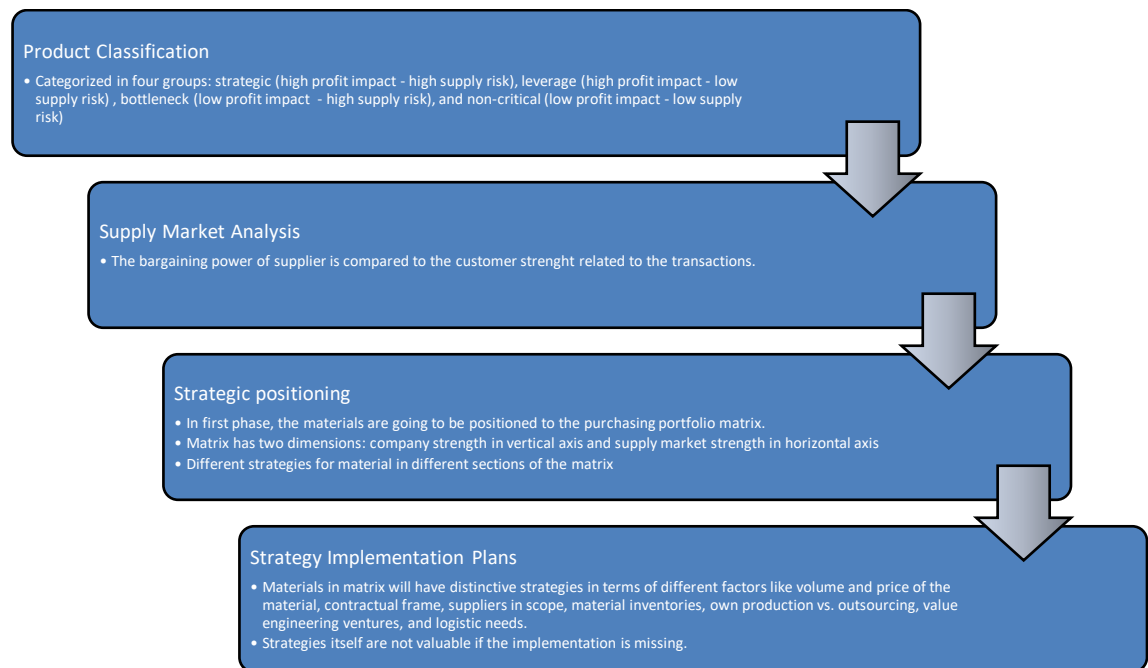


Figure 2. Process steps for creating supply strategy. (Modified from (Kraljic, 1983)).

The product classification in the first step of the process of creating purchasing strategy, the products or components are classified simply by assessing combination of their profit impact and supply risk. Also, an important variable on defining the class of a product is changes that may happen in supply market or demand, which might be affecting on the need on re-evaluating the class of the product or component in question. For example, strategic emphasis on bottleneck items may be on specific market analysis and getting volume insurances from supplier to secure the stock, which might mean that buyer will have to accept price premiums to do that. On the other hand, for leverage items the strategic focus might more relevantly to be in vendor and value analysing, creating forecast models for pricing, and finding substitute items from the market. (Kraljic, 1983)

Product classification can be presented more visually in a figure 3 in a matrix form that is called Purchasing Sophistication Matrix or Purchase Portfolio Matrix (PPM) and is also created by Kraljic (1983). Kraljic's PPM is a tool for classification of purchased material for a company's purchase portfolio.

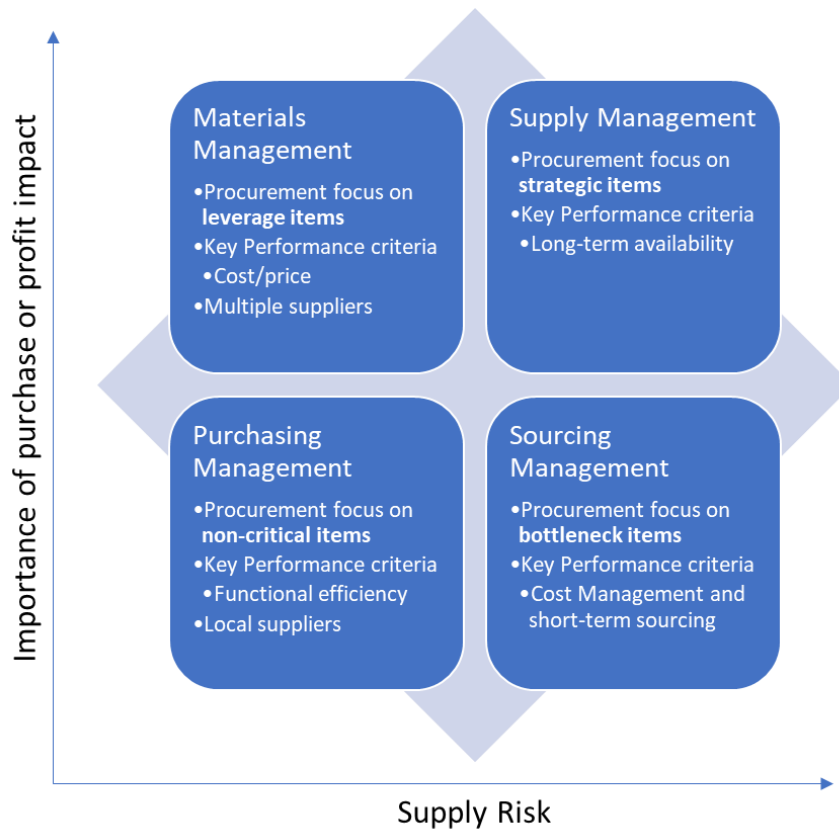


Figure 3. Purchasing sophistication from Kraljic (1983).

Olsen & Ellram (1997) has determined the factors that effect on the positioning of purchased items to the portfolio. They (Olsen and Ellram, 1997, p. 103) divide the factors in two categories: internal and external factors or as said before “strategic importance of the purchase and the difficulty in managing the purchase situation as the key classification dimensions is suggested”. One critic that has been given from multiple scholars towards these purchase portfolio matrixes or models is that the classification of products in to the portfolio is highly subjective (Gelderman and Van Weele, 2003; Hesping and Schiele, 2016; Montgomery et al., 2018; Olsen and Ellram, 1997)

Classification of the purchased products is an important part of the product category strategy building and development. Although, supplier selection for the purchased products cannot be foreseen. Roodhooft & Konings (1997) argues that Activity Based Costing can act as a support when selecting suitable supplier. They (Roodhooft and Konings, 1997) have built a comprehensive equation to calculate the best supplier. The equation takes in consideration also quality and punctuality as cost drivers when problems related to quality or punctuality occurs.

The score of each supplier that produce similar products and it gives an estimate for the score that can be used in comparison which supplier should be awarded. (Roodhooft and Konings, 1997)

In a short summary, before going deeper on the cost analysis of a product's costs, procurement professionals need to be aware of the supplier performance and identify the problems that are causing the high costs. Also, SCA can be revealing the potential flaws in suppliers operations and processes and therefore it can be seen working as a supportive function when figuring out if the supplier is suitable as a whole to the buyer (US Army, 1972).

After the purchasing portfolio of company is classified, company should analyse its supplier base by conducting market analysis to determine its strength against its suppliers' bargaining power. Olsen and Ellram (1997) are giving a frame to start evaluating company's supplier base and supply market against its own capabilities. They (Olsen and Ellram, 1997) are dividing factors that are influencing to the strategic importance of the purchase into three different categories: competence factors, economic factors and image factors. Competence factors considers the usage of firm's core competencies, knowledge development and technological strengths. Economic factors consider importance of the purchases economically by volume, value, profitability, and the leverage on supplier for future purchases. Image factors can have affection for the company's image in the eyes of customers and suppliers. (Olsen and Ellram, 1997)

Olsen and Ellram (1997) are also introducing the factors that might affect add difficulties or challenges to the situations when purchasing goods from the supply market. Novelty and high complexity of a product are adding the needed research to be done to secure sensible purchases of those products. From the supplier side, supplier power is a critical variable factor in terms of company size, number of suppliers, resource dependence, or the criticality of the goods needed. Along with the supplier power, its commercial and technical competences should be evaluated when selecting supplier. Also, environmental factors like uncertainty and risk are varying amongst different suppliers, and should be critically evaluated before making a decision on the supplier selection. (Olsen and Ellram, 1997)

This chapter has presented the Kraljic matrix and its quadrants; however, it has not taken a stand on pursuing strategic goals with concrete tactical levers that work on specified quadrants of the Kraljic matrix. Hesping & Schiele (2016) have been studying specifically about the tactical sourcing levers that can give procurement professionals the tools to utilize on products in the different quadrants of the matrix. These tactical sourcing levers are going to be presented in the next chapter.

Hesping & Schiele (2015) with other scholars (Gelderman and Van Weele, 2003; Hesping and Schiele, 2016; Kraljic, 1983; Olsen and Ellram, 1997) are highlighting the

importance of customizing purchasing strategies based on product categories or suppliers. They argue against using broad strategies for all categories within the same quadrant of the purchase portfolio matrix (e.g., Kraljic's (1983) PPM). Sourcing levers, such as "volume bundling, price evaluation, extension of supply base, product optimization, process optimization, optimization of supply relationship, and category-spanned optimization", are key elements in implementing differentiated strategies (Hesping and Schiele, 2016, p. 105). These levers, as per Hesping and Schiele (2016), can be applied across all portfolio quadrants, emphasizing the flexibility needed in purchasing situations. The term "sourcing levers" is linked to various terms found in German and English literature, reflecting the diversity of research in this field.

3. COST MANAGEMENT IN THE CONTEXT OF SOURCING

Successful companies rely on their core competencies, those competencies aim to make them better than other companies to gain sustainable competitive advantage. Core competencies are differentiating company from its competitors and tend to have qualities that are difficult to imitate. (Kak and Sushil, 2002) Pursuing for sustainable competitive advantage is requiring companies to replace production of products, components, and services that are not matching their core competencies with forming strategic alliances with the companies that are having those skills as their core competencies. The decision of which products, components, and services should be made in house or bought from the supply markets must be in line with company's business strategy which sets the frame for operations for the company to achieve its long-term goals and is also a part of the company's risk management. (Kak and Sushil, 2002)

Cost management and cost reduction ventures are on every procurement professional's table. However, managing costs in an efficient way might not be an easy task even if the function has all the information on hand. The challenge is to respond to the right information and opportunities. To achieve sustainable competitive advantage, a company must manage its costs wisely and even aggressively. On a competitive market the key is to reduce costs and improve their processes more quickly than competitors. It means that companies must develop efficient cost management practices and systems to keep ahead of the competition. Otherwise, company will see its profit margins to reduce and in the worst case its whole existence might be threatened. (Kulmala et al., 2002)

To avoid the pitfall of an inefficient cost management practices, Kulmala et al. (2002) want to highlight three important points that cost accounting systems should consider: Cost objects like for example "customers, products, services, functions, processes, and activities" (p. 37) must have a multi-dimensional focus in the companies; Support for key business decisions for example "sourcing, pricing, investment justification, efficiency and productivity measures, product elimination and new product introduction; and planning and control activities" (p. 37) should be on the focus instead of tracking and reporting the costs. (Kulmala et al., 2002)

This chapter is going to build a context on SCA deployment and to the requirements behind well performing cost modelling methods. As there will be presented in this chapter, IOCM is about joint cost reduction between different parties in the supply chain and

the relevant relationship for this research is between buyer and supplier. Chapter is going to start on general introduction to IOCM practices, then information sharing between organizations and the cooperative cost reduction activities will be presented lastly.

3.1 Interorganizational Cost Management

Many scholars (e.g. Iida (2012), Kulmala (2004), Bodendorf et al. (2022)) state that cost management in supply chains and in buyer-supplier relationships is a joint venture and the transparency to costs between these actors is the key for IOCM. In the early 2000's organizational buying shifted its focus from transactional relationships to longer lasting supplier relationship processes. The cause for this shift is that companies started to concentrate more on their core competencies, which is lowering the products prices and therefore causing cost pressure to companies. (Kulmala, 2004) Collaboration for optimizing costs and leveraging their partners capabilities are made possible with close cooperation and interorganizational cost information sharing between buyer and supplier (Bodendorf et al., 2022). Iida (2012) also highlights the importance of buyer organization's close cooperation with its suppliers and especially lean manufacturers have been reporting production cost reductions through cooperative operational capabilities development activities.

Management accounting beyond legal requirements regarding the value chain of companies is a newer research line. Change towards interactional cost management between buyer and supplier allows them to build the processes more efficient which will lead to cost reductions. (Anderson, 2006)

Cost reductions are in most of the cases one of the goals for people attending procurement related tasks (Kulmala, 2004). To find cost reduction related opportunities, it is essential to acknowledge the reasons lying behind the too high costs for the specific product. Van Weele (2018) presents six reasons for the slack in costs and prices in materials that may exist: "Traditional purchasing, continuous and relentless competitive bidding among a fixed group of suppliers, products overspecification, price increases passed to the next in line, supplier cartels, and suppliers' customer relationship programmes (Weele and Rozemeijer, 2022, pp. 100–101). These reasons are going to be discussed in the next paragraphs excluding the supplier cartels and customer relationship programmes for those being out of the research's scope, because for the context of the research SCA is having an effective affection only on the business between buyer and supplier (Trudelle et al., 2017).

First aspect that may be causing unnecessarily high costs is the lack of strategy in purchasing. Buyers are included to the buying decision making process at a late state and there might be a familiar fixed group of suppliers that have been used for similar purchases for years. In this case price competition does not really exist. Second is bidding against a group of suppliers: buyer gets an offer from a supplier and presents a lower offer to the next supplier. This behaviour might cause suppliers to offer higher prices in the first place with the slack baked into the costs and in the worst case there is a possibility on suppliers forming a cartel with pre-decided lowest pricing. It is likely to happen because of information sharing between suppliers, they do not operate in a vacuum and have to be seen as rational operatives in the supply chain. Third presented problem with high costs is that the increased costs are passed next in the line. Suppliers are simply passing the increases in costs to their customers in the form of higher pricing and the customers are doing the same to the final consumers, and that can be seen as higher costs throughout the supply chain in the form of higher pricing in every step of the supply chain. Lastly, specifications for purchased products might not all be necessary or bring value to the product. That is called overspecification. (van Weele, 2018)

Interorganizational cost management and learning closely with supplier can enhance both buyer and supplier cost efficiency. The issues with pricing that van Weele (2018) mentioned is a product of a lack of transparency and communication within the supply chain. Some tools that are used to achieve cost reductions are for example target costing and Value Engineering and Value Analysis (VAVE) which is going to be introduced and discussed in the chapter 4.3 (Iida, 2012) Iida (2012) also highlights that in his research the prices of the products are given externally (from e.g., market) so that buyer and supplier are only focusing on reducing the costs of the product via production or process improvements.

Agndal & Nilsson (2009, p. 86) states that IOCM can be divided in to a three types: “target costing, trade-off techniques & continuous improvement, and philosophies & techniques related to supplier’s costs”. Target Costing (TC) is a tool for the manufacturer or buyer to set goals for the products component’s costs. It compares the price from the market which acts as a goal for the costs. It sets pressures to the whole supply chain to match those targeted costs (Agndal and Nilsson, 2009). Target costing is according to Agndal & Nilsson (2009) and Ibusuki & Aminski (2007) mostly efficient for new product development and according to literature does not take a stand on existing products’ production costs. However, it can be used as a benchmark for existing products by determining the target cost of products and then comparing those calculated costs to the costs that have been realised in the production processes. According to Anderson (2006) VAVE activities

are supporting target costing by ensuring that products are responding to the customer requirements on a lowest cost level possible.

IOCM requires openness in sharing information between buyer and supplier. For example, Möller et al. (2011) are stating that Open Book Accounting (OBA) is one critical success factor for IOCM between relationship parties. Therefore, after presenting IOCM in general in this chapter, in the next chapter is going to be presented the enablers for successful IOCM between buyer and supplier.

3.2 Interorganizational Cost Information Sharing

In chapter 4.1 there is presented the framework for IOCM and Cooperative Cost Management based on the research literature. Together those two elements are creating the need for cost information for which the actual IOCM and cost reductions are based. Creating possibilities for interorganizational cost management which Sower & Sower (2015, p. 65) defines as external cost models and they (Sower and Sower, 2015, p. 65) say that are often referred as “industry cost models”, “projected cost models”, and “Should-cost models”. To create these external cost models for IOCM needs procurement professionals are required to have a good understanding about supplier costs. To achieve its strategic goals for competitive pricing of the goods the buying organization needs to understand that future price fluctuations must be based on factual cost data, and they must have a way to know the cost of design and the cost of operational decisions on price. (Sower and Sower, 2015, p. 19) This sets requirements to the cost information sharing between buyer and supplier. Van Weele (2018) states that most manufacturers and suppliers do not want to disclose detailed information related to the products that they are supplying to the customer, which can make it more difficult to pursue cooperative cost reductions between buyer and supplier. Even though it might be difficult to get the needed cost information from suppliers, it is still important to put effort on getting that information. According to Zachariassen (2008, p. 765) Kulp (2002) for example mentions that many authors have emphasized the fact that there exists a positive correlation in buyer-supplier relationships “between information exchanges and improved supply chain competitiveness, profit and performance”. Therefore, it is safe to say that it is beneficial for buyer to aim for open information sharing relationship with its suppliers.

In much research it has been noted that longer-term relationships between buyer and supplier is the determining factor on desire to share cost information between parties. Krause et al. (2006) for example state that chance for repetitive purchases and continuity for the relationship makes the possibility higher for information sharing which also has an affection on negotiations bargaining stances. With bargaining stance in the context of

price negotiations is meant situation where buyer and supplier might choose negotiation tactics to be distributive (e.g., win-lose) or integrative (e.g., win-win) (Krause et al., 2006).

3.2.1 Open Book Accounting

Open Book Accounting (OBA) is a systematic tool for disclose cost data between partner firms, for example buyer and supplier (Möller et al., 2011). Möller et al. (2011) researched OBA's impact to IOCM practices and how does supplier's or buyer's commitment to the relationship affect on OBA and IOCM. OBA is in that research seen as a critical success factor for IOCM, and suppliers' commitment effects on OBA's implementation. This speaks for longer-term relationship to secure the positive cost effects that OBA is potentially able to result in. Longer-term relationships come from contracts that shows buyer's trust towards supplier and it might be significant factor on successful OBA implementation in IOCM. IOCM is also more collaborative way of doing business together which lowers the risk of opportunistic behaviour, that might be a risk for suppliers in some relationships. (Möller et al., 2011)

OBA at its best is a way for joint development projects between buyer and supplier having the goal to improve cost efficiency related to the relationship between buyer and supplier. Kulmala et al. (2004) have researched OBA's influence in the context of customer-supplier relationships. When information sharing between buyer and supplier is inadequate it can lead to weaker trust between parties and that can be harmful for their relationship. On the other hand, better trust lowers the level of risks and therefore can affect positively on total costs. They (Kulmala, 2004) have also noted an interesting contradictory connection between trust and OBA, in some relationships OBA is a result of trust between buyer and supplier and in other cases trust is a consequence of the openness between those parties.

Suomala et al. (2010) also mentions that OBA can be used also as a tool for negotiations, as a channel to communicate objectives and keeping suppliers "alert". They (Suomala et al., 2010) also bring up a great note that OBA alone is not as valuable as it might sound. However, it is valuable when the results of OBA are tied to the progress or benefits and resource usage that it has been enabling (Suomala et al., 2010).

OBA might let some room for buyers' opportunistic behaviour, like Möller et al. (2011) also stated, because for most of the cases the cost information sharing is unidirectional, from supplier to buyer. This insight might also give to the buyer an urge to use the information on price negotiations or even temptation to change supplier without considering

a more collaborative approach to the issue. (Agndal and Nilsson, 2010) Windolph and Moeller (2012) are addressing the same issue as Agndal & Nilsson (2010) of the suppliers possibility to opportunistic behaviour.

3.3 Cooperative Cost Reduction Between Buyer and Supplier

Agndal & Nilsson (2009) are highlighting the importance of cost reduction actions in buyer – supplier relationship that is made possible through IOCM. According to Agndal and Nilsson (2019), Ask and Ax, Van Weele and van der Vossen estimated costs related to purchased goods and services are 60 – 70 % of manufacturing costs, so those costs are conducting a major part of the products manufacturing costs and therefore actions to achieve cost reductions in purchased materials is a significant factor behind pursuing for competitive advantage.

Merckx & Chaturvedi (2020) presents a trade-off that exists in buyer's strategy, it can pursue for cost reductions by two ways: supplier can be offered a long-term contract based on a relation-specific cooperation between buyer and supplier or it can use full leverage over supplier by making competitive short-term contract offers.

When considering buyer-supplier relation-based investments made by supplier to reduce costs on buyer-specific orders the duration of the relationship/contract is on the essence. In short-term relationships with high competition on the buyer's business the risk associated with investments made to reduce production costs to fulfil buyer-specific orders is high. Also, these investments are possible only after working and learning from buyer. Therefore, it can be seen that longer-term relationships are more viable for these investments that supplier might implement. (Merckx and Chaturvedi, 2020)

The supply base i.e., the amount of competition on the buyer's business, is a nominating factor when considering which one, the long or short-term contract between buyer and supplier is preferable. Also, Merckx & Chaturvedi (2020) highlight that "system cost (ie., the sum of production cost and investment) is lower with short-term contracts than with longer-term contracts". (Merckx and Chaturvedi, 2020, p. 2)

Now that there has been presented the literature review about IOCM and the requirements for successful collaborative ways between buyer and supplier, it is time to move on to cost modelling techniques. Those techniques take as a requirement that IOCM practices are in use for the case company to be able to deploy cost estimation to their product portfolio.

4. COST MODELLING

Cost modelling is a tool to analyse resource data which consists of "direct labour; direct material; indirect costs; sales, general, and administrative costs; research and development costs; and to understand the projected or true costs of a produced or purchased products it is important to also know the profits". At simplest, cost models can be a fact-based tool consisting of information about product's cost components to help procurement professionals in decision making and in price negotiations. Buyers' negotiation power is more likely to be higher when the negotiations are based on fact-based cost model than with a simple negotiation strategy that trusts only to meet the supplier price offer on a halfway when for example cost increases appear. Then buyer might accept a higher price for the product with the negotiations based only to a general price increase in the market or industry. Cost models come also in handy to keep the discussion around prices based on facts and not on opinions or political manoeuvres. (Sower and Sower, 2015, p. 9)

For the reader of this research, it is beneficial to know at this point that there is not exhaustive amount of peer reviewed literature available about SCA. Therefore, this chapter is going to move towards the definition of SCA by introducing different product cost and value estimation methods that can be seen to be connected closely to SCA. SCA is used to bring visible all cost drivers affecting to the product and it is aimed to be used to gain negotiation power for example, in price negotiations with suppliers (Hiller, 2012; Trudelle et al., 2017). Based on the knowledge on behind product cost formation there will be selection of methods presented that are able to shed light to that topic. There might also be other suitable methods to estimate cost and value of a product or a process, but this research focuses on the most often referred methods related to this context. As determined in the introduction of this research, these methods will have approaches related to products on their design phase and life cycle phases after the product has been launched.

4.1 Cost Estimation

It can be beneficial for both buyer and supplier to produce accurate and effective cost estimates for the products. Around 70 % to 80 % of the costs of products are determined at the early state of design phase, which is obviously the best place to have an affection to the costs (Bodendorf et al., 2022; Retolaza et al., 2021). Well executed cost estimation is highly probable to have direct impact to the effectiveness of a company (Retolaza et

al., 2021). But still measuring and evaluating the reality behind the cost estimates in the production phase of the products can reveal significant cost savings and process development (incl. buying, production, sourcing etc.) potential. Bodendorf et al. (2022) states that Original Equipment Manufacturers (OEM) does have difficulties on getting the information needed from the suppliers, which leaves room for future improvements related to the relationship with supplier to enhance cooperation and reliance between the buyer and supplier. He (Bodendorf et al., 2022) also states that when buying organization confronts difficulties on getting the information, cost estimation and prediction can be done with the help of function-based costing methods. Function-based costing methods does not take the cost information as given but takes in consideration all production processes on single function level (e.g., machining, cutting etc.) and cost estimates can be made based on estimated processing times and resource needs on each function (Bodendorf et al., 2022).

4.2 Cost Models

Internal cost models are for companies to gain knowledge and fact-based information of costs of products that they are manufacturing by themselves. They are used as for example for cost reductions, capacity planning, product or service development, efficiency improvements and as a part of product quality management. (Sower and Sower, 2015, p. 27) All of the models presented in this chapter can be used to support both internal and external costing of a company. But for the sake of the context of the research this chapter is going to be focused cost modelling and analysis from external cost modelling point of view.

Sower & Sower (2015, p. 65) are discussing about external cost models which are especially interesting in the context of this research. They (Sower and Sower, 2015, p. 65) refer external cost models as “industry cost models”, “projected cost models”, or “Should-cost models”. External cost models are considering purchased products and the costs that the products are consisted of, in other words external cost models and analysis can be used to support the knowledge of cost drivers and reveal those cost drivers that can be influenced. As the external cost models and analysis are focusing on costs that appear on the supplier side of the process, fact-based cost information sharing is needed between buyer and supplier. Regarding information sharing, there lies higher probabilities on getting the information needed to construct the cost model from a supplier if the relationship has long-term contract (Bodendorf et al., 2022).

Krause et al. (2006) have researched assumptions that buyer and supplier have before price negotiations. In their research Krause et al. (2006) put emphasis on three factors:

reserve price, market price and aspiration price. Based on their research market price has the least affection on price negotiation outcomes and it might work as a guide for the average items sold recently, but it is not the most desired result price for the negotiations. Reserve price for the buyer is the highest price they would be willing to accept and lowest for the supplier. Aspirated price is the lowest price for buyer and highest for the supplier so that is the expected best possible price on their own sides of the negotiation table. Contracted price should fall somewhere between the reserve prices. There might also appear situations on price negotiations that buyers' and suppliers' aspiration zones are not meeting each other. In the figure 4 there is shown negotiation zones by buyer and supplier.

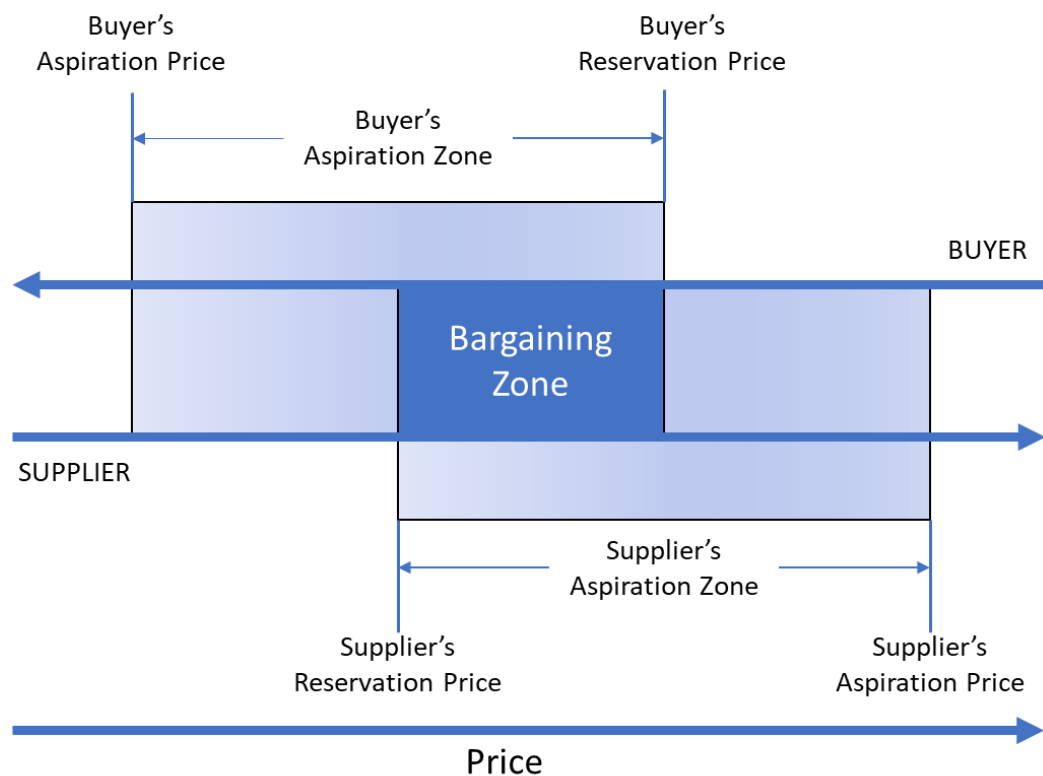


Figure 4. Negotiation zones in buyer-supplier price negotiations. (Modified from source: (Krause et al., 2006))

Krause et al. (2006) found that bargaining stance significantly affects negotiation outcomes, especially regarding price. In distributive stances, the more powerful negotiation party tends to “win”. Integrative stances are better for long-term relationships. Surprisingly, in situations lacking common ground in negotiations, negotiations still succeeded 7 out of 10 times, indicating the flexibility of reserve prices. The key takeaways that Krause (2006) is presenting include the influence of reference points, their potential for change during the negotiations, the need for strategies to alter the opponents reference points, and the importance of negotiators' skills and experience in adapting to unforeseen

events. Overall, preparation is crucial for keeping on track for changing reference points and strategies in negotiations. (Krause et al., 2006)

Cost modelling is a fact-based way to prepare for price negotiations and to affect suppliers' reference points by bringing the discussion to the factors affecting to the costs. In the next sub-chapter, there is going to be discussed more about different cost modelling and cost estimation tools that may have a positive affection to the negotiation results between buyer and supplier.

4.3 Value Analysis and Value Engineering

Value Analysis and Value Engineering both have the same goal, to justify the valuable elements, components, functions, and features of a product. However, the moment of deployment of these processes differs from each other. VE is a tool for determining the value of product that is in design phase of its life cycle and VA can be deployed when the product is already in production. These qualities of the processes set constraints and enablers for both processes, which are going to be presented in the next chapters. (Sato and Kaufman, 2005)

Value Analysis and Value Engineering (VAVE) are usually used as a combined term for estimating functions and features of a product, component, or service that are valuable to the customer. Especially in spoken language these terms are often used as a combination, but it is important to understand that those processes are, in fact, used in different phases of the products' life cycle and therefore there exists differentiating factors between Value Analysis and Value Engineering.

Value Analysis (VA) and Value Engineering (VE) can be described as a tool for bringing visible products components or specifications that creates value to the product. It is a product design optimization tool on identifying not necessary costs within the structure of the product. These can be materials, components or systems and services. Costs that are caused by not necessary product's specifications and functionalities can be recognized with function analysis. (Vijayan et al., 2019) Although, the goal for Value Analysis and Value Engineering is the same they are both used in a different part of the products life cycle. Value Engineering is used in the design phase of a product and Value Analysis is used for products that are already commercialized and there might be customer feedback available (Kassa, 2016). In the next paragraphs there are going to be presented timeline and information on which situations VA or VE is most beneficial to use.

4.3.1 Value of a Product

To be able to estimate the value of design, product, process, or system, we need to define value for those. Oja (2011) defines value in the context of configured or tailored products but he (Oja, 2011) does not strictly exclude other types of products from this value definition.

As it can be seen from definitions for value gathered by Jensen (2005), Oja (2011), and Singh et al. (2017) for example, the value is a relative measure of a product or a service. Jensen (2005) highlights that the two ways for customers gaining value are by the product offering and by the relationship between buyer and supplier. Although most of the discussion around value of the products is circulating around customer value and use-value of the products, it is important to remember that buyer and in this case referred as producer of products has its own productivity demands, so it shall not be forgotten that value of its own production processes and the ability to produce added value is very significant matter for the very existence of a producers business. (Oja, 2011)

Adding to the list that Oja (2011) has built regarding values Jensen (2005, p. 1) has a value category approach on determining the value of a product or a component: “Economic value – Value as exchange, Use value – Value as utility, Cultural value- Value as meaning and sign, and Perception value – Value as experience”. He (Jensen, 2005) states that use value is a point to start product development and design. The reason for defining the value of a product or a service is that manufacturing and selling companies must produce more value to the customer than the cost or the sacrifice is for them. When the value is known, it is more probable that customer will be satisfied and the business of producing and selling these products or services is successful. (Oja, 2011)

4.3.2 Value Engineering

Singh et al. (2017) are sharing Kassa’s (2016) and other scholars’ vision on VE being a tool for the value determination of a product or service during its design phase. In a figure 5 is a visualization of VE use tied to the life cycle phase of a product with determination of a general point where costs of deploying VE exceeds the profits that are can be potentially achieved from VE deployment. It is extremely important to highlight, that most of the products costs (70 – 80 %) are defined during the design process of the product with a relatively low financial resources (Retolaza et al., 2021).

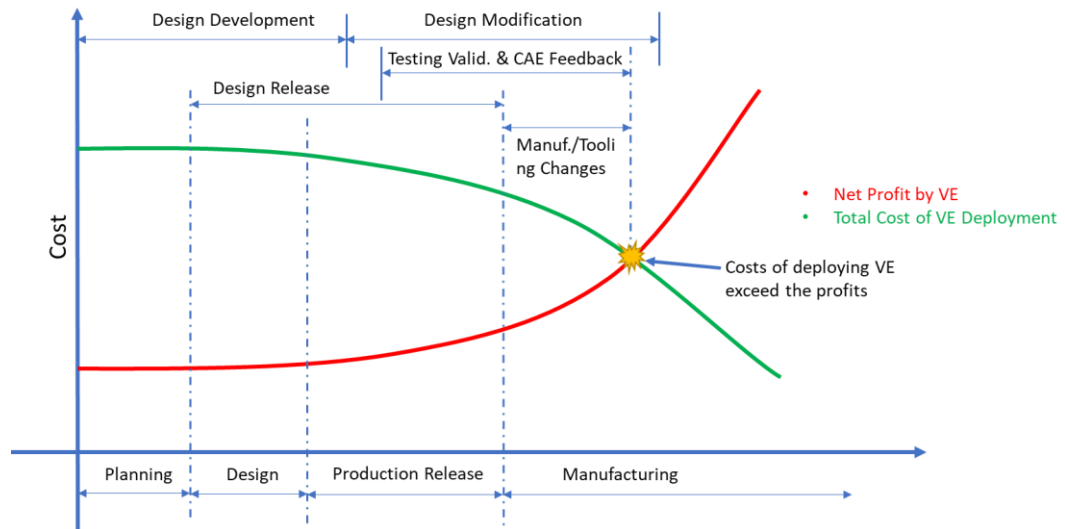


Figure 5. Relation between costs and profits of deploying the VE activities in different phases of a life cycle of a product. (Modified from: (Singh et al., 2017))

As mentioned, VE activities produce the most value prior to the product launch. Product related life cycle phases that are most profitable for VE activities deployment are according to Singh et al. (2017, p. 350) "1. Planning and strategy building, 2. concept evaluation, 3. concept building, 4. design & development, 5. testing & validation, 6. production release, and 7. manufacturing". The first four steps include only planning and design validation related tasks and yet no concrete investments for production equipment are made. This allows costly lighter changes to the features of the product to be made. In the step 5. prototype building comes into a figure. Hence, the product is still yet not in production, targets for costs can be evaluated thoroughly before making the investments. In the step 6. there will be designated space for production to be made and in the step 7. the production of the final product is planned to be started. (Singh et al., 2017) As we can see, the further we go with the steps, the lesser is the chance to have an effect to the costs of the product in hand with the deployment of VE. Still, it is possible to have a positive effect to the costs at least to the point where manufacturing and tooling changes are relatively easy to do.

Although, the product costs, that are easiest to report and to recognize, VAVE activities are not solely concentrating on those. Deploying VE activities in an early stage of product designing have a potentiality to lower the costs of the product, align processes with lean methodologies by reducing waste, increase reliability of a product, result in a higher customer satisfaction level. Deploying VE activities on cost optimization ventures are likely to lead to better results, because it allows more complete view on the valuable elements of a product and offers a better understanding on customer needs compared to focusing only on cost reductions. (Singh et al., 2017)

4.3.3 Value Analysis

Kassa (2016) highlights that most customers do not buy product but functionalities the product is able to offer for the use of the customer. He (Kassa, 2016) presents three different strategies for pursuing competitive advantage keeping in mind at the same time the experienced value for customer: time-based, cost-based and quality-based strategies. VA also is a tool for identifying unnecessary costs that can be described as waste. Kassa (2016) defines all waste as costs of all efforts done that cannot provide results to the end product such as overspecification and not-using being the most significant forms of waste. VA activities are concentrating on the components, specifications that produce value to the products and do not necessarily try to influence efficiency of processes like activity-based costing and should-costing models do. (Kassa, 2016) VA activities can be used similarly to the products and the process itself is identical after initiating.

According to Fernandes (2015) value is equal to function divided by cost. Function analysis is a critical part of VA. It includes determining the value to the customer for each function of a product. Then the relations between functions are going to be determined. That will reveal the value of each function when the cost of producing each function is known. (Fernandes, 2015)

4.4 Activity Based Costing

Andrade et al. (1999) are defining Activity Based Costing (ABC) as a tool that considers all costs that can be controlled. The aim for ABC is to reduce costs by continuous improvements that enhance the value of a product and the processes on producing it and reducing waste which again includes usage of materials and productivity of processes. (Andrade et al., 1999) They (Andrade et al., 1999) also promote that ABC has been thoroughly researched for its capabilities on product costing, and also cost reduction activities that are run on a company level can be planned and monitored with the support of ABC.

ABC could be used also on mapping the product's production costs in real time. Wouters & Stecher (2017) call this kind of ABC as Time Driven Activity Based Costing (TDABC). For accurate cost calculations from the production TDABC requires high level of information from every step of the manufacturing processes, including labour rates, production cycle times, service costs, tools and auxiliary materials, sales costs, depreciation costs and imputed interest to mention few (Wouters and Stecher, 2017). Kulmala et al. (2002) state that causality is the key in cost assigning, which means that cost allocation with general overhead allocation is not the best way to assign costs to the products.

Direct charge of the costs and causal determination whether the cost should be affecting certain product or not.

In discrete part manufacturing, overhead costs can rival direct costs, making Activity Based Costing essential. This approach ensures accurate allocation of overhead costs to products by considering various resources. (Brierley et al., 2006) Brierley et al. (2006) highlight two overhead calculation methods. Blanket overhead rates suit single-product manufacturing, allocating all costs to the factory at a single rate. Alternatively, rates based on factors like labor, machine hours, or production units are crucial for products utilizing diverse resources across multiple departments (Brierley et al., 2006).

4.5 Design to Cost Method

Now that there has been introduced Cost Estimation and Cost Modelling in general, Value Management practices that support product optimization ventures, and ABC practices to support understanding on how each production process effects on costs in VAVE activities, the contents of this part of the research are moving more towards methods and tools to improve cost efficiency of products and processes. Design for X (DfX) methods have been developed to support engineering purposes to designing products and production processes to be effective. In DfX the X can stand for Assembly (DfA), Production (DfP), and to Cost (DtC), for example. (Retolaza et al., 2021) Favi et al. (2016) stated that DtC methods can be seen as a subsequent for DfA and DfM methods. Both of the mentioned authors (Favi et al., 2016; Retolaza et al., 2021) are focusing their researches to the products/projects that are in the design phase of their life cycle. The most relevant for this research is DtC method, so this chapter is going to be focused on that.

Retolaza et al. (2021, p. 829) presents a Conceptual Design to Cost (CDtC) approach which consists of six different stages: "Target Cost definition, Cost Model definition, Cost Drivers definition, Assembly/Test concept graphic development, Evaluation of the cost attached to each cost driver, and Analysis and Validation of the results". This CDtC approach aligns with the Pareto principle which can be defined also as "80-20 rule" or "vital few, many trivial principle". In other words, 20 percent of the products cause 80 percent of the costs. (Retolaza et al., 2021, p. 829)

Retolaza et al. (2021, p. 831) are proposing a process for deploying a CDtC. It includes three different phases after defining the problem (with costs): "Target Cost Definition, Design Solution Proposal and Cost Definition, and Result Analysis and Validation". Target Cost Definition is a phase where producer must be aware of the costs that customer

is willing to pay. Retolaza et al. (2021) proposes three levels that are going to support decision making on what features the product will be included with. Basic level contains all essential attributes with a minimum cost. Medium level products include features that are increasing the performance of the product but are not vital to the products functions. High level products are containing more luxury elements that add value to the product, but neither those are vital to the product. In the figure 6 is presented the Retolazas et al. (2021) proposed framework for the DtC process deployment.

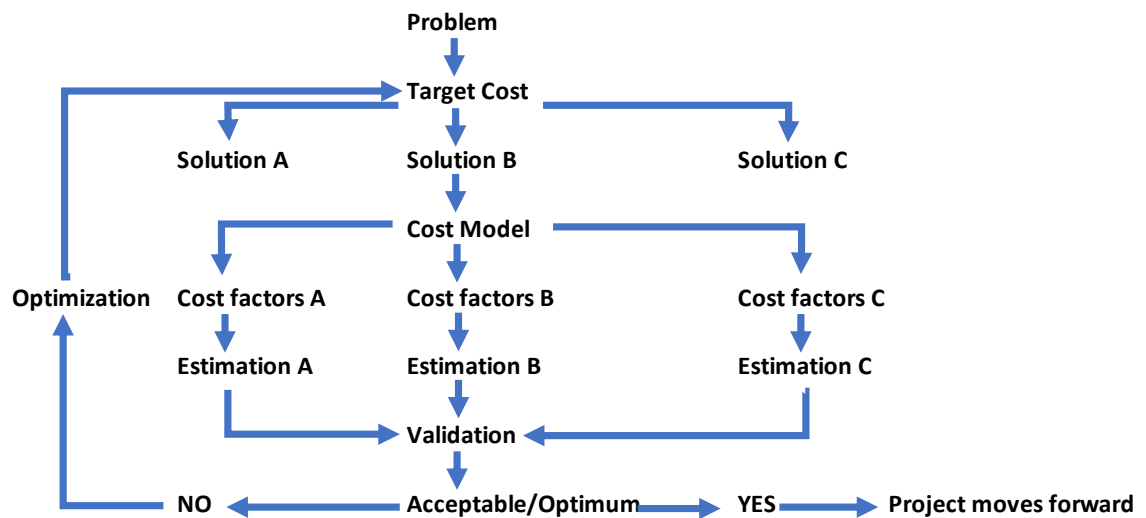


Figure 6. Proposed example of a framework for CDtC process flow. (Modified from (Retolaza et al., 2021))

After the target cost is defined for the product, cost modelling with the factors defined in the solutions can be formulated. These design solutions are then used as a basis for the cost models that are noting all cost drivers related to the specific solution, and then the cost estimate can be calculated with the identified cost drivers. (Retolaza et al., 2021) Also, Favi et al. (2016) raises a proposition that DtC methodologies are most beneficial to deploy after DfA and DfM methodologies, which is in line with the Retolaza et al. (2021) statement that solutions should be defined before the cost models can be created, and in the solution design phase for knowing all cost drivers of the product it is essential to know the processes behind producing the product.

When the cost estimation of each solution is ready for comparison there is one very critical step to do: validation of the cost estimate. In this stage calculated cost estimate and solution is compared against the objectives of the product, how well does the solution fit to the objective is going to be determined. If the solution is not acceptable, it might require further optimization and then the steps of the process will be initiated again, and it can be seen as an iterative process. If the solution is acceptable or in the best-case

optimum solution, then the project can be moved forward to the next stages. In some cases, there can be a situation that the solution is not able to meet the requirements of an optimal or even acceptable solution, then it might need further review if it would be desired to move forward with that solution. (Retolaza et al., 2021)

4.6 Should-Cost Analysis

SCA gives procurement professionals a reasoned target price to support them in price negotiations with suppliers. One aim with conducting a SCA is to drive productivity improvements in supplier side. These productivity improvements can be done by identifying inefficiencies in processes, that might reveal cost savings opportunities and then eliminating them. (Trudelle et al., 2017) Also Wong (2013) states that SCA makes visible the variable costs that are coming from the production processes and the processing times, production methods, materials used, and the estimated profits added to the production related costs. In the SCA's scope is also the costs that can behave both like fixed and variable costs, for example manufacturing overhead costs like maintenance and repair costs (Wong, 2013). In other words, SCA is a tool to find cost savings opportunities within production related costs that can be seen as variable costs when looking at the production of the items. Wong (2013) stated that many suppliers approved the win-win approach that SCA was able to produce, which meant cost savings for both parties (buyer and supplier).

Although, the scope is different from SCA, there can be seen similarities in the characteristics of adopters of both practices (SCA and ZBB): high costs which makes bigger cost savings and bigger efficiency improvements along company's processes possible and therefore more desirable (Böhm, 2019; Hiller, 2012; Wong, 2013). Also, according to Coyte et al. (2022) Zero Based Budgeting (ZBB) starts from the zero level and is not based on a last year budget. This has been reported to result in cost savings (Coyte et al., 2022). Böhm (2019) describes ZBB as budgeting method for companies business units and the idea is to start budgeting from an empty paper and go through its processes and costs (incl. production and products) to find cost saving opportunities by reducing waste. He (Böhm, 2019) also highlights that high cost levels and lower level of complexity were combining factor that had a pull effect towards ZBB. The reason for it being not so probably been implemented by bigger companies with high complexity in budgeting and costing was determined to raise from the resource intensity of the ZBB process. (Böhm, 2019)

OBA can in most of the cases be seen as unidirectional information sharing information flow being from supplier to buyer. According to Kulmala et. al. (2004) this can be

potentially a fact that will lead to opportunistic behaviour from buyers side when the information is used only aiming to reducing its own costs. Also, for example Windolph & Moeller (2012) addresses the same problematic behaviour as Kulmala et al.(2004) that OBA might add risks to the relationship between buyer and supplier. Therefore, it can be clearly stated that a win-win situation in information sharing would be pursued, which means the relationship and information sharing should be beneficial to both parties. Should-cost modelling could be the answer to that. As Trudelle et al. (2017) highlights that Should-cost Analysis is going to give future looking estimate for the costs that production may confront. SCA can be conducted without OBA or cost breakdowns got from the supplier and it can be used to power the negotiation power of the buyer against supplier. Those said it is possible that presenting buyer produced SCA to the supplier it will embrace the supplier to reveal cost structure of the products or at least agree on the SCA generated costs at some level (Hiller, 2012). SCA is in most of the times the best in class guesses of the production costs of the products and it should not be used as a diagnostic tool but rather as a leverage tool in price negotiations with supplier, used alone it might not be as valuable tool (Hiller, 2012). As Hiller (2012) shows that SCA alone is an analysis for the products' costs and it requires negotiations, showing the analysis to supplier to have a chance that the original quote for the products will change.

Sower and Sower (2015, p. 68) are presenting the procured material cost model, which is presented in the figure 7.



Figure 7. Procured material cost model creation. (Modified from: (Sower and Sower, 2015, p. 68))

When creating external cost model for purchased materials or Should-cost models it is crucial to identify the direct costs from material usage and labour usage. Then when applying the model, it will give reasonable baseline for determining the cost structure of a product. It is a simple process, but each of the steps includes a lot of information needs from the costs. (Sower and Sower, 2015, pp. 68–80)

After short introduction to the factors that are affecting on cost model creation, it is relevant to highlight that it is not reasonable to conduct the SCA to all items that company is buying from suppliers because it takes manual labour to conduct the analysis. Wong (2013) suggests that good rule to determine the items to conduct the SCA would be 20 % of the items that are making up 80 % of the costs. Price for the material got from SCA

might be wrong, but when going through the SCA with the supplier, supplier will show to the negotiator in which part of the SCA there are mistakes. At this point supplier accepts that not all of the SCA produced price calculation are wrong and is agreeing to the buyer's calculation in to some extent. (Hiller, 2012) In other words SCA is one tool to open discussions with supplier and that is viable on getting leverage position against supplier and to realize cost reductions.

5. CONCLUSIONS FROM THE LITERATURE REVIEW COMBINED WITH VIEW FROM CASE COMPANY

This chapter is created to summarize theoretical background from the literature review. The reason for summarizing is that there is no exhaustive amount of research done around Should-cost Analysis. Therefore, it is beneficial to create a chapter that is going to summarize the information gathered to the theoretical part to conclude what is meant when SCA is brought to the context of the case company and this research. The goal for this chapter is to clarify connections between sourcing strategy, IOCM and cost modeling to be able to define SCA for the needs of the case company. If we look at the figure 1 from the introduction chapter, it focuses on the case company's internal cost estimation ventures and strategic sourcing towards the common ground which includes IOCM practices. As we can see from the formation of the literature review, the emphasis is on SCA and VAVE activities, and those are seen to be the enabler for fact-based negotiations with suppliers after the case company has identified the suitable products from its purchasing portfolio. This chapter is going to be summarized with describing SCA and VAVE activities and their differences and connections. Also, this chapter is going to combine researchers own thoughts to the factors that are presented in the literature review.

5.1 Summary From the Literature Review

The literature review consists of most significant factors that might affect on desirability of SCA. Sourcing and purchasing strategy build the frame around operative sourcing and purchasing activities. It is critical for companies to create operative sourcing and purchasing strategy that is in line with its broader business strategy. Purchasing strategy can be usually seen to be built around PPM by Kraljic (1983). PPM builds the frame for product and supplier segmentation when considering different strategies to be implemented.

Although, PPM is a great tool to classify company's purchasing portfolio there is a critical factor to remember: it works poorly as a general strict guide on forming purchase strategies for companies. PPM should be used more as a guiding framework, and it must be related to every company's current situation in a suitable way. Tactical sourcing levers might be helpful in creating strategies for purchasing, but the usage of those has also to be matched company's current situation rather than to the matrix itself. (Hesping and Schiele, 2016)

IOCM activities between buyer and supplier are crucial when deploying strategic sourcing to the procurement activities. For successful joint cost management in the form of cost information sharing and mutual benefits for both parties in result, it is important to form a relationship that is in favour for this kind of collaboration. OBA and cost breakdowns from the products might be the keys for fruitful discussions to improve cost efficiency for both parties. The goal is that IOCM activities would not be benefitting only buyer, but both parties.

Cost estimation chapter included general introduction to cost estimation and modelling. That works as a base on presenting VAVE activities starting from defining value for the product. It is needed to understand the elements of VAVE activities. According to the literature review VE process is deployed for products in their design phase and VA for products after their launch (Kassa, 2016; Singh et al., 2017). ABC part of the literature review is introducing overhead allocation to production processes in general, which is crucial to understanding when considering product cost drivers and how indirect costs will be assigned to the products (Brierley et al., 2006). DtC method is relating to SCA as it is aimed at creating cost estimates for products in their design phase. Although, the difference is that it is building cost model based on target cost (Retolaza et al., 2021) rather than real costs of products like the SCA is doing (Sower and Sower, 2015).

5.2 SCA and Relation to VAVE

Conclusions from the theoretical part of the research will also include introduction to SCA and VAVE activities. VAVE is already in use in the case company and SCA can be seen as closely related to the VAVE processes. The distinction between those processes is critical to make visible to avoid overlapping work and that way minimize wasted resources from the process. In the figure 7 there is presented the designed usage of processes of Value Analysis, Value Engineering and Should-cost Analysis in the different phases of products life cycle.

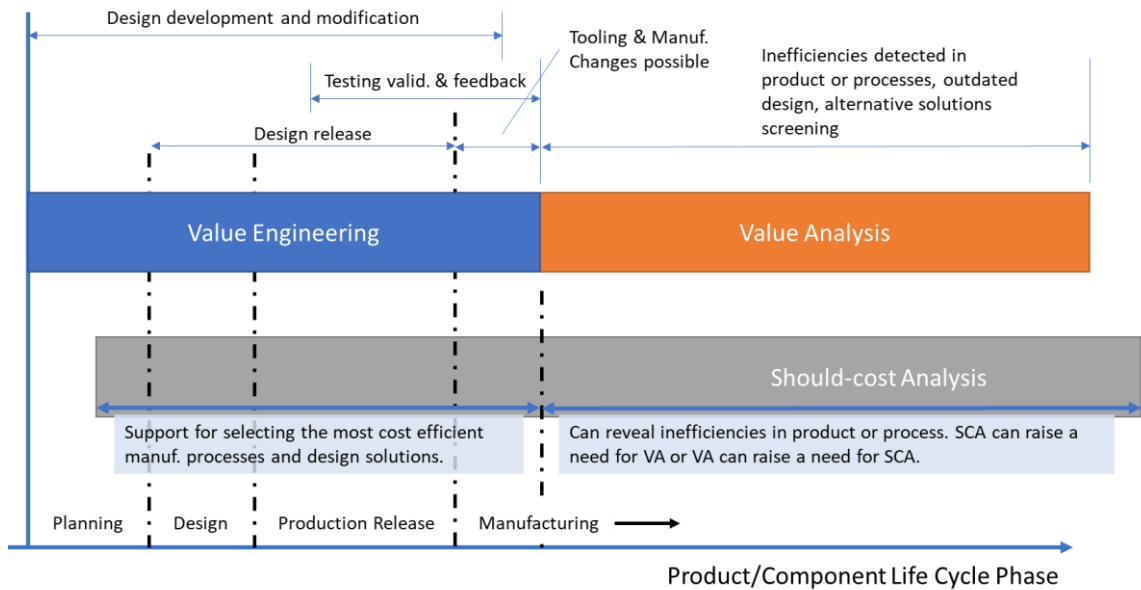


Figure 7. Utilization of SCA in different life cycle phases of a product.

First from the figure can be noticed that SCA is starting slightly after the process of VE, and it can be seen to continue after VA deployment would not be beneficial anymore. VE can be seen to help designers even in the earliest stages of planning of the product. On the other hand, SCA will need information on the chosen or to be chosen componentry, design, and processes to support on selecting the best combination of customer value and cost efficiency on a producer side.

In the end of a products life cycle, it might not be profitable to make design changes to the products by deploying VA process, but it might be reasonable to estimate costs of the purchased components and find some cost reduction opportunities by deploying SCA process if there are major cost issues identified.

By the introductions for SCA and DtC methods in the literature review of this research, these processes seem to have many features in common. DtC methods are applied on the design phase of a products life cycle. It is said that most of the product's costs are defined during the design phase. This underlines the need of a systematic approach to the design also from the cost point of view. VE can support product designers to select the most valuable elements of a product, that can include material selection, production method selection, component selection, functional analysis, etc. After defining the valuable elements, SCA steps into the figure. With the support of SCA design engineers can define the most cost-effective way to implement the design choices in cooperation with production, sourcing and purchasing professionals.

VA works similarly, only big difference being the life cycle phase of a product when the process is beneficial to deploy. VA is meant to be implemented to the existing products,

products that are already launched to the market and are in production. Process itself is similar, all the valuable elements of a product or a component are identified and then cost analysis can be conducted to support the decision. VA will need more specific selection criteria for the products that are going to be selected to the process, because it will require resources to perform functional analysis and cost analysis with the support of SCA in a desired way.

Cost modelling includes different factors that are going to influence the calculations of product costs (for example one classification introduced by Wong (2013)). In SCA there must be taken in consideration direct overhead rate and indirect overhead rate. Direct overhead rate includes all costs that have an affect directly to the costs, e.g., machine hour rate, labour rate and machinery related investment costs including energy usage etc. Indirect overhead rate takes in consideration the costs that appear from the facility investments, rents, liability insurances etc. In Should-cost modelling the goal is to have negotiation power against supplier and then it is considerable to focus on direct costs of product manufacturing. As a buyer there might not be much to negotiate regarding the manufacturing facility rents, however, the buyer negotiation power lies on how those costs will be assigned to the purchased products and the knowledge on ABC can be valuable for allocating those costs.

As table 1 shows, there are differences in the description of the processes of VE, VA and SCA. Main differences are that VAVE activities focuses on value of a product/component and SCA determines the best-in-class cost situation for the product.

Table 1. Own elaboration on the differences between VAVE and SCA activities based on literature and case company's approach.

Function	Description	Utilization	Initiator
Value Engineering	Most of the products costs (70-80 %) are defined in the design phase, VE can support on determinating the valuable elements of a product.	From early design phase of a product to a point where tooling and manufacturing changes are possible and the costs to make those changes are acceptable.	Can be initiated by designer, production, or SCA professionals.
Value Analysis	VA supports on identifying the valuable elements of existing products. Can support on decisions whether existing function is still needed, there is a need for new element, or if there is inefficient process on producing that function. VA can result in design changes in product or in production processes or both.	For launched products that are already on a market. In maturity life cycle phase of a product critical assessment of VA desirability has to be done to avoid excess costs resulting from making changes to the product that is not going to cover those costs with its sales.	Can be initiated by designer, production, SCA professionals, or even suppliers (by revealing better way to produce the product). Also, changed customer needs can be initiator as well as SCA by revealing excess costs.
Should-cost Analysis	Cost situation of a product. Considers all cost drivers. Can reveal significant inefficiencies in processes (for example production, purchasing, RFQ), usage of wrong material, better alternative location for production.	Can be utilized after costs for designed alternative features can be calculated (materials, processes, location) to the point where new design changes might not be desirable to deploy, but cost saving potential is real.	Can be initiated by product management, procurement, people conducting VAVE activities, or professionals that have noticed cost/process changes on market.

VAVE activities are tools for revealing the needed specifications to a product and SCA will define how much is it going to cost to produce that kind of a product. Initiation for SCA can be coming from when VAVE professionals identify unnecessary specification or inefficient production processes. On the other hand, SCA can reveal high costs related to a certain function and alternative options to fulfil customer needs concerning that product will be analysed by VAVE professionals. Next is going to be presented the methodological choices behind this research, the empirical research, and the results and conclusions to summarize outputs of this research.

6. RESEARCH METHODOLOGY

This chapter will introduce and conclude the chosen research methodology, data collection and data analysis methods, structure of thesis including theoretical and empirical sections. The purpose of this chapter is to give directions for the writer and the reader to understand the design of this thesis. This chapter's structure is following the structure of the chapter related to research methodology by Saunders et al. (2019) starting from research philosophy and continuing with approaches to theoretical choices, research methodology and strategy, and analysis of the results.

6.1 Research Methodology and Data Collection

This research combines theoretical information that is important on building the understanding on IOCM and product cost estimation methods in relation to the purchasing strategies in use. The goal for the research is to combine theoretical background to the empirical data collected from the interviews to form a framework for the selected products, components, or product categories that the case company should start the process of SCA, and what will be the benefits for the case company on implementing this SCA process. Saunders et al. (2019, p. 145) describes pragmatism to be a research philosophy that starts usually with a problem and the aim of the research is to form practical solution/-s to the problem with contributions of theory.

6.2 Research Philosophy

The current situation in the case company revealed major improvement potential for the procurement processes by implementing SCA. The goal for this research is concrete and practical framework to support decision making on which products or components case company should start implementing SCA, and to find what would be the benefits of deploying this process. Research includes a clear problem or a challenge and sets a need for a practical solution, which according to Saunders et al. (2019, p. 145) is in a line with the pragmatic research philosophy. Also, the nature of this research including interviews from different people in different organizations in the case company, it will require interpretation of the answers which are coming from slightly different contexts and that may imply that the research philosophy has also some nuances of interpretivism. As Saunders et al. (2019, p. 145) describes interpretivism, answers from people in different roles may differ because of different views to the issue in question. Although, this research includes nuances from both, pragmatist, and interpretivist research philosophies,

because of the clear practical challenge that sets the goal for practical and unequivocal solution for the challenge. In this case, information got from interviewees is coming from cost knowledge, which is the basis for the development needs identified. Also, with this Flick's (2018) approach to the research philosophy it can be deduced that pragmatist approach is the most suitable philosophy in the context of this research.

6.3 Approach to Theoretical Development

The method for conducting this research can be determined to be abductive. The starting point of view to this research is to build a theoretical framework for SCA and to the suitable strategy behind that. In the next phase, after building the theoretical background it is time to interview internal stakeholders to the team that oversees procurement processes and the development of those processes. During the interviews might be brought up information that makes it necessary to review the implementation strategy that would have emerged from the theory. After revising the theoretical section post interviews, it is possible to compare theory and the results, and recognize the possible causes behind these differences or to see if there are any gaps between theory and practical implication of the analysis method. Conducting this research can therefore be seen as an iterative process that has both, theory, and data collection for which the research is built on. Yin (2018) has noticed that in many cases qualitative researches start with deductive approach for theory testing through qualitative methods like interviews. Still, deductive approach might be supplemented with inductive data comparison to the existing theoretical background, which is combining these two approaches. Among many scholars, Saunders et al. (2019, pp. 152–153) defines this kind of process for the approach to develop the theory as abductive.

6.4 Qualitative Research

The primary source for the information to this research is qualitative, gathered from the interviews. As a secondary source for information is used information got from the director of the team and from the person who is leading daily operations related to SCA. This secondary information is not disclosed to the full measures in this research, but it is acting as a background information for researcher to be able to summarize results from the interviews to the actual context of the SCA development project. In this research the significant information is coming from the interviews and therefore the method of this research is qualitative.

Interviewing was selected to be the main method for sourcing information to support on answering research questions. Interviewing people around procurement and more

specifically people that are or have been working with suppliers, negotiating prices and setting specifications for product purchase agreements, and are aware of product category management strategy development can provide valuable insights on what are the characteristics that make distinction to the products that will be worth of allocating resources with more structured processes to analyse the costs of products with the characteristics that are not in favour of such resource investments.

Interview data is analysed in the light of literature review and the SCA development project actual progress. This is how the results can be tied to the context of the project progressing at the same time with this research and for it to be useful documented guide for the deployment of SCA.

6.5 Introduction to Interviews

The information gathering to build a figure of a desired use of SCA in the case company was implemented by interviews. Interviews were conducted as theme interviews. Theme rather than asking strict, simple questions the interview is going to build around discussion related to the research topic. In this research there were questions used as a discussion opener from the most important topics and then more open discussion was embraced with more specific questions or different point of views to the topic.

There were total number of eight interviewees interviewed, which is a low number, but even during those interviews the vision around SCA implementation was shared with the interviewees. In table 2 is presented codifications of the interviewees, dates and durations of each interviewee, red colour shows if the interview was recorded.

Table 2. Interview overview.

Interviewee	Date of interview	Duration of the interview
CM1	10.10.2023	~30 min
CM2	3.10.2023	~30 min
SM1	4.9.2023	~60 min
SM2	13.9.2023	~30 min
	29.9.2023	~60 min
SM3	16.10.2023	~30 min
SM4	29.8.2023	~60 min
SM5	15.8.2023	~60 min
VS	6.9.2023	~45 min
	11.10.2023	~45 min

Interviewees were consisted of five persons from senior management (SM1, SM2, SM3, SM4, SM5), two from category management (CM1, CM2), and one from operative VAVE function (VS). Besides those interviews, lot of valuable information from the SCA process

was gained during the discussions with the supervisors of this research as in Director of Procurement Excellence (DPE) and Head of Should Costing (HSC) in the case company.

7. EMPIRICAL FINDINGS

This chapter is going to present the findings from the interviews and the analysis of the interviews is going to be presented in the next chapters. The chapter starts with short introduction to the context of the research, and it is going to include introduction on motivation to implement the SCA to the procurement processes of the case company as a background information. After inductive part there will be presented the findings from the interviews, first introducing current state of the sourcing activities, then going through general benefits that interviewees see case company could achieve by implementing the SCA, next characteristics of the products/components that interviewees think would make them desirable to include in to the SCA process, and lastly challenges for the SCA implementation that was brought up in the interviews.

7.1 Case Introduction

The case company has made plans to start utilizing SCA with a designated process and team to do it. The motivation for the plans on implementing SCA lies in making the procurement processes more efficient and cost effective and increasing knowledge of the cost-drivers that are affecting the price of a product. By knowing the cost-drivers and mechanisms behind costs, it is possible for those professionals operatively implement procurement related actions towards the goals that are defined in the business strategy. In other words, doing sourcing and purchasing of products in a way to achieve better negotiation power against suppliers in contract negotiations, and to track their own performance against the best-in-class cost estimates. Negotiation power can be gained from the cost estimates that SCA is able to produce. Fact-based cost information is crucial on being convincing also in the eyes of the supplier.

Getting information from the production, procurement, and sourcing processes in the matter of costs is important on recognising the opportunities for process development and cost reductions. When company knows its own cost structure, cost formation, and the factors that are affecting to the costs, it is possible to compare for example, received quotes to cost estimations and calculations for the company to be able to better judge the quoted prices and have solid base for further negotiations with selected suppliers. The tool that is going to be supporting SCA actions is going to be 3D model based tool that will have a detailed 3D model from a product (with all needed information on materials) and together with information from production processes (available machinery,

manpower, machine hour rate, labour hour rate) it can calculate the cost of the product with selected production processes and methods.

7.2 Status and Challenges of Current Sourcing Processes Bringing Up the Need for SCA

For every company there is a current state of a processes and for every company there exists a need for developing those processes to stay along or ahead of the competition. In the case company's situation, the matter is improving its processes to ensure its leadership in the competitive field. Every development project should start by defining the current state and the problems or challenges that should be solved.

A big figure from the status of case company's sourcing processes can be formed by the information extracted from the interviews. The process does not differ from a generic traditional strategic sourcing process and when the need for purchasing a product is identified and the valuable features and specifications have been defined, starts screening for potential suppliers for those products. After potential suppliers have been evaluated, RFQ process is going to be initiated. For the most suitable, selected suppliers (usually 3-5 as for example SM2 and SM5 stated in the interview) is going to be sent RFQ with a defined need for the product and what is the quantity that is going to be needed. Also, in this point other relevant factors that might affect to the ingredients of the possible agreement and the price of the product, should be agreed by buyer and supplier. After supplier has received the RFQ, supplier can start evaluating if it could make a matching offer for the products. For the case company the sourcing process from sending RFQs to receiving an offer can usually take anything between days to months, depending on the RFQ.

After receiving the quote that matches the RFQ, case company's representatives (typically Sourcing Specialists, Category Managers, or Purchasers) will evaluate the offered price and products and evaluate the need for further negotiations with supplier regarding the offer. This phase of the process requires a lot of understanding and information about the pricing and cost drivers that are affecting the price. Determining the best offer is going to be based on the price, quality, performance of the supplier, and the match between suppliers offering and case company's customer's needs. Validation of the price is depending highly on the competence of the negotiating party and his/her knowledge on the cost drivers. The information for the costs can be difficult and time consuming to gather and the whole sourcing process can take a lot of time and consume lot of resources. Accepted purchase price on most of the components relies heavily on supplier offers and, on every case, where fact-based cost information would give better understanding

to the sourcing professionals it might not exist. Fact-based cost information would give purchase decision makers leverage to negotiate with suppliers, whereas if it does not exist it might lead to a situation where purchaser accepts a price too high including excess profit margin or costs within the cost-structure of the product.

A statement from SM1 describes well the journey from traditional sourcing towards more developed sourcing activities. The statement can be seen as a description of procurement activities evolving towards best in class by gathering information from purchases over the years and building a solid database to support on estimations made on the future purchases. This kind of information gathering is relevant for all companies that are buying products or services from the supply market to better understand their costs and pricing at the supplier end of the supply chain.

“I believe that normally companies will go through a saga, that during decades when company is growing, they are first RFQ driven without the knowledge of bottom-up costs any other way but just mapping them with quotations. The further they will go, the better they will become and eventually become better than their suppliers on the knowledge of costs. It still requires a lot of data, information, skills, and tools to basically do pricing better than supplier. ... We are starting to be there, if we want to continue growing, we need to become better in pricing in most of the categories that we are operating.” - SM1

Although, the current process works now, development is needed to maintain competitive advantage. SCA can be one part of developing procurement processes along with analysing historical data together with RFQs and current data, Linear Performance Pricing (LPP), drive teardowns of products, arrange idea generation workshops internally or with selected external partners to drive down the tooling costs and amortizations to give few examples that were raised up in the interviews. The important part to understand is that there is no easy and “one fits for all” kind of a solution, but more of a set of tools and methods that will be desirable to utilize when driving performance increase for the procurement processes.

7.3 Benefits for Deployment of SCA in the Case Company

Implementing SCA to be part of the case company’s procurement processes based on the interviews can offer a high level of increase potential in the efficiency of procurement processes for example, RFQ process can be more easily standardized for the product/component segments that are selected to the SCA process, on operative level, it can release valuable time from procurement professionals that they are now using on evaluating RFQ prices or setting target costs to the products, or it can offer fact-based

information from the costs of products to support sourcing operatives in the price negotiations.

Next is going to be gone through interview outcomes that are affecting to the efficiency of the processes on more detailed level. In the table 3 there are listed the concrete benefits that interviewees mention as opportunities that are speaking for SCA implementation in the case company. Opportunities and benefits that are mentioned in the table 3 will be discussed more later in this chapter. There are SCA related challenges reported in the table 3, also, and those will be discussed later in this thesis.

Table 3. Benefits and challenges for deploying SCA mentioned during interviews.

Interviewee	Benefits	Challenges
SM1	Tool optimizing the purchasing process, agreed cost parameters between cust. and supplier -> RFQ not needed. SCA for R&I and R&D activities supporting cost evaluation.	Definition on how great looks like missing, availability of drawings poor, transparency between functions can be a problem. By identifying the problems company is readier to answer the real needs and create a plan on how to make it work. Supplier processes should be understood in the long run to optimize our design.
CM1	Improving negotiation power against supplier, developing collaboration with supplier. Especially for single source products. Cost and value knowledge to be better in price negotiations. Own competence increase - more specific RFQs.	Even if it would be possible to know the costs of products, the supplier still determines its own LHR and the amount of used time. But it can raise possibilities to optimize the processes for the supplier? For certain components the supplier still can propose better solution, high competence and knowledge about components and the functionalities in certain categories like automation components. Overspecification at a risk - bigger costs.
VS	Improving performance against supplier, gain negotiation power. More efficient RFQ validation, RFQ process might be seen as a waste like SM1 said in a optimal case.	Collaboration with supplier must be in a high level. Products with big size and complex design more challenging.

SM2	Structured tool for pricing. Cost knowledge increase, SCA can reveal development needs in processes (or unnecessary processing) and competences, and also location dependent cost factors. Selecting the correct production process.	How do we want to feed SCA process. We need data, detailed data about cost drivers of own production. Need to determine the scope, TCO, TLC? How we can determine what information to include to the SCA.
SM3	If we change specifications of a product/component, it is easier to immediately see what will be the cost impact of the change, for example is the product more sensible to do by casting or machine it from a steel bar. Fact-based tool for estimating costs in a design phase and validating the costs in a prototype phase. Supports in price negotiations with supplier.	Requires OBA practices to be taken into use with supplier in necessary measures, sets requirements for the collaboration with supplier (willingness to share material and labour costs, and profit margins), smaller suppliers with less knowledge of the cost drivers might be more challenging to get the required information.
CM2	Understanding the changes in pricing, cost impact of cost drivers for the products. MHR, LHR estimations.	
SM4	Support the product design process. Product engineer might not be sure how much certain design cost (DtC methods). Existing products and their costs could be evaluated from time to time.	Tool selection and data collection to have sufficient information.
SM5	Competence increases within engineering, transparency and contact between manufacturing suppliers and product design engineer can be enhanced for example by tools like SCA. Deployment in early phases of design process is recommended to get the most benefits out of the tool and the process. Also, there are costs worth of millions of euros that we have not yet been able to have an impact before.	For small components SCA and DfX methods work well, bigger components require more manual labour, for example to move those around on shop floor. There might not be possibilities to have an effect to the shopfloor logistics. Therefore, the scope of the costs that we are going to be able to impact with SCA should be determined.

Although, cost reductions are mentioned in much research in literature, procurement management highlights in the interviews that the focus should be on making value to the customer, by making its own processes more efficient. With the focus on customer value, companies can see the top and bottom line of company's sales and income to be growing. Clearly some of it is coming from cost reductions, but the focus should not be mainly on reportable cost reductions, because then there is a risk of losing the elements that are valuable to the customer and therefore, lowest cost does not always mean the best value for the customer.

SCA can bring a lot of valuable information to the figure when trying to resolve cost issues of a product. SM1 brought up an example of a situation, sometimes it is possible that for example too tight tolerances can cause large amount of quality issues resulting in a large amount of waste at the supplier side, which might be causing costs that are not clearly visible to the case company. In this case if the tolerances are required and those specifications requiring tight tolerances are stated to be impossible to change, SCA can give an output for the need for optimizing cost of labour, which can mean that components should be more beneficial to be produced in a different country. SM5 mentioned a similar observation to the example, cost of labour or cost of material can have a large impact to the costs depending on the geographical location of the production. SM5 also brought up a thought that if the product or component has to be made close to the customer globally, case company should evaluate on for which kind of characteristics can determine if the component should have different design for different manufacturing location, for example in some locations it would be beneficial to optimize the material usage of a product (low labour cost, higher material cost) and in some other location to optimize the labour cost (low material cost, higher labour cost).

Negotiation power was mentioned often as a benefit of the SCA deployment. CM1 stated that especially in single source situations it is good to have fact-based knowledge on the product's costs to have better understanding and negotiation power in the price negotiations. For products that there are no competing offers available, negotiation tactics can be difficult to form. CM1 mentioned also that price changes and price lists come too often from suppliers as given and it might be very difficult to challenge those changes without proper information on costs. For example, SCA can give better view on material or labour costs without the need for complex calculations conducted by the case company's category managers, sourcing specialists or purchasers on a regular basis. The relationship with supplier might even be on a healthier ground when the supplier knows that customer has real knowledge around the costs of the products.

Improving efficiency of RFQ process, understand costs of products and production processes, and understand pricing of supplier have now been discussed. According to the interviewees, SCA can be seen having major potential to increase the competence of personnel related to knowing the costs of products. The increase in competence can be possibly experienced in different levels or departments of the organization. SM5 brought up product designer's visibility to the actual production costs. Although, the case company has a set of talented designers working for it, it might still be difficult to see the cost impact of every design choice. SM5 said that it is usually caused by lack of visibility or communication between designers and production. SCA tool and for example team of should-costing engineers can support and eliminate this gap in cost information sharing within the company. By having a tool to reveal the those cost impacts, it might be easier to determine the right design and the process to implement the design. In this case SM5 also highlights the need for a VAVE process, too. By utilizing VAVE, designers can determine the valuable elements of a product and then have the possibility to compare the cost impact of each potential design for the element or feature by conducting SCA.

Despite SCA is mainly focusing on improvements affecting buyers' side of the supply chain, in this case the case company side, it can have a positive effect on both buyer and supplier cost efficiency. SM4 said *"If we can reduce the costs of a product together with the help of a SCA, we can improve the efficiency of both parties. Lower costs will help us to allocate more business to that designated supplier. That way we can grow the business together."* (SM4, interview 29.8.2023) In order for case company to be able to have a possibility to propose supplier to make investments that are required to develop the spotted inefficiencies, communication related to costs and processes will have to be as open as possible. The truly open communication as in OBA can be seen one of the challenges that when implementing SCA could be faced. Next chapter is going to address this challenge amongst other challenges that emerged in the interviews related to the SCA implementation.

7.4 Challenges Related on Deploying SCA

There were many potential challenges raised in the interviews and this chapter is going to be addressed on those. Challenges were related to data quality and availability, collaboration with suppliers, supplier determining, and amount of labour used to produce the product which case company might not be able to have impact, and the selection criteria that is going to determine products that are going to be included to the SCA process. The selection criteria are presented in the previous chapter so it will not be discussed in this chapter.

SM1 stated in the interview that the case company does not yet have clear view on how the optimal process should be constructed in relation to the SCA, in interviewees words "Definition on how great looks like is missing". To successfully deploy any process, like the SCA process, development team must have clear vision on what is the end goal, what are the aspirations behind deploying the process and what is the roadmap towards successful deployment. Now the case company needs to develop a plan, standards and find the possible challenges that also needs to be overcome. SM1 were highlighting the importance of understanding the supplier processes for the case company to be able to optimize its products' design. Improving efficiency of the purchasing and sourcing processes by designing more suitable products to match capabilities of the suppliers will be related to this challenge very closely.

One of the first challenges that emerged during the interviews was quality of information available. The tool calculating the actual SCA needs 3D-drawings from the products as an input for it to be able to calculate costs for the products. Now there are problems to be solved with existing products and the availability and quality of 3D-drawings. In certain categories, for example castings, the availability of drawings (especially 3D-drawings) is not great, and the quality of available drawings might be questioned due to outdated drawings in most of the products. Slightly better situation is with machined parts, but as SM1 said, it requires a lot of time and resources from engineering to collect or create the information on missing drawings and creation of the 3D-drawings. This kind of a problem is causing delays in RFQ and in SCA processes. For the sourcing purposes, in many cases 2D-drawings might be sufficient, but for the SCA tool it is necessary to have also up-to-date 3D-drawings of the products. Especially SM1 and SM4 brought up this challenge of having sufficient information to calculate SCA with the existing products that have been in the case company's purchasing portfolio for years or even decades.

Requirement of open cost information sharing between buyer and supplier can be seen as an opportunity and as a challenge. When OBA practises are in use the collaboration can be seen enhanced and the trust between the actors to be better. On the other hand, OBA often requires partnership and longer-term relationship between buyer and supplier as SM5 stated in the interview: *"The challenge in this case is to get the supplier to accept this kind of openness with sharing costs, because it reveals their profit margins"*. SM5 also states that it is crucial to have better knowledge on own costs to avoid paying price premiums by accepting an offer from supplier with too high price. SM3 was also mentioning that OBA practices can set requirements for the collaboration between the actors, for example supplier's willingness to share direct cost information and profit margins. Also, one interesting and worth mentioning fact raised in the interview with SM3,

especially smaller suppliers with lesser knowledge about their cost drivers might set a challenge when negotiating prices or costs with them. In many cases it might be discriminating factor on becoming a designated supplier to the case company or not if the supplier does not have deeper knowledge of its own costs. SM1 also adds on a view that OBA could be required to become a strategic (e.g., partnership between buyer and supplier) supplier to the case company.

One challenge on the point of SCA's view is the cost drivers that cannot be impacted from customer side without deep collaboration between buyer and supplier. LHR was mentioned being such cost. Every supplier can define the labour rates and the time they are using to produce products by themselves. It can be major differing variable in different countries and in different production settings that supplier may possess. However, there might be a slight opportunity to gain trust from a supplier if the case company can find possible inefficiencies from the supplier's processes with the help of a SCA. Level of this kind of knowledge from supplier's processes is also again requiring open communication around the cost drivers, but by improving its supplier's processes, case company might be able to allocate more orders to the supplier if they are willing to lower the price in result of a lowered costs of the product as CM1, SM2 and SM5 were stating in their interviews.

Lastly, one challenge, or it might even be described as a feature in this kind of procurement process development and implementation of SCA is roadmap creation. In every interview the cost-competitiveness of products were brought up. Also, in the interviews were mentioned that there are products that have issues in the cost-competitiveness and the hope is to take those products or components into the SCA calculations as soon as possible. That sets requirements for the roadmap creation, case company will need to look on to the products or components that are in hurry to be revised and at the same time create strategy for the long-time functioning of the process as the SM1 stated.

7.5 Product Selection Criteria

In this chapter is going to be presented the outcomes from interviews related to product characteristics that can define the desirability on using the SCA to improve product cost efficiency with reasonable usage of resources. Interviewees from category management and leader from sourcing processes could give concrete examples of a products that in their opinion should be included to the SCA process. Products and their characteristics mentioned in the interviews are presented in the table 4.

Table 4. Suggested products and product characteristics to determine the desirability to deploy SCA.

Interviewee	Suggested products	Product characteristics
SM1	-	We need to select those categories and suppliers that we want to have more knowledge. Usually companies start from mechanics. Volume selection, spend selection, design complexity can require a lot of resources. Mechanical components where MHR and LHR high, a lot of machining etc. Analyse processes etc. that where value could be added.
CM1	I/O Modules possible from automation components. Mechanic components. Electric and automation components can be difficult. No IPR, brand impact to the price etc.	IPR, Supplier and location of product does not matter too much, machined, sheet metal etc.
VS	More efficient to the products that are simpler in design.	Proprietary products (motors etc.) are not in scope. Own design, High spend/High value products for both VAVE and SCA
SM2	-	High spend, parts that needs some review
SM3	Steel structures, sheet metal, machined parts. End carriages, load beams examples from a bigger components.	Simple design, high spend, high volume, high costs.
CM2	Empty cubicles	High spend/High volume/High costs, products with fluctuating prices due to material price changes - easier access to the causes of pricing changes
SM4	Can be used for commercial componentry too, products should be sliced down to a components to determine the scope for the parts we could have an impact. Mechanical products in the first scope. IPR offers opportunity to have an impact to design and cost. Mechanical, machined, sheet metal.	Competitive position of a product defines priorities for product selection. High spend/high volume - smaller improvements will have bigger impact.

SM5	For example, machined, smaller parts, where the costs can be easily validated.	-
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In the table 4 are listed the products that interviewees were having interest on being included to the SCA process, which contains the most important factors in the context of this research to be considered when developing strategies for the operations around SCA process. IPR is one key factor when interviewees were asked what kind of products they would like to include in the SCA process. When the case company has the IPR of the product, it can freely change its design, materials, production methods, etc. and that gives freedom to use the results got from the SCA calculations more effectively. SM4 also stated that he had seen great results from earlier working career when costs of commercial products (products that buyer does not have IPR) have been analysed. SM4 highlighted that with those products the scope to what components would be reasonable to include in SCA calculations should be determined carefully. Bigger product assemblies should be sliced into small enough portions for the buying company to be able to determine if it could have an affection to those costs.

Complexity of the design of the products was also mentioned in the interviews. VS said in the interview that products that are smaller in size and simpler in complexity, the SCA will be more efficient to deploy. Simple design and small products were mentioned also by SM5 and SM3. Simple design alone was mentioned by CM1, CM2, and SM4. Usually, these products with simple design are, in the of case company, mechanical or sheet metal components for which the SCA will be relatively easy and effective to calculate and has been done manually for example by category managers. This allows the procurement professionals to reallocate the time from the manual calculations that was used to calculate cost estimates for those products.

From the steel structures, machined, sheet metal, or even simpler electrical components there were few examples given. SM3 mentioned that steel structures and machined components could include for example load beams and end carriages that are bigger in size but simple in design, which would allow to find bigger improvements on costs due to the high cost of these components. CM2 stated that from the sheet metal products empty cubicles would be interesting to involve to the SCA process, because of their simple design and manufacturing methods. CM1 was thinking if simpler automation components like I/O Modules could be included to the process, even if they are most of the times commercial products. In the case of automation components CM1 said that at least the case company could increase knowledge of those components to support validation on

the right product selection from the supplier catalogues and this can increase negotiation power over supplier in the price negotiations.

Complexity of the design, size of a component and IPR are important criteria to be considered when selecting products to the SCA. But in every interview spend and volume of purchased products were mentioned. To be more precise, high spend, high volume, or high value was seen as a requirement on the desirability of deploying SCA. All these qualities of purchase value or volume were said to have an impact on the selection of the products. For a product with high spend, high volume, or high value even small improvements on process efficiency can lower the level of waste or result in cost savings on selecting different material or location for product. SM5 raised an interesting view that for smaller and simpler components SCA will be easy to deploy, but it can potentially cause that big and more complex products can be forgotten. In SM5's point of view the most important products are the most valuable products that the case company has not earlier had ability to have an impact on cost-wise. As SM5 highlighted *"There are costs worth of millions of euros that we have not yet been able to have an impact"*.

To add one more quality for the component that was seen desirable to deploy SCA, cost competitiveness was seen an important factor. If the product is performing poorly in a cost competition on the market, it should at least be analysed if SCA could support the cost reduction needs for example by revealing process improvement needs causing excess costs. SCA has potential to reveal cost savings opportunities, but as SM1 said, cost reduction needs will not alone be initiator for the SCA process. All other qualities of the product in question should be analysed before to define the desirability for the SCA process deployment.

8. SUMMARY AND CONCLUSION

In this research there have been presented literature review that is creating a domain to the framework built in the literature summary. After literature review and summary was presented the actual interview results as a goal to present current situation of sourcing processes in the case company and after that benefits, desired products and their characteristics, and possible challenges that the case company might face when implementing SCA. This chapter will be divided into discussion, answering the research questions, and lastly is going to be presented limitations and potential needs for further research. Discussions will include more research approach by combining thoughts from literature to the findings from the interviews and mirroring them on where they are complimenting each other and what might be differing between theory and practical world. There also will be presented shortly how the SCA process in the case company has started and will continue. Answer to research question 1 will summarize the benefits of SCA deployment for the case company and answer to research question 2 will summarize desirable characteristics for the selected products.

8.1 Discussion

Discussions is written more on a research approach which means that it will combine theoretical background to the findings and present findings based on the discussion between these two domains. The chapter begins with thoughts about strategy development around SCA implementation, then it is going to be tied to the interorganisational context and lastly is presented findings on how theory from cost estimation methods aligns with the findings from the interviews.

Based on insights gotten from the interviews, the first step towards SCA process implementation is the roadmap and strategy development for the short- and long-term operation of the SCA process. In the interviews the products that needs attention to reduce their costs were the first ones that were mentioned. Those products are examples for the short-term plans when considering the deployment of SCA. Hard benefits of implementing SCA, like cost savings, can be tested against case company's assumptions by deploying SCA to the products that already have identified possibilities to make their cost structure more efficient. Strategy for the SCA operations, also, is going to be built for long-term goals. In a strategical point of view purchased products are going to be divided into four different categories as are the suppliers for the case company: strategic, bottleneck, leverage and non-critical items and suppliers. For the strategic items literature

highlights long-term availability as a critical success factor (Bodendorf et al., 2022; Krause et al., 2006) and in the case company strategic supplier and product can mean also more partnership like collaboration to develop products and the relationship to improve processes and cost efficiency. Bottleneck items represent in the literature cost management and short-term sourcing ventures (Kraljic, 1983). Issue with bottleneck items and suppliers are that long-term availability of the products might not be an easy task to ensure. SCA can offer support managing costs in the availability issues by producing information on the costs for the possible alternative options that can replace products that have the biggest impact on cost efficiency in the case company's purchase portfolio. According to the interviews these two product categories, strategic and bottleneck, are the ones that SCA can offer biggest support on improving wasted time on RFQ validation and money on revealing excess costs. When analysing purchasing portfolio sophistication matrix that is dividing purchased products into four quadrants according to their importance and supply risk, supply risk is highest for strategic and bottleneck categories (Kraljic, 1983). And as that was highlighted in the interviews, there might not be many alternative options available and therefore cost negotiations without thorough knowledge on product costs might not be as successful as possible.

Leverage and non-critical items' cost efficiency is easier to be controlled by more traditional sourcing activities as the supply risk is smaller and usually there are alternative suppliers and products available to secure case company's supply demand (Kraljic, 1983). With these products SCA can be seen wise to be applied in more as a cost updating tool. High spend caused by high volume and/or high value of purchased products are wanted to be evaluated first to validate current prices and to understand supplier pricing future better. In that way case company can prepare better for the future price fluctuations and to understand if the price changes are valid or not.

The effect of SCA deployment can be seen to be different for different functions of organization. There are four internal key stakeholders identified based on the interviews: management, procurement, engineering, and production. Each of these functions will have different interests and benefits coming from the deployment of SCA deployment.

Management of a company sets the goals for the processes and functions based on the business strategy of the company. Measurement against goals is done by performance reporting. By accurate performance measurement it is possible to deduct if the processes are working as they should and to find the needs for improvement. Management is also aware of the cost issues and can make decisions related to the products that are going to be needed to be reviewed by the SCA to identify the issues on costs. Management

can also set goals for the SCA team on how they should perform and how the performance should be measured over time.

For production and engineering professionals SCA deployment will mean close collaboration during the SCA process. Like discussed in the interviews, it is important to form correct ways to arrange the collaboration between production and engineering without forgetting that SCA dedicated team also does not operate in vacuum. Professionals from production can validate design changes and if the design is possible to produce. They can also bring up problematic designs or processes related to the products and then in collaboration with SCA team, VAVE specialists and engineering professionals will decide the best alternative option.

VAVE activities and SCA processes must be defined to avoid overlapping activities and wasted time. In the literature separating factor between VA and VE is their beneficial application period in relation to the products phase in their life cycle (Retolaza et al., 2021). Like stated in the literature review VAVE activities are more value orientated than cost orientated. During the interviews, procurement professionals were all mentioning the cost benefits before value benefits related to VAVE. That is because processes or components that are not matching their expected value can make the costs surpass the benefits. For example, VS stated that the VA starts usually from a need that is recognized by production workers, production managers professionals that are questioning existing processes, designs or materials used to produce the product or component. It can be argued that SCA is more often raised from the cost perspective and VAVE is initiated by the production or product design professionals.

Interviews raised many benefits that SCA deployment has potential to achieve. Those benefits are going to be presented in the next chapter. It will include general benefits coming from deployment of SCA process and benefits that are seen to be affecting directly to different departments of the case company.

8.2 Answer to the Research Question 1

RQ 1: What are the benefits and challenges of deploying an SCA process?

Answers from the interviews were well aligned with the material that is included in the literature review. IOCM literature highlighted importance of collaboration with supplier, and the collaboration in this context is sufficient information sharing between buyer and supplier. Knowledge on costs that SCA can provide might result in more healthier relationships with suppliers and even give credibility to the price negotiator in the eyes of the supplier.

Realisation of the benefits of SCA are depending on multiple factors related to procurement decisions, engineering and design decisions, and supplier capabilities, size, partnership level, and willingness for more open collaboration with the buyer. SCA requires deep level of communicating cost information and trust between partners, but calculations from SCA can support in most of the price negotiations by offering facts to give better negotiation power to the buyer. As mentioned in the interviews, all suppliers are not willing to share their cost information right away, and SCA can support in these kinds of situations. Revealing knowledge on costs in needed measures and challenging supplier's vision on pricing can help in opening more open discussion around costs. Best scenario would be if the supplier were to provide detailed cost breakdowns to the buyer, in that way excess costs could be seen more clearly by the buyer and in best case it would reveal inefficiencies on supplier side and result in valuable information and savings for both parties.

Direct cost information sharing and agreement on cost parameters still does not give the freedom on not actively update the cost information and negotiate new cost levels when for example there is more efficient production processes with better machinery available. So, updating cost information, keeping on track with competitors pricing and production processes and updating case company's own knowledge shall not stop even if it has now the best-in-class pricing available with some of its suppliers. Situations are likely to change, and the case company would need to be ahead of those changes to stay competitive over long period of time. The tool for calculating SCA is to be used in these kinds of situations, it can easily make visible the impacts for example if new and more efficient production machinery would be taken into use or if there would be material or tooling changes in the processes.

If we are looking at the engineering professionals in the case company, it sees that deployment of SCA process can bring visible all cost drivers of the product. That will support engineers to make right decisions related to the design of a product. Design of the product determines used production methods, usage of material and the raw material that the product is going to be made of and therefore is directly linked to the costs. Engineering competence regarding on making right design choices is likely to increase, and it will benefit case company on making its processes more efficient and products more cost effective.

As been said in the interviews, SCA can enhance the efficiency of the procurement processes and have direct impact on used time in for example RFQ process. In the interviews there were described an optimal process for SCA in the case company that can be used if buyer and supplier are going to agree all the parameters behind the cost

drivers of the product. This of course demands highest level of transparency between the contract parties so that the cost drivers can be agreed on both sides. Also, in this case there will be a tool for building the SCA or should-cost model for the products. The tool has information on the latest production processes and tooling available and has MHR, LHR, processing times, setup times, and all other relevant cost drivers as parameters that are going to have an impact to the costs of a product. With the transparency and trust between buyer and supplier and with the tool that can calculate costs, buyer can in optimal case, save time by setting a purchase order without time consuming RFQ process. In this kind of case, buyer can send the 3D drawing of a product to the supplier who is going to produce the product with the agreed costing parameters. This will of course be the ultimate solution and is not suitable for every supplier or product type. Supplier will have to be strategically significant and the product simple enough for the contract parties being able to agree on costing of every element of the product.

8.3 Answer to the Research Question 2

RQ 2: What are the key characteristics for the purchased products that define the desirability of SCA?

Repeating message during the interviews was that we need to be aware of the factors that might make the product more suitable or unsuitable for the SCA process. There can be seen clear linkage between literature related to more complex cost modelling techniques and the statements that production and procurement professionals gave during the interviews. Complex cost modelling will require software as a resource and human work inputs to conduct and validate cost estimates that the software is able to provide. In the literature Wong (2013) stated that SCA would be reasonable to deploy for 20 % of the products that will cause 80 % of the costs. Big spend was mentioned in the interviews also. It is important that the potential for cost improvement, either in directly connected to the products (material, production method) or indirectly by process improvement (minimizing waste by developing sourcing process for example), is big enough. Otherwise, if the cost reduction potential is not big enough, the cost of conducting the SCA process will surpass the benefits it would be able to produce.

In the context of the case company, interest lies in the products or components that are going to be selected for the process. Literature was able to provide small amount of characteristics that would be seen favourable to include in such complex cost estimation process. High costs and high value were the combining factor in the literature. The same message repeated in the interviews, but interviewees were able to identify more specific and concrete factors for the products and components within the case company. Owing

the IPR and design being simple enough were the factors that repeated in every interview. Machined and sheet metal products were seen in interviews to be the most potential group of components to start with. Those are products, which costs are relatively easy to validate and to negotiate with suppliers, because of the simple cost structure. First scope for the deployment of SCA those kinds of simple components would be reasonable to start with, that way it is possible to see how the process functions and to identify improvement needs for the future development.

There is a clear need in the case company for the SCA implementation to be viewed in two different timelines, short- and long-term. These two timelines are shown as two scopes in figure 8. Short-term timeline will be focused on building capabilities to solve cost issues for the most urgent needs at the moment and is presented as scope 1. Long-term timeline focuses on building structured and detailed strategy for the SCA operation to fulfil its goals during and after the urgent cases are solved and will be presented as scope 2. Although, it is important to acknowledge, that there will be always emerging products that will have issues in cost competitiveness, availability or some other issues that are bigger than with other products. Therefore, it will be necessary to prepare the strategy in a way that it will define actions that are going to be stated as daily operations and form ways of working to support that (collaboration between procurement, engineering, production, and management) and make sure that urgency of the need for SCA is identified and the actions resulting from the urgency are deployed in correct measures.

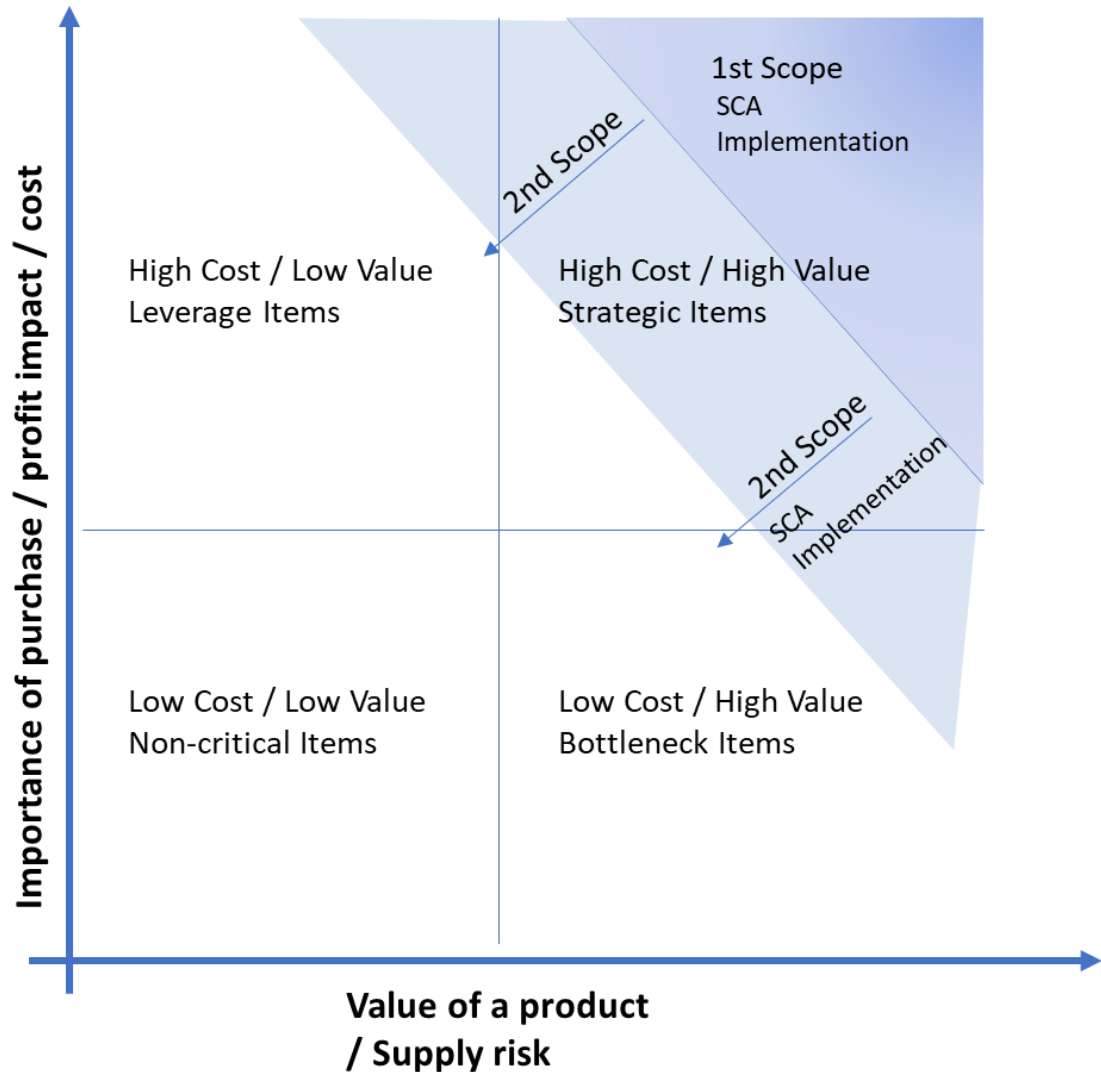


Figure 8. Different type of items and 2 different scopes to deploy the SCA.

During the interviews, there was brought up a clear need for cost improvement for certain existing products and components. Cost issues that are going to impact the product's competitiveness on the market are wanted to be solved as soon as possible. Also, at the same time there must be defined long-term strategy on how SCA process should be operating on a daily basis over longer time period. Therefore, the implementation of SCA should be done in two different scopes for desirable product characteristics. First scope considers products with cost issues, their cost and value are high, and they are suitable for SCA process. High cost/spend and high value products are chosen to the first scope, because there the improvement potential is likely to be the highest. Also, SCA process is needing resources from SCA dedicated team members, from designers, product managers, and professionals from sourcing and purchasing teams and savings potential has to be bigger than the invested costs in a long run. In the case company this first scope is going to be started by pilot project, which helps procurement managers to make

decisions related to required resources and to refine the long-term strategy to match case company's business strategy. The first scope also gives directions on how internal collaboration between functions should (procurement, product design and management, and production) should be arranged. SCA is also a tool for supplier negotiation and therefore information flow to sourcing and purchasing professionals should be included in strategy considering SCA.

The biggest cost and process improvement potential lies in a design phase of a product, and it is going to be considered when creating strategy for SCA. At the same time as pilot project is deployed, long-term strategy is formed. In the figure 8 longer term operations are forming the second scope. First scope includes existing products with cost issues, the second scope will also include products that are in design phase. In the literature review, cost estimates are mentioned to be the most effective to the products that are in their early design phase. SCA as a fact-based tool for estimating costs for a products that can support selection of the best alternative designs together with VAVE activities. It can also support in developing IOCM activities and in enhancing more open discussion and information sharing with existing or potential new suppliers. When case company has best in class knowledge on costs, it can gain negotiation power over suppliers by for example being able to allocate more business to suppliers that are willing to become a strategic supplier.

8.4 Managerial Implications to the Case Company

This research is supporting the idea behind a need for deployment of a new cost management practices to the case company. The objective for this research was defined by the case company and it was to define the benefits for the deployment of SCA and for what kind of products it would be desirable to implement. Also, VAVE activities were identified to be related to SCA process closely early in the problem defining phase in with the representative from the case company, and that connection was enhanced during the research.

Professionals who have been involved in procurement related activities in their working career showed interest in taking the SCA process and tool to be a support function for developing procurement activities more efficient. One main message related to the SCA process besides the tool selection and the selection of materials to be included into the process was to set up collaboration between key stakeholders internally. SCA dedicated team should be closely working with engineering, VAVE specialists and sourcing professionals. This collaboration should be included in the process of SCA to avoid the pitfall

of duplicate work in different teams and to ensure that decisions are made by identifying all necessary information available.

The first task after deciding to start selecting the tool for better visibility on products true costs is to determine the information needs for the tool to be handled. It sets requirements for the tool and narrows options for the tool provider. For the requirements of the case company the tool must be able to provide as accurate as possible estimations for the cost breakdowns of the products. That must include all relevant cost drivers (e.g., material price, labour rate, machine hour rate, production cycle time, setup time, batch size), which will be able to be calculated by the chosen software. One challenge is that the software will require up-to-date 3D drawings from the parts that costs are going to be estimated. The case company has started to gather information regarding the status of drawings available, and the next step is to update the drawings to the level that is needed to conduct the calculations. Starting from the ones that are going to be included into the SCA process in the first scope.

8.5 Limitations

There can be identified few limitations to the research. First and foremost, of the limitations is the researchers lack prior knowledge around SCA. On cost estimation techniques the researcher was familiar with but specifically SCA was new technique for the researcher. Small amount of research literature available from SCA did not make it easier to produce exhaustive literature review. SCA characteristics had to be built by utilizing elements from similar cost estimation methods and to describe the possibilities of SCA in the context of the case company it was important to introduce for example VAVE and DtC methods as they were identified to be closely related to the SCA operation.

Time in use was one limiting factor to the research process. There was given six-month time frame by the case company to conduct the research, which was enough to fulfil the aim for thesis. At the same time, SCA development process was only starting and at the end of the research process, the SCA deployment project was still on its starting phase. It was expected to be so from the start of the research process. That was limiting the use of data because it was not yet existing during the research process. Although, interviews gave a good and positive signal from the procurement leaders and professionals that they are interested and committed to support SCA process and are believing to its potential.

8.6 Possibilities for Future Research

At the time of this research, there is very small amount of research literature available directly related to SCA. In general, there lies potential for research related to SCA process, for example the benefits on the general level. Specifically, when considering the context of this research it would be interesting to research to which kind of characteristics will define the profitability in SCA deployment. For example, how significant is the complexity of design of the selected products or components that the SCA is deployed especially in industrial context.

Hesping and Schiele (2016, 2015) for example have researched sourcing levers and their significance in sourcing processes and their relevance in constructing sourcing strategies. Interesting approach for research related to Hesping and Schiele's (2016, 2015) sourcing levers and would SCA implementation have any affection to the usage of those levers and what kind of affection it could be. SCA is affecting to price negotiations and sourcing processes, but would it ultimately have an affection to the sourcing and purchasing strategy creation? Within possible interesting new research areas related to SCA there might be different approaches and options to go with. Hopefully, in the future there will be researchers interested in studying SCA more deeply for us to have better understanding around this topic.

In the interviews, there were mentioned that SCA would be interesting to implement also to commercial products. Most of this research and most of the research that I found related to cost estimation techniques, were done with the focus in manufacturing and design of the product. The potential of SCA with purchased, commercial products and the scope that it would be beneficial to utilize might shed some light to the full potential of SCA.

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APPENDIX A: FRAME FOR INTERVIEWS

This interview framework includes themes that were discussed in the interviews.

The status of procurement/sourcing activities in the case company?

- How sourcing is done, and the offers judged?
- What are the biggest challenges with the activities now?

SCA benefits for case company?

- What is the end goal for deployment of SCA?
- How should we align procurement, production and product management/engineering functions to get the benefits out of the SC activities?
- What could be the situations when conducting SCA could be less profitable and why?

Product selection criteria

- What are the most important characteristics of the products that can define if it would be beneficial to do SCA?
- Are there products/product categories that conducting SCA would be no go?
 - Costs that we cannot influence.

Supplier related factors

- Are there requirements with the relationship with supplier?
- Single source vs. Multi source ?

VAVE and SCA differences?

- We are doing VAVE activities in the case company at least in one function, so how would you see the differences between those two?
 - Overlapping or complementing each other?
- Are there clear differences with the selection of the products that will be better to do VAVE or SCA?