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EX ANTE ACCOUNTING INFORMATION IN ANALYZING DISTRIBUTION CHOICES: CASE US LOGISTICS CENTER

Master's Thesis
Faculty of Engineering and Natural Sciences
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ABSTRACT

JERIS TANUS: Ex ante accounting information in analyzing distribution choices: case US logistics center
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Effective management accounting requires that scarce organizational resources are actively directed towards creating information with most managerial value. This master's thesis therefore seeks to further the understanding of how managers utilize ex ante accounting information and what information qualities managers consider most important. This is done by creating ex ante accounting information for a case company and later analyzing its use and the associated quality requirements. The first research question of the thesis is: *how should different product configurations be distributed to the US market to ensure long-term profitability?* This research question addresses the case company's uncertainties regarding an expansion of US operations and seeks to identify general guidelines for feature option distribution. The second research question is: *how do managers use ex ante accounting information in decision making, and what kind of requirements a new decision-making situation sets for ex ante accounting information?* The case company situation studied in the first research question is used to analyze the use and requirements for ex ante accounting information. The objective is to further the understanding of how ex ante accounting information is used in decision making and to provide insights with which management accountants can effectively create valuable ex ante accounting information.

The findings indicate that product configuration related distribution-decisions should be based on analyzing the dynamic in which different configurations affect profitability and the operational challenges associated with distribution alternatives. In the sample case, this meant distributing feature options in a way that maximizes the overall sales of the case company's product families. Studying the use of accounting information showed that managers mainly utilize ex ante accounting information for learning about issue at hand by identifying and weighing factors affecting it. This information is then used to direct attention and analysis. Ex ante accounting information is also used for setting financial boundaries in which decision-alternatives should reside for a more detailed analysis to take place. These uses display in the associated quality requirements. While reasonable accuracy is expected, completeness and believability of accounting information were considered most important. These quality factors work as enablers for trust to be given to the accounting objects representing an uncertain phenomenon and for the information to be used. Representational quality supports in establishing trust in the accounting objects and supports the knowledge integration when creating ex ante accounting objects. Based on the empirical findings, a four-step process model is presented for efficiently creating valuable ex ante accounting information.

TIIVISTELMÄ

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Yrityksen rajalliset resurssit on aktiivisesti ohjattava sellaisen informaation luomiseen, jolla on suurin arvo yrityksen päätöksentekijöille. Tämä diplomityö pyrkii siksi parantamaan ymmärrystä siitä, miten yritysjohto hyödyntää ex ante laskentainformaatiota, ja mitkä ex ante laskentainformaation laatutekijät ovat yritysjohdolle tärkeimpiä. Aihetta tutkitaan luomalla laskentainformaatiota kohdeyrityksen ongelman ratkaisemiseen, ja analysoimalla sitten laskentainformaation käyttöä ja sille asetettuja vaatimuksia. Diplomityön ensimmäinen tutkimuskysymys on: *miten eri tuotekonfiguraatioiden jakelu Yhdysvaltoihin tulisi järjestää pitkän aikavälin kannattavuuden varmistamiseksi?* Tutkimuskysymys vastaa kohdeyrityksen Yhdysvaltain liiketoiminnan laajentamiseen liittyviin haasteisiin, sekä pyrkii tunnistamaan yleisiä suosituksia optiotarjoomien jakeluun. Työn toinen tutkimuskysymys on: *miten yritysjohto hyödyntää ex ante laskentainformaatiota päätöksentekotilanteessa, ja millaisia vaatimuksia uusi päätöksentekotilanne asettaa ex ante laskentainformaatiolle?* Tutkimuskysymykseen vastataan analysoimalla ensimmäiseen tutkimuskysymykseen vastaamisen yhteydessä luodun laskentainformaation käyttöä ja laskentainformaatiolle asetettuja vaatimuksia. Tavoitteena on edistää ymmärrystä ex ante laskentainformaation hyödyntämisestä päätöksenteossa, sekä tuottaa tietoa siitä, miten laskentatoimen harjoittajat voivat tehokkaasti luoda arvokasta ex ante laskentainformaatiota päätöksentekijöiden tarpeisiin.

Työn tulokset viittaavat siihen, että tuotekonfiguraatioiden jakeluun liittyvien päätösten tulisi osaltaan perustua erilaisten tuotekonfiguraatioiden kannattavuusdynamiikan analysointiin sekä erilaisiin jakeluvaihtoehtoihin liittyvien operatiivisten haasteiden analysointiin. Kohdeyrityksen tilanteessa tämä tarkoittaa tuoteisiin myytävien optioiden jakelua niin, että itse tuoteperheen myynti saadaan maksimoitua. Empiiriset tulokset osoittavat, että yritysjohto hyödyntää laskentainformaatiota ensisijaisesti päätöksenteon kohteesta oppimiseen tunnistamalla kohteeseen vaikuttavia tekijöitä ja arvioimalla niiden merkitystä. Informaatiota hyödynnetään näin huomion sekä jatkoanalyysien kohdistamiseen. Laskentainformaatiota hyödynnetään lisäksi taloudellisten reunaehtojen asettamiseen, joiden sisällä päätösvaihtoehtojen tulisi pysyä vaihtoehtojen analysoinnin jatkamiseksi. Käyttötavat näkyvät laskentatoimelle asetetuissa laatuvaatimuksissa. Vaikka informaation riittävä tarkkuus on tärkeää, kohdeyrityksen johto näki tärkeimpänä sen, että laskentainformaatio on tarpeeksi laajaa sekä uskottavaa. Nämä laatutekijät mahdollistavat luottamuksen luomisen epävarmaa tilannetta kuvaavaan laskentainformaatioon, ja täten laskentainformaation hyödyntämisen. Tiedon esittämiseen liittyvä laatu tukee samoin luottamuksen luomista, sekä tiedon integrointia laskentainformaatiota luotaessa. Työn lopuksi esitetään empiiristen tulosten perusteella muodostettu neliosainen prosessimalli, joka tukee hyödyllisen ex ante laskentainformaation resurssitehokkaassa luomisessa.

PREFACE

This thesis has been my biggest project to date. While requiring a great amount of time, this thesis has been a very educational project. I would like to thank the case company for the opportunity for writing this thesis while working in the company. My biggest thanks belong to the CFO of the case company who devoted the time to direct me in the thesis work.

I would also like to thank professor Teemu Laine and postdoctoral research fellow Tuomas Korhonen for supervising the thesis. You provided great direction and suggestions during the thesis work.

I am also grateful for all of my friends and family who cheered me up after the long days of working on the thesis. I would like to especially thank my mom and dad, One Solution, and Juulia, for pushing me forward with the thesis work.

This thesis will now conclude my university studies which have been filled with many great experiences. I would therefore like to conclude by thanking all of my friends for the fantastic and unforgettable university time.

Now, however, it is time for new challenges.

Tampere, 31.10.2019

Jeris Tanus

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LIST OF FIGURES

LIST OF ABBREVIATIONS

CFO	Chief Financial Officer
COGS	Cost of goods sold
ERP	Enterprise resource planning (system)
FCL	Full container load; a shipment the size of a standard container
IT	Information technology, referencing different computer and software systems
LC	Logistics center, which the case company has established to United States
MA	Management accounting
PF A	Product family A of the case company
PF B	Product family B of the case company
P&L	Profit and loss (statement)
SKU	Stock keeping unit
US	United States (of America)

1. INTRODUCTION

Management accounting (MA) is a group of activities performed to support managerial work and decision making. Research of MA thus aims to study how to better support managerial work via different accounting practices (such as cost accounting methods), performance measurement, and other accounting analyses, such as sensitivity analyses. Even with the clear focus of MA as a tool for managerial work, many previous management accounting publications (such as Hall 2010) have raised the issue of MA research being too far from actual managerial work. This issue has partially led to MA research losing its relevance among its most essential users: the managers. The previous, combined with the finding that managers are often dissatisfied with the information they receive (McKinnon & Bruns Jr 1992), greatly emphasizes the need for research to focus on topics that either have clear and practical value for managers or that support the creation of information that is of value to managers.

In addition to managers (as information users), MA research is relevant to other parties as well. Of these other parties, management accountants are naturally the most obvious ones. While not always being the ones making the decisions, management accountants work as facilitators for creating accounting information by integrating, (Laine et al. 2016) analyzing, and presenting information scattered both inside and outside an organization. This supporting role of management accountants (see Suomala et al. 2011) is essential to recognize, as management accountants are often responsible for creating and presenting the accounting information for the management or other organizational parties for decision-making purposes. This separation of information creation and information use raises many practical questions for management accountants, such as *what information decision-makers consider relevant*, *how detailed or accurate should the information be,* and *how should the information be presented*.

These questions become exceedingly relevant outside academia, where scarce resources (in forms such as time and man-hours) limit the ability to create information or systems for decision making. As such, the cost-payoff ratio of different MA activities is not the same. The efficient use of organizational resources thus requires understanding about the impact of different pieces of information and their qualities, as they indicate how scarce organizational resources can be best utilized to obtain the most significant organizational impact (in terms of information value). The most significant value creating activities are nonetheless not always obvious, as previous literature shows. As an example, Wihinen (2012) found that improving the accuracy of a costing system is not always the most value creating activity from a managerial perspective. Studying how to maximize value creation of management accounting activities can therefore be considered similarly important as

studying the value creation and optimization of industrial processes. It is relevant for not only academics but also the daily practitioners of management accounting and their respective "customers", the managers.

An excellent possibility for analyzing the requirements for accounting information presented itself in the form of a distribution related analysis needed by a case company offering mass customized products. The company had established a new distribution center to the United States of America (US) and was now in need of an analysis regarding the profitability and other financial impacts of an offering decision related to the distribution center. The case organization had experienced tremendous growth in both turnover and volumes, which had directed attention to managing growth instead of more closely studying profitability optimizing activities. The establishment of the US distribution center had then changed the case company's operating landscape. Managing much larger inventories with long restocking lead times (from Finland to the US) was then required, challenging the relatively young organization's ability to manage its operations. The case company offers product families accompanied by a large pool of optional feature options, which together combine into numerous distinct product variants (or product configurations). The company therefore faced a challenge of deciding how large a part of its offering should be available from its US distribution center. This was the foundation for the first objective of the thesis, which is to explore...

> *…how should different product configurations be distributed to the US market to ensure long-term profitability*?

The first objective focuses on the consideration of clearly quantifiable profitability impacts of different decisions. Both absolute measures (earnings before interest and taxes, gross margin, and residual income) and relative measures (return on investment; ROI) of profitability are considered. In addition, the more qualitative aspects (from both sales and supply chain standpoint) are considered for ensuring that the distribution decisions support the case company's long-term strategic market positioning and consecutively its long-term profitability.

In support of the first research question, the thesis also seeks to identify and rank key attributes and aspects of feature options that affect both distribution profitability and feasibility. Identifying these key attributes can be later used to assess the profitability impacts of distribution decisions in the future, when new offerings are created. The question is highly relevant, as deepening the understanding of the profitability implications of configurable products provides concrete directions for managerial decision making for companies in similar situations. In addition, it is also important to recognize that the deepened understanding of the dynamics of profitability in the setting of the case company not only allows improved decision making at a single point in time but could also support profitability development by supporting the prioritization and recognition of new development

actions (Lindholm et al. 2017). The research question is thus highly relevant from both academic and managerial aspects.

The case company's need and the research setting for the first research question provided an excellent setting to analyze how the created ex ante accounting information was used in decision making. Similarly, analyzing the use and development of the accounting information created for the first research question provided an opportunity to analyze what requirements managers actually set for the accounting information. The second objective of the thesis is therefore to support daily MA work and the related research by studying…

> *…how do managers use ex ante accounting information in decision making, and what kind of requirements a new decision-making situation sets for ex ante accounting information?*

The second research question focuses on understanding the role of MA in an ex ante situation, and how can MA best be used to support organizational decision making in the setting of the case company. This question includes considerations of the role of MA and the information quality requirements; what is seen important and why, and what is sufficient quality and extent of information. The second objective also seeks to increase knowledge of the particular ways managers utilize accounting information, as such information has been found missing from previous literature (Hall 2010). This contributes to clarifying accounting information's role as a part of the larger information set of managers, which has been suggested as a topic for future research by Hall (2010).

The first chapter continues by giving the reader an overview of the case company, its products, and its production and order fulfillment systems. The aim is to allow the reader to better contextualize the company situation and the later analyses that were performed. Chapter 1.2 more closely discusses the case company's motivation for the study. Chapter 1.3 presents the research objectives and the structure of the thesis.

1.1 The case company

The case company is a producer of prefabricated office furniture. The company has been in operation for over five years and has experienced staggering growth in previous years. It has had its turnover grown by a factor of 50 in under five years, fueled largely by its new and rapidly growing market, combined with the company's product leadership. The rapid growth of the case company had led to the constant change and development in business processes and practices. Similarly, all of its processes were being continuously scaled up. This was also seen in the company's management practices and management accounting, which were both being continuously developed.

During its growth, the company has positioned itself as the product leader in its market, focusing on offering the best products in terms of design, quality, and different technical

properties. This has allowed the company to fend off price competition generated by many competitors who actively pursue market share through lower prices. The market position of the case company has also allowed it to upkeep premium pricing compared to its competitors in all of its product segments. The company is located in Finland, with currently one production facility serving all of the global demand. The company exports approximately 90 % of its production.

The strong growth, which is expected to continue in the following years, has also been the company's reason for looking into expanding its operations to the United States of America (US). While the company has currently been able to serve its European market well from its operating location, its US customers have suffered from extended lead times due to affordable shipping. While air freight is available for customers, the physical size and weight of the products make it very expensive for the customer. In turn, overseas shipping, as the only affordable shipping method, currently adds approximately six weeks to the company's order-to-delivery time. The total order lead time is thus considered being an issue for many of the US customers and has made the lead time one of the major disadvantages of the case company when compared to its local US competition. Many of the company's sales representatives have stated that the US lead times have been a greater issue for customers than the current prices, which are already the highest on the market.

The United States is one of the company's key markets, both in terms of current volume and growth expectations. Thus, ensuring the delivery of high customer value in terms of both product and service-related aspects is seen as critical for ensuring the company's continued market leadership in the future. The previous has led the company to look into establishing a logistics center (LC) operation in the US, which would improve its market offering by shortening the order-to-delivery lead times.

1.1.1 Products

All of the products of the company are mass customized. This means that the company has generally aligned itself to use "information technology, flexible processes, and organizational structures to deliver a wide range of products and services that meet specific needs of individual customers (often defined by a series of options), at a cost near that of mass-produced item" (Da Silveira et al. 2001, p. 2). The case company currently has four product families, which are all designed to be mass customized. Each of the product families is offered via a product configurator, which allows the customer to change the different features of the product. These feature options offered either change a specific feature of the product (e.g. outer color) or add entirely new functionality to the product. This customer selection (also called a *configuration* in the company vocabulary) determines the actual product variant that is sold, and the corresponding bill of materials passed on to production.

The mass customization and configurability can be viewed as being very similar to *optional customization,* as described by Alford et al. (2000, pp. 101-103), seen in the automotive industry. Similar to the automotive industry, the customers participate in the manufacturing process by defining requirements for a product, according to which the actual product variant is then assembled (Alford et al. 2000, p. 103). In practice, the cars of a specific product family share the major components (such as the chassis), and the individual features (such as the exterior color) of the car are then selected from a curated list of options according to the customer's liking. The case company offers a similar way of customizing the product, with some options available for free and some available for a premium price. It is noteworthy that the general configurability of the products includes both *changing product features* (such as the exterior color of a car) and *adding completely new features* to the product (such as adding a rear camera to a car). Currently, almost all of the options offered are the former.

While the case company currently offers four product families, the majority of its sales are generated by two of its oldest product families. These product families are later referenced as product family A (PF A) and product family B (PF B). The case company provides price lists for all the product families. These price lists include prices for the standard products of the product families and additional prices for different feature options with which the standard products can be altered. Standard product was a term used in the case company for the most popular product configuration, in which no feature options were selected. In addition, the company offers "package prices" for product family A, in which the customer can select some feature options for a set cost. This is less expensive than changing all of the features separately. For example, the company offers a "package price" for the ability to change all the different color features in a product. As opposed to the other product families, product family A also has a special "budget package", in which some of the features are replaced with more inexpensive options or removed altogether. The "budget package" allows the company to also attract more price sensitive customers.

In addition to having different prices for different product variants (which are based on the customer configuration), the company also offers different lead times for different product variants. For example, a customer can order a standard product as an express order with two weeks order-to-shipping (for an extra price). The majority of orders and product variants are currently available with a four-week order-to-shipping (although according to one European sales director of the case company, many customers had already grown accustomed to smaller than stated lead times in their orders). The longest order-to-shipping time class was eight weeks, which was mainly reserved for orders in which options for one specific feature had been selected, or in which any custom coloring had been ordered for the other features. This was partly done to allow the purchasing of the required parts on a per-order basis (allowing time for ordering and manufacturing the required subassemblies), and partly to encourage ordering the product with the default feature.

In general, the company has aimed to keep as little inventory as possible, which is partly done by ordering some product variant required parts (such as parts with specific feature option colors) from suppliers at the time of a customer order. This has lowered the company's inventory-related risks, while also increasing the customer experienced lead time.

> *The ability to customize the products is generally seen as a key part of the company's premium brand and market offering, with the company continuously marketing its products with different configurations in trade shows and other marketing material.*

Each of the company's product variants is composed of a specific number of specific subassemblies from which the actual product variant is assembled. Each of the subassemblies is compatible with other subassemblies, meaning that, any of the available feature option subassemblies could be used together with any other subassemblies to assemble the final product variant. On top of the larger subassemblies, each product variant also requires other smaller components, such as screws and instructions, that are specific to product families and are shared between all product variants of a product family. While all of the company's product families are assembled from subassemblies, each of the product families has its own subassemblies, meaning that a subassembly of one product family cannot be used in another product family. The subassemblies used in product family A are presented in Figure 1. Grey and green subassemblies are built by the case company, whereas yellow subassemblies' or components' manufacturing is outsourced by the case company.

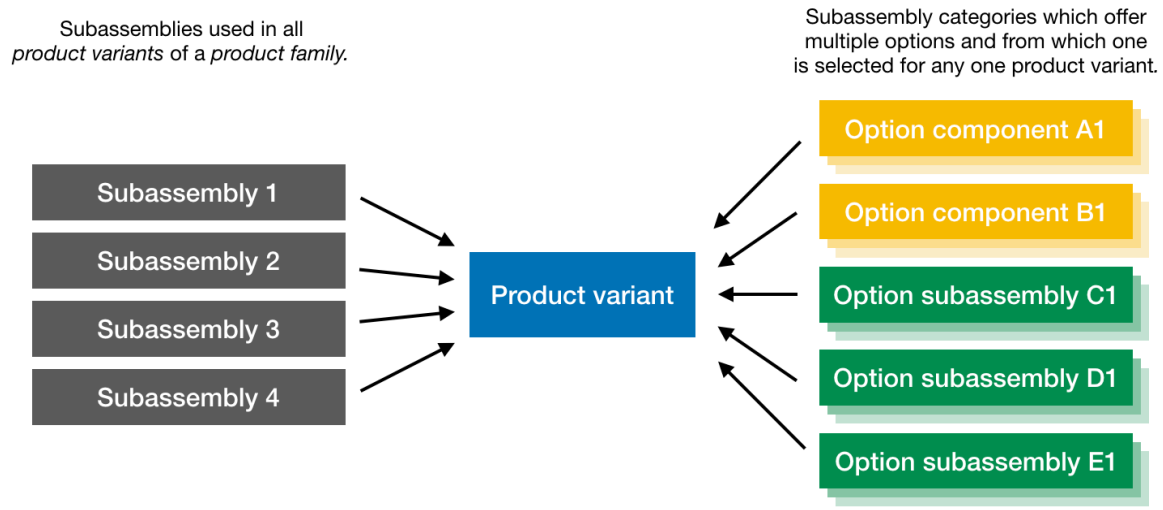

Figure 1. *Subassemblies and components used to assemble product family A.*

The subassemblies used in different product families can roughly be divided into three classes:

1. subassemblies that are manufactured by the case company and used in all variants of a product family,

2. subassemblies that are manufactured by the case company and used in some product variants but not in others, and
3. subassemblies or components with an outsourced production that are used some product variants but not in others.

When considering the research question regarding the offering, only subassembly classes 2 and 3 (green and yellow in Figure 1) are of interest, as the decision to offer specific product variants affects those subassemblies. Subassemblies of class 1 (grey in Figure 1) are used in all variants of any specific product family and are therefore always required if any variants of a product family are to be offered.

For the most part, the case company creates mass customization by packing different subassemblies (i.e. modules) according to each customer order. Each specific subassembly to pack is, in turn, determined by the actual product variant that the customer has ordered. The only exception is a subassembly containing electric components, which is built according to each customer order. This subassembly contains 2-4 customizable features, depending on the product family. Additionally, some of the feature option subassemblies are only manufactured (and the required parts ordered) when a product variant using the subassembly is ordered. This results in lower inventories for the said feature option subassemblies at the expense of order lead times. Overall, the mass customization in the case company can best be described being at the *package and distribution level*, according to the levels of mass customization composed by Da Silveira et al. (2001).

1.1.2 Production and distribution system

The primary distribution method for the company is local office furniture distributors, who are also called “dealers” or “resellers” in the case company. These distributors usually offer the case company’s products as part of their larger office furniture offering and general office solutions. These distributors then sell the company’s products to the actual end customers, who are the primary source of demand for the company. While some distributors (especially in the US) hold their own local inventories, the majority of the case company orders are made by distributors directly as a result of an end customer ordering the product from the distributor. While the majority of the company sales are made through distributors, the company also sells directly to end customers. These direct sales are generally to either large multinational companies (and are commonly key accounts due to their importance as single customers) such as the tech companies in Silicon Valley, or to other general companies in the case company’s home country.

Having a network of resellers has allowed the company to easily and efficiently expand its sales network around the world without heavily investing in local sales offices. It has allowed the company to get its products into the view of the end customers more easily, as the majority of the office furniture sales are made from office furniture distributors. While utilizing a distributor network has allowed the rapid expansion of the company’s

market presence, it also partly passed the end customer ownership to its distributors, who mainly deal with the end customers.

On top of customer ownership, the distributors have also been recognized as having a strong influence on the specific product variants (or product configurations) that are sold. As an example, a distributor's own sales force might only push the sales of one specific configuration due to either not knowing about the availability of other configurations, because of lead time related issues or because of other barriers to ordering. Such barriers can, for example, relate difficulties or complexities in the distributors' own ordering systems or ordering procedures. It was not surprising that some of the company's distributors only focused on selling standard products. As an opposite example, analyzing the company's sales data showed that one of the distributors of the case company had sold a significant number of products configured with blue exterior colors. It is worth noting that the blue was also a significant color in the distributor's own brand, which naturally could have affected the configurations sold. Nonetheless, the examples show that the distributor could potentially have a significant impact on both

1. how the case company's offering (such as the configurability of the products and the different options available) are presented to the end customers, and
2. how the different options are priced to the end customers, thus affecting the interest the end customers have on the options.

In addition to distributors and end customers, there is also a third party that plays an important role in the industry: architects. Architects commonly design different offices and interior spaces, thus also specifying different furniture elements (such as the case company's products) that are to be bought for the office. While architects are not part of the value chain itself, they have an important role in affecting the decisions made in the value chain. The role and influence of architects have also become clear in the case company, pushing the case company to increase collaboration with different architect offices. This has also generally lead to recognizing that relevant third parties, such as architects, should also be considered when planning and deciding about the company offering. Figure 2 shows a simplified value chain of the case company. Black arrows indicate product sales and material flows, whereas grey arrows indicate the influence that architects have on ordering decisions.

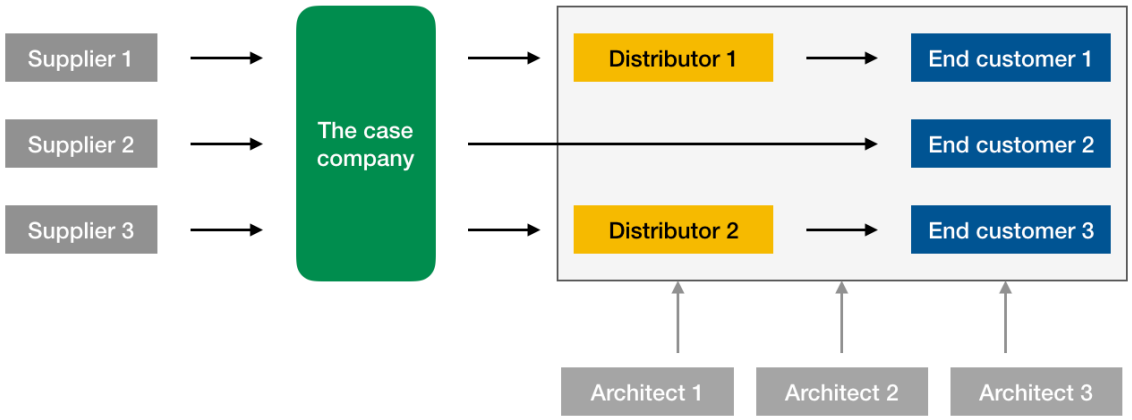

Figure 2. *The value chain in the office furniture industry.*

The newly opened logistics center's primary purpose is to shorten the order-to-delivery times experienced by customers who are located in the United States of America, which is one of the main markets of the case company. This is why the LC has currently been planned to only supply orders made by US customers, although it is likely that it will later fulfill orders for the whole North American continent. The company has added a surcharge to all orders fulfilled from the LC. This surcharge is set in a way which would result in most orders being fulfilled from the LC, but simultaneously incentivize the customers to place large orders to the European factory instead of the LC. For the customers, this results in fewer costs for large and lead-time insensitive orders. For the case company, this allows better demand forecasting for the LC, as large unexpected orders are less likely to disrupt the inventory management of the logistics center. Orders made to non-US countries will continue to be fulfilled from the company's European factory.

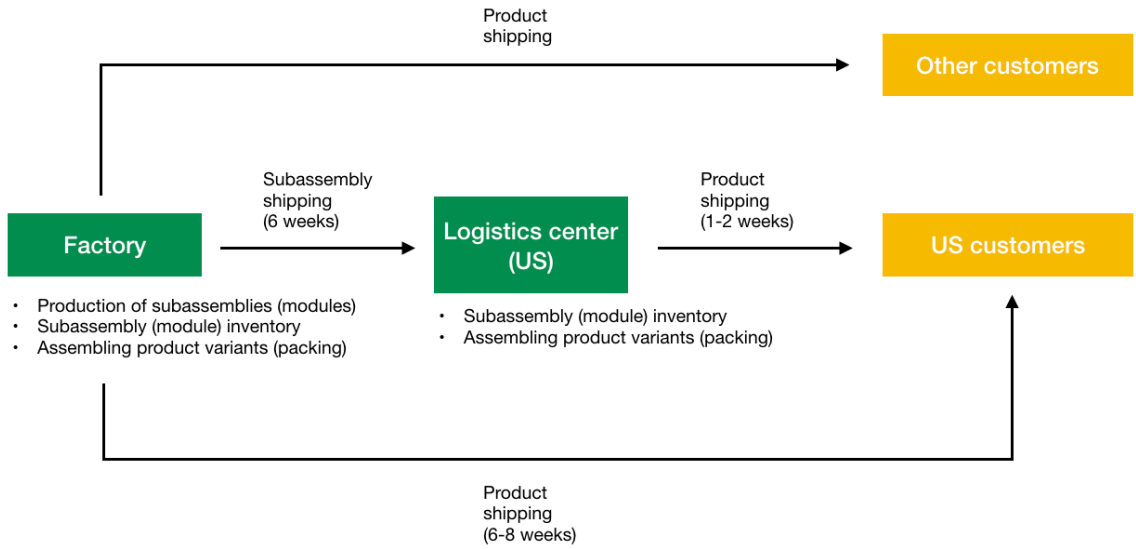

Figure 3. *The production and order fulfillment system at the case company.*

The logistics center is planned to hold inventories of different subassemblies, which are then used to assemble the specific, customer configured product variant on a per order

basis. It is important to note that assembling a product variant is (almost) equivalent to just packing different subassemblies in a crate, as the final product can be directly put together using the different subassemblies. No subassembly manufacturing is done at the LC. As the actual subassembly production is done in the company factory, a constant stream of subassembly shipments is required from the company factory to the logistics center. It is also worth noting that while the actual shipping time from Finland to the logistics center is six weeks, the subassembly manufacturing and packing is assumed to take an additional one to two weeks. This makes the total factory to logistics center inter-company order-to-delivery time approximately 7-8 weeks. Figure 3 displays the current production and order fulfillment system of the case company, including the estimated shipping times between facilities and customers. The displayed differences in shipping times are the primary reason for establishing the logistics center operation.

It is also important to recognize that, as with the intercompany orders, the customer shipping times displayed in Figure 3 do not include manufacturing and packing related order lead-times. These lead times are ones promised to the customer in the company's delivery policy. The total customer experienced order-to-delivery time can thus be anything from three weeks (two weeks for production plus one week for shipping) to 12 weeks (four weeks for production and eight weeks for shipping). The customer experienced order-to-delivery time can therefore vary greatly depending on the order and shipping destination. This can naturally affect both the customer experienced value and the ordering decisions made.

1.2 The case company's motivation for the thesis

The initial need for this thesis originated from the case company, which had been starting its logistics center operation in the US. As the company has multiple mass customized product families with many different feature options, it was essential for the company to be able to analyze and determine the kind of offering it should provide from the new logistics center. The new requirements associated with the LC, such as the overall need to manage larger inventories for a larger number of subassemblies, created the need for a more detailed financial analysis to be made.

Having all manufacturing operations in Finland, the logistics center is currently only able to pack product variants from premade subassemblies held in its inventory. This means that all product variants that are offered from the logistics center (with a lead time of four weeks or less) should either have the required subassemblies kept in the US inventory or be able to source those locally from subcontractors. Due to the company's large number of features to configure in each product family and the number of different feature options available (all with different demands), it has previously not been considered logical to keep the complete offering available in the logistics center. This raises the question of the part of the offering that should be available from the US logistics center (with a short lead

time), and which part should be available only from the case company's European factory (therefore being only available at a long lead time).

As the case company had previously strongly focused on the overall objective of setting up a logistics center operation in the US, the more detailed questions were still somewhat unanswered. It was generally known that the operation would most likely be profitable enough, whatever the logistics center related decisions. The questions focused more on the profitability and market positioning impacts the more detailed decisions relating to the LC offering would have. The original idea in the supply chain was to "take the most common, yet basic" feature options and have those available at first, and then begin manufacturing operations in the US after approximately 1-2 years. This is why the analysis of the details had previously been left to less attention.

As the company and its market are still growing rapidly, it was also seen as vital to consider the long-term implications of the decisions made. The company management has generally agreed that in addition to a financially rational short-term solution, a solution should also support the company's long-term strategic objectives. This consideration has become increasingly important in the company due to the continuously growing number of competitors, who are constantly improving their competitive offerings. This means that instead of just aiming to find the best short-term solution, the solution should be able to best support the company's long-term strategic objectives – even at the cost of short-term financial performance.

1.3 Research objectives and structure of the thesis

There are three main research objectives associated with the two research questions of the thesis. The main objective of the first research question is to support the case company and other companies in similar situations by identifying key factors affecting distribution offering related decisions. The aim is not to obtain a mathematical optimization model, as often seen in distribution-related literature, but instead to obtain qualitative guidelines for such a decision. These include key product- and demand-related factors to be considered and other points that need to be assessed by companies in similar situations. While the objective is qualitative, the associated research is based on both qualitative and quantitative analysis of the case company's situation.

The first objective of the second research question is to first contribute to the management accounting literature by studying the way ex ante accounting information is used in an uncertain decision-making situation and the quality requirements set for such information. This is to better understand the role of ex ante accounting information in managerial decision making by seeing how managers use the information and relate it to information originating from other sources. The quality requirements are similarly studied to understand what quality attributes are most relevant in the described ex ante accounting situation. Here, the case company's LC project and the associated analysis of the first

research question are used as a sample case. The final objective turns academia into practice by providing information about how management accounts should seek to provide information in a similar decision-making situation. Here, the practical relevance of the research findings is highlighted.

The thesis is divided into five main chapters. The first chapter introduced the research questions and the case company in which the research was conducted. The second chapter reviews literature on management accounting as a tool for managerial decision making, and literature of distribution operations. The third chapter presents the research methodology used and describes the analyses made. The fourth chapter presents the empirical findings. The fifth chapter discusses the findings and concludes. The two research questions are separated in chapters four and five to allow a more explicit distinction between the analysis of both research questions.

2. THEORETICAL BACKGROUND

The literature review is divided into two chapters. Chapter 2.1 reviews previous literature regarding management accounting, its development, and its role in managerial decision making. Chapter 2.2 introduces distribution operations and the related challenges identified in previous literature.

2.1 Management accounting and decision making

Quoting Laine et al. (2016, p. 309), "the basis for practical and meaningful work is an available set of facts, that outlines factual possibilities". Management accounting, as an organizational support function, focuses on the creation of accounting information that can support a more informed fact-based decision making. This chapter reviews previous literature about MA in decision making, knowledge integration in accounting system development and the related challenges, and the quality requirements for accounting information. The literature builds a theoretical background for the uses, potentials, and challenges of MA.

2.1.1 Management accounting in managerial decision making

Organizational managers face decision-making situations every day, ranging from day-to-day operational decisions (such as focusing work time for specific development tasks) to big strategic decisions with significant financial and organizational consequences. These decisions are made with varying amounts of information, with managers utilizing information ranging from undisputable quantitative information to intuition and "gut feeling" (McKinnon & Bruns Jr 1992). These decisions are also often not straightforward, with managerial problems being often filled with doubt and uncertainty, with general turbulence and potential for significant error (Landau & Stout Jr 1979, referred from Hall 2010).

Suomala et al. (2011) describe management accounting as a support function of an organization, with the general task of creating information for supporting decision making, decision implementation, and decision follow up in both operational and strategic levels of an organization. Spinkle (2003) describes MA in a similar way, defining two roles of MA as *decision-facilitating* (supporting decision making) and *decision-influencing* (supporting implementation and follow-up). In decision-making situations, MA is used to translate the different consequences of decisions to a single financial unit of measure (Wouters & Verdaasdonk 2002), such as currency, allowing both evaluation and comparison of potential decision alternatives. At the same time, accounting information is used to lessen the uncertainties associated with the decision alternatives (Sprinkle 2003). In

addition to clearly distinguishable decision-making situations, managers also use accounting information for developing general knowledge about the work environment (Hall 2010). This, according to Hall (2010, p. 302), "can help managers to develop knowledge to prepare for unknown future decisions and activities" (Preston 1986; March 1987). In addition to preparing for unknown decisions, MA can also help managers in recognizing completely new surrounding possibilities (Laine et al. 2016). MA tool facilitated knowledge integration has been found to support in setting clearer targets and responsibilities among different organization actors (Laine et al. 2016), thus also indirectly supporting decision making in larger projects. Similarly, accounting information and reports can also support focusing attention among a group of managers or other organizational actors (Laine et al. 2016).

The wide range of different uses for management accounting means that the internal customers of accounting information are also many, ranging from factory level workers and middle management all the way to the board of directors of a company. The use of accounting information differs greatly depending on the manager's role and "closeness" to the object of accounting, with the importance of accounting information growing when the distance of a manager and the object of accounting grows (Hall 2010). Similarly, financial information is more critical in the measurement and analysis of performance as the inspected time horizon increases (Preston 1986; McKinnon & Bruns Jr 1992). Unsurprisingly, operational level managers thus mainly utilize observations, informal reports and non-financial performance measures (Preston 1986; Wouters & Van der Veeken 2002), which better facilitate knowledge development by relating more to the day-to-day operational concerns and are usually available without delay (McKinnon & Bruns Jr 1992). Hall (2010) suggests that such tools can be adequate especially when only a few operational factors are considered, but refers to Van der Veeken and Wouters (2002) reminding that the utility value of financial accounting information could increase when the number of operational factors affecting performance grows, as the overall impact of different factors can then be better assessed.

As accounting is used to create information to support decision making and reduce the associated uncertainty (Sprinkle 2003), the role accounting naturally also differs depending on the decision-making situation and its properties. Burchell et al. (1980) have suggested four roles for accounting that depend on both the *uncertainty of objectives* (i.e., what the organization is trying to achieve) and the *uncertainty of cause and effect* (i.e. what consequences given actions have) in an organizational setting. These roles are summarized in Table 1.

Table 1. *Roles of accounting in decision making (Wouters & Verdaasdonk 2002, adapted from Burchell et al. 1980).*

		Uncertainty of objectives	
		Low	*High*
Uncertainty of cause and effect	*Low*	Decision by computation: Answer machine	Decision by compromise: Ammunition machine
	High	Decision by judgement: Answer and Learning Machines	Decision by inspiration: Rationalization machines

Burchell et al. (1980) suggest that when uncertainties of objectives and causalities are low, accounting is used as an "answer machine". In such a situation, the potential consequences of different decisions can be computed and compared against previously known objectives to assess each decision. When organizational objectives are clear, but there are uncertainties in causalities, MA can also be used as a "learning machine". In this role, accounting is used to support decision making by providing insights about the potential effects of decisions, after which the decision is made based on more subjective judgment. "Learning machine" role of MA displays in a number of different supportive ad hoc analyses, what if models, and sensitivity analyses. When the uncertainty of objectives is high, the role of accounting moves from purely supporting decision making to supporting organizational politics and common object setting. In such a situation, with low uncertainty of causalities, accounting is used as an "ammunition machine", in which accounting information is used to promote the positions of different parties. Lastly, when both the objectives and causalities related to decision making are uncertain, accounting works as a "rationalization machine", which is used to "legitimize and justify the actions that already have been already decided upon" (p. 15). (Burchell et al. 1980) Suomala et al. (2011) have also introduced a somewhat similar division, with the roles of management accountant being separated into a "number generator" role and a "discussion partner" role, based on the type of interaction and support provided to the rest of the organization.

Uncertainty has also been recognized causing the incompleteness of accounting information. In situations in which uncertainty is little, more MA work can be performed without other organizational parties, as accounting information can be seen well representing the business phenomena being analyzed. Oppositely, increasing uncertainty has been found requiring more interaction with other actors of the organization to fill the voids left in the incomplete accounting information regarding the business phenomena. (Chapman 1998) This (at least partially) explains why Burchell et al. (1980) describe MA work as a *number generator* only when the associated uncertainties are little, as displayed in Table 1. Nonetheless, Chapman's (1998) findings also strongly indicate that accounting information is beneficial even in situations with highly uncertain factors.

As suggested by Burchell's et al. (1980) and Chapman's (1998) research, it has been found that managers (and other employees alike) will not base decisions on accounting information alone, but also use other forms of knowledge in decision making (Preston 1986; McKinnon & Bruns Jr 1992; Jørgensen & Messner 2010) to complement and contextualize accounting information (Jordan & Messner 2012). In this vast array of information, the strengths of accounting lie in its aggregational properties and its use as a common financial language (Hall 2010). On the other hand, the always incomplete translation of physical operations into accounting figures also leads to operational richness being lost (Chapman 1997; Wouters & Verdaasdonk 2002). Similarly, formalization required by accounting also limits its ability to support managing all kinds of uncertainty. Accounting information can support managing uncertainty related to known factors having unknown values, but not uncertainty created from not knowing what the relevant variables are or how the variables are related to each other. (Galbraith 1973; Wouters & Verdaasdonk 2002) While accounting information has been found to generally support individual decision making (Sprinkle 2003), the previous studies about managerial work and MA show that accounting information alone is not always enough for supporting the needs of comprehensive managerial decision making.

Chapman (1997), discussing about a case company example in Kaplan's (1984) article, noted that accounting information was used more as an *informing* instead of *directing* activity. In Kaplan's (1984) article, this meant moderating accounting information by also considering a wider range of economic factors, such as the business cycle. This, nonetheless, was not seen as an issue preventing the use of accounting information in the comparison of operational units. (Chapman 1997) The example demonstrated how accounting information was complementing and complemented by the understanding of physical operations and business needs, and that accounting information itself is meaningless if not being related to the context of business (Chapman 1997). To summarize, the previous literature shows that the successful utilization of accounting information in managerial decision making requires a comprehensive understanding of the entirety of the business situation, or the "big picture". The notion of "big picture" also strongly relates to the development of MA systems, as discussed later in chapter 2.1.2.

Accounting information and analyses can be chronologically separated to *ex ante* (before a decision) information and *ex post* (after a decision) information (Suomala et al. 2011), both with different uses. *Ex ante* (i.e. decision-facilitating) accounting information is generally used to improve employees' knowledge and to reduce uncertainty related to a forthcoming decision (Sprinkle 2003). More specifically, Wouters and Verdaasdonk (2002) found that managers use *ex ante* accounting information in three situations:

1. when information was needed to resolve uncertainty arising when making a new or infrequent decision
2. when new considerations had to be taken into account when making a familiar decision, or

3. when knowledge about operational consequences was dispersed to across different people or organizational units, such as functions, departments, hierarchical levels, or organizations.

In the first two situations managers had no previous knowledge about the trade-offs of consequences related to different decisions. In such situations, accounting information acted as a "common unit of measurement" for integrating and weighing the different consequences of different decisions. (Wouters & Verdaasdonk 2002) Such situations closely resemble the "answer and learning machine" roles suggested by Burchell et al. (1980). The third situation was when *ex ante* accounting information was needed as a knowledge integration tool among different parties. In such a situation, an exchange of knowledge about various operational consequences was required, with accounting information working as a common language for condensed knowledge exchange. (Wouters & Verdaasdonk 2002) Wouters & Verdaasdonk (2002) also confirmed Chapman's (1997) finding: turning operational knowledge into abstract accounting information is incomplete, thus highlighting the role of a thorough understanding of the aspects (such as plant operations and the related processes) that are being translated into accounting information.

Ex ante accounting information is also not created only at a single point in time, as it can also develop over time, providing better support for decisions made later in time. This can be seen in projects in which quantitative information is scarce in the beginning but grows over time, allowing more detailed and accurate *ex ante* accounting information to be created. (Nixon 1998) As an example of the previous, Laine et al. (2016) found that this longitudinal accounting development is essential in product development projects, as new accounting information can continuously be used to redirect decision making.

Ex post accounting information is, oppositely, related to reducing after-decision uncertainty and measurement of performance, and thus works more as decision-influencing information (Sprinkle 2003). In practice, *ex post* information can, for example, mean information created from comparing performance measures to budgeted figures or measuring actual costs (Laine et al. 2016) and profitability, and comparing those to the *ex ante* estimates done earlier. Comparable measures can thus range from easily observable operational measures (such as production output or efficiency) to accounting-driven financial measures, such as profit center profitability. *Ex post* information can thus be used to verify the estimates and success of *ex ante* analyses and decisions made.

Accounting information is nonetheless not only a part of one "class", as the same accounting information can either be decision influencing or decision facilitating depending on the organizational party (Sprinkle 2003). The multiuse nature of accounting information has also been recognized in previous literature, with Lindholm et al. (2017) noting that the details of the decision-making situation should always be reflected in the view-

point of accounting information. The dynamic nature of MA information and its requirements in managerial decision making also show in MA development, which will be discussed in the following chapter.

2.1.2 Knowledge integration, cooperation, and prototyping in accounting development

Management accounting should continuously develop to suit changes in both external factors and managerial objectives (Korhonen et al. 2013), making MA an active object of development. As the general objective of MA is to support activities relating to decision making and related subsequent work (Suomala et al. 2011, p. 14), other organizational actors are always present either in the development of MA systems, as users of the accounting information, or both.

Previous literature has well recognized the importance of both cooperation and knowledge integration of different organizational actors (both accountants and non-accountants) in developing MA systems and the related organizational communication. The creation of effective organizational systems, such as ones used for costing or performance measurement, can often require combining the expertise of many different people from departments such as information technology (IT), accounting, production, and from the users of the system (see e.g. Emsley 2005; Wouters & Roijmans 2011). This is not surprising, as accounting information and the possibilities it provides are rarely about single parts of an organization (Laine et al. 2016). This is especially true when creating *ex ante* accounting information, in which an effective MA work requires a thorough understanding of both accounting and operations. One such situation is when MA works as a *learning machine* (following the classification of Burchell et al. 1980), where ad hoc analyses, what if models, and sensitivity analyses are used to teach managers about potential decision alternatives and their consequences. (Wouters & Verdaasdonk 2002)

Knowledge integration has been recognized both as one of the important factors in developing MA tools and systems (Laine et al. 2016) and as an important value created by the development process and use of MA systems (Otley 1999; Wouters & Roijmans 2011; Laine et al. 2016). Knowledge integration, defined as the extent of organizational actors' communication and cooperation by D'Adderio (2001), refers to the organizational ability to utilize a diverse set of expertise from different sources when building organizational practices (Wouters & Roijmans 2011). This ability to utilize many sources of different expertise has previously been identified as a key success fostering capability in fields such as accounting (Anderson 1995) and strategic management (Eisenhardt & Martin 2000). In an accounting setting, knowledge integration displays, for example, in the incorporation of multiple parties (both accountants and non-accountants) in the development and testing of accounting systems. Such a setting allows both tacit and non-tacit knowledge to be drawn from different parties and utilized in development efforts.

(Wouters & Roijmans 2011) Laine et al. (2016) have also emphasized the importance of knowledge integration as it allows different actors' organizational realities, values and valuations to be understood when constructing and communicating accounting facts, which can later work as boundary objects. Upkeeping this knowledge can generally be seen important as it allows management accountants to better respond to the changing needs of decision-makers. While the importance of sharing and integrating the knowledge of different organizational actors might seem mundane and obvious, its potential is not always self-evident for organizational actors. Actively seeking to promote knowledge integration can be beneficial as it is possible that, quoting Vaivio (2004, p. 42), "organizational agents may not realize that their locally embedded insight can have value-creating potential across organizational boundaries".

Previous literature has also widely recognized the important role of cross-departmental cooperation (and the following knowledge integration) in developing management accounting systems. Laine et al. (2016) found that accounting prototypes built with the participation of different organizational parties increased the reliability of calculations. Wouters & Roijmans (2011) found that the process of co-creating performance management systems using prototypes facilitated knowledge integration by allowing organizational actors to recognize previously unrecognized *differences* and *interdependencies* between different individuals. Anderson's (1995) case study showed indications that cooperation and stronger user-involvement would better the usability of information generated by an activity-based costing system. As a more management-oriented perspective, Fry et al. (1995) argue that cooperation supports the creation of accounting systems that better support (and direct actions towards) the fulfillment of the *right* organizational objectives. Laine's et al. (2016) work also suggested that using boundary objects, such as accounting tools and information, can help to build a shared understanding of different organizational actors' roles and information needs, and help respond to those needs, thus supporting effective accounting enactment.

The different ways in which accounting-related cooperation and knowledge integration benefit an organization can also be more subtle, and not always related to any single MA development effort. Vaivio (2004) describes how targeted non-financial performance measures and their cooperative analysis can assist in identifying previously unforeseen business issues and uncover insights previously only stored in local knowledge, thus also facilitating knowledge integration. Emsley's (2005) research suggests that a (business unit oriented) management accountant's interaction with business unit personnel increased innovativeness and was associated with the level of radical accounting innovations. In addition to the cooperation of different organizational parties being closely related to the creation of accounting information, it is also important for its further communication (Laine et al. 2016).

Cooperation has also been found to support the further implementation and organizational impact of accounting systems. Abernethy & Bouwens (2005) found that cooperation and

managerial participation in the creation of accounting systems positively influences the acceptance of accounting innovations and thus the further utilization of accounting information. Similarly, McGowan's and Klammer's (1997) study indicates that user participation can support the successful implementation of accounting systems. Chenhall's and Euske's (2007) research also suggests that even "light cooperation" in the form of talking about benefits and requirements can potentially contribute to the acceptance of and the trust in new accounting systems.

In addition to general cooperation, more detailed ways to increase knowledge integration have also been found. Wouters and Roijmans (2011) suggest that knowledge integration can be facilitated in performance measurement development by

1. experimenting with contextualized data,
2. joint ownership of experimentation, and
3. user reporting.

Experimenting with contextualized data means experimentation with information already available in current information systems. Utilizing already available information in experimentation and iterative development (as opposed to experimenting with fictitious data) allows organizational actors to recognize previously unknown differences and interdependencies between different actors, thus facilitating knowledge integration. Joint ownership of experimentation relates to active cooperation in development efforts, in which *both* accountants and non-accountants are jointly responsible for the system design. Such a setting requires all parties to agree on the design principles of the system, which directs towards creating a shared understanding of what different parties considered important and why, thus facilitating knowledge integration. User reporting refers to a situation in which the user of an accounting system either creates the resulting accounting reports themselves or provides key inputs for the accounting system. User reporting thus requires that "the operational user needs to understand not only the meaning of the output, but also details as to which inputs are required and how the output is generated" (Wouters & Roijmans 2011, p. 715). This enhances organizational interdependencies, and consecutively supports knowledge integration. (Wouters & Roijmans 2011)

Prototyping, experimentation, and iterative development are also beneficial for MA development itself. In an MA setting, prototyping and iterative development respond to the challenges related to working with different organization actors (or boundaries, as discussed in boundary object literature), while also improving the relevancy of accounting facts provided by the system (Wouters & Roijmans 2011). In practice, this means that prototyping allows the accounting systems being developed to output information (such as cost information or performance measures) that is both more accurate (in terms of accurately representing real-life operations) and more useful for the users of the information. Prototypes do not necessarily need to be complex or have specific data gathered.

Working prototypes can even be simple "examples" of accounting systems that are calculated only using available data (Wouters & Roijmans 2011).

Prototyping supports the reliability, validity and understandability of information generated. This is because prototyping allows addressing the shortcomings related to any of the previous while simultaneously making the definitions, conceptualizations, and IT requirements visible for actors involved in the prototyping process (Wouters & Wilderom 2008). Prototypes thus also facilitate social interaction and discussion between organizational actors involved in accounting development, thus also advancing knowledge integration (Laine et al. 2016). Continuous development efforts also improve the perceived legitimacy and fairness of accounting systems (Malina et al. 2007).

2.1.3 Challenges of MA development and use of information

Accounting development and the related knowledge integration are not without their challenges. This is especially the case when both accountants and non-accountants are involved, as their viewpoints can differ greatly. Accountants see the world through financial terms such as cost centers and inventory valuations, whereas engineers, for example, focus on more practical considerations of physical inputs, outputs, and time-dependencies of activities. (Wouters & Roijmans 2011) It is thus not surprising that, quoting Laine et al. (2016, p. 310), "integrating different viewpoints is challenging". An extended *distance* (i.e. little involvement in day-to-day matters) between an accountant and the object of reporting can also potentially hinder the ability to recognize potential local knowledge of actors (Vaivio 2004), hindering the probability of unfacilitated knowledge integration. This can be the case in situations where accounting experts are physically away from the object of accounting or where there are social barriers lessening the possibilities for integrating knowledge.

When considering the development of an (enabling) performance management system, Wouters and Roijmans (2011) found it to be challenging to bring together organizational actors' knowledge about how particular operational processes were conducted, and how these processes were represented in various information systems (including both accounting and operational systems). This shows that the challenges are very much related to the communication of knowledge about different actor groups' core competencies, i.e. knowledge of operational processes and IT systems.

Accounting development-related communication challenges can, nonetheless, be mitigated. Five means were identified by Briers and Chua (2001), who suggest that databases, visions regarding the future, idealistic objectives, boundary objects, and standardized procedures could be used to support communication (Laine et al. 2016). Of these, boundary objects and standardized procedures can be seen most closely relating to the challenges listed by Wouters and Roijmans (2011).

Previous literature has also found challenges relating to the role of MA as an instrument of control, especially when performance measures used are incomplete (i.e. not completely representing the underlying organizational phenomenon and all the factors considered important). Even though management accounting is mainly focused on utilizing financial information (Suomala et al. 2011), Fry et al. (1995) have also criticized that too large a focus on financial performance measures (e.g. such displayed in the profit and loss statement (P&L) of a factory plant) could often lead other performance measures being overlooked. This is especially important as other (non-financial) measures could potentially better address the actual underlying drivers of financial performance (Vaivio 2004). In their article Fry et al. (1995) discuss standard cost accounting systems that are often not consistent with manufacturing infrastructure which is used to fulfill order winning criteria demanded by customers. They note that the previous, combined with the fact that many plant managers closely follow the short-term financial performance from reports such as P&L, could lead to short-term financial performance being overemphasized and other performance measures (that could be more closely related to the order winning criteria) being potentially less valued. A mismatch of performance measures and long-term objectives can even result in operative decisions being made to better the measured results even though this could lead to negative long-term effects (Wouters & Wilderom 2008).

Fry et al. (1995) thus state that management accountants should take a proactive role in the development of accounting systems, for example, by generally educating managers about alternative accounting systems that could better support long-term competitiveness. While their article generally discusses about cost accounting as part of manufacturing infrastructure, the key notion is that it is also the management accountant's responsibility to support the fulfillment of order winning criteria by recognizing the potential mismatch of long-term objectives and the accounting systems, which could direct managers to focus on short-term objectives. This strongly relates to Jordan and Messner's (2012) notion that performance indicators will not only serve as a facilitator for managerial action but also serve as instruments of control. They note that performance indicators "impose a particular focus on managers' actions and attention at the expense of other things deemed less important" (p. 545), highlighting the fact that the performance indicators should indeed always be in line with order winning criteria, as suggested by Fry et al. (1995).

This need to align accounting systems and objectives supporting long-term success can be seen emphasizing management accountants' role as a *discussion partner* (discussed by Suomala et al. 2011), and the broader understanding of business context (discussed by Chapman 1997) in management accounting. Understanding the implications and objectives of both financial measures (better enabling the aggregation and comparison of information, as described by Hall 2010) and non-financial measures (better penetrating into the underlying processes, as described by Vaivio 2004) is thus evident for accounting to successfully support organizational decision making and performance. The iterative de-

velopment efforts in the form of refining and prototyping MA systems have been suggested as one of the potential ways of combatting the aforementioned challenges, as these efforts can be used to identify potential mismatches in the designs of the accounting systems and their desired control effects (Wouters & Wilderom 2008).

Table 2. *A summary of challenges recognized in the development and use of MA information, and the potential solutions indicated by previous literature*

Challenge	Potential solutions
• Integrating different viewpoints of different actors and bringing together organizational knowledge (Wouters & Roijmans 2011)	• Boundary objects and standardized procedures (Briers & Chua 2001) • Iterative development of accounting systems (Wouters & Wilderom 2008) • Joint ownership of experimentation in developing accounting systems (Wouters & Roijmans 2011)
• Misalignment of accounting information (and its control effects) and long-term organizational objectives (Fry et al. 1995; Wouters & Wilderom 2008)	• Proactively offering alternative, more suitable accounting systems for managers (Fry et al. 1995) • Thorough understanding of the business context (Chapman 1997) • Iterative development of accounting systems (Wouters & Wilderom 2008)

Table 2 summarizes the previously identified challenges related to developing and using accounting information. The potential solutions for the challenges identified in the literature are also presented.

2.1.4 Quality of accounting information

The requirements for the accuracy of accounting information can vary greatly depending on its use, user, and potential business impacts of the following decision making. For example, accurate production cost information is more critical for a company utilizing cost-plus pricing with a small gross margin compared to a company selling premium branded products with a high gross margin. A 5% error in production cost information could significantly affect the calculated profitability (or unprofitability) of the first company's product offering, while a similar error has a significantly smaller impact on the calculated profitability of the second company. In the previous example, the accuracy of cost information can have a significant impact on the first company's product offering decisions, while the accuracy of costs can be seen as having a lesser impact on the second company's product offering related decisions-making. Accuracy requirements (and more generally, quality requirements) for other types of accounting information and systems can similarly vary.

Accuracy, while being at the center of the previous example, is not the only aspect of data quality presented in data quality literature. Data quality, as a more general term, also includes other aspects such as data completeness and accuracy. (Wang & Strong 1996) Wang and Strong (1996) have proposed a conceptual data consumer oriented framework that divides data quality into four main categories: *intrinsic data quality*, *contextual data quality*, *representational data quality,* and *accessibility data quality*. The framework is presented in Figure 4.

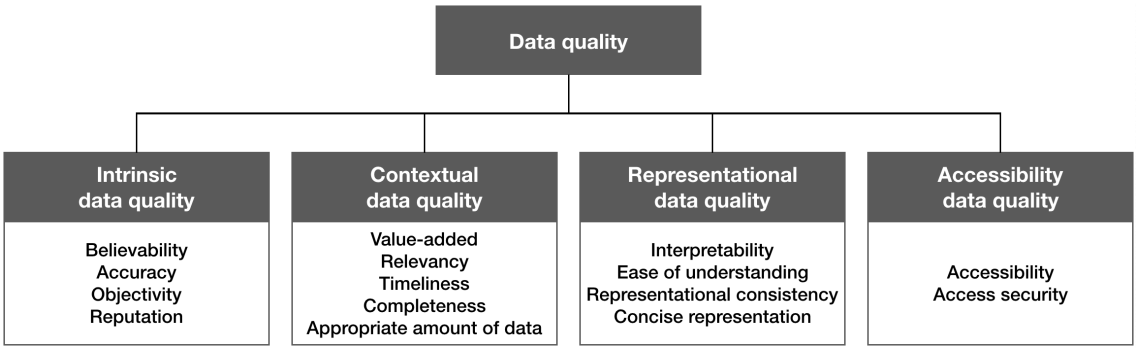

Figure 4. *A conceptual framework for data quality (Wang & Strong 1996).*

In Wang's and Strong's (1996) framework, *intrinsic data quality* refers to the quality of the data in its own right. *Contextual data quality* refers to the quality of the data for the task or decision that it is used for. *Representational data quality* refers to the way the data is presented and thus the ease for the data consumer to understand the data. Lastly, *accessibility data quality* refers to the user's ability and ease of accessing the data. As displayed in the framework, *intrinsic data quality* is only one aspect for overall data quality, and accuracy is only a part of the *intrinsic data quality*. This can be considered highly intuitive from a managerial decision-making view, as accuracy will likely be irrelevant if the data (or information) is not believable and from a reputable source, i.e. data (or information) is not trusted. Wihinen (2012) refers to Strong et al. (1997), noting that it is nonetheless important to recognize that the previous attributes of intrinsic data quality are interdependent concepts, and continues suggesting that it is unlikely that one displays with others being completely absent.

While not the only attribute of information quality, accuracy of accounting information is still important for successful decision making and has been shown to result in more profitable decisions being made (Sprinkle 2003). In a performance measurement setting, the accuracy and objectivity are required for a positive perception towards performance measurement systems (Malina & Selto 2001). Accuracy can also work as a precondition for increasing interest in MA development that focuses on other factors (Wihinen 2012). Best-in-class accuracy (or overall information quality) is nonetheless not always optimal for organizations, as more resources are required for improving the quality of information. As an example, the optimal product costing accuracy is dependent on the cost of measurement, cost of errors, and diversity of products (Wihinen 2012, originally from Cooper

1988). In a more general sense, the optimal quality of information can thus be seen being contingent on the cost of a wrong decision; the benefits must outweigh the costs.

In line with Wang's and Strong's (1996) framework, previous MA literature has also recognized that accuracy is only partly responsible for the performance of MA systems. As such, development efforts focusing on other aspects of accounting information can be beneficial for increasing the quality and impact of the information. Wihinen (2012) found that in cost systems, development efforts are sometimes better directed at improving the content of existing information to better suit decision-makers' contextual needs instead of focusing on the accuracy of the cost figures. Hall (2010) also refers to previous literature (Preston 1986; McKinnon & Bruns Jr 1992; Simons 1995) noting that the ease of comprehension of accounting information is important for managers (or information users in general) to have confidence in the data.

From a managerial point of view, accuracy and other factors of intrinsic data quality are also not always the most important properties required. Managers have been generally found to require information that is easy to understand and provides a generally understandable story of organizational performance (Hall 2010). As an example, Hall (2010) mentions Malina's et al. (2007) study, in which they show that it is more important for a performance measurement system to communicate the clear and credible story of business operations instead of the system being 100% valid. Technical jargon and complexity of accounting information can even inhibit the effective utilization of accounting information (Rowe et al. 2008). Providing too much information can, in the worst case, even reduce decision quality, with the relation of the amount of information and judgment accuracy resembling an inverted U-curve (Sprinkle 2003). Thus, presenting highly complex and detailed information (and analyzes) can in some situations be a suboptimal choice. In line with the previous, Wihinen (2012), studying cost accounting systems, suggested that information should be tailored to meet various contextual and representational requirements of a decision-making situation. Similarly, Hall's (2010) paper indicates that "…the quality and relevance of accounting information should relate primarily to whether it helps managers to carry out their work and less to whether it adequately describes underlying organisational activities" (p. 313). It is thus not necessary for accounting information to always be elegant, complete, or accurate for it to be useful for developing knowledge (Hall 2010) or for supporting organizational actors in their work.

The previous findings also display in the daily communication of accounting information among organizational managers. They have been found to mainly utilize verbal forms of communication when interacting with information and other managers, with written reports being less important in managerial work (Hall 2010). This can also be considered strongly relating to the need to establish an organizational story of performance, as verbal communication "provides a context to debate and discuss the meanings and implications of accounting data" (Hall 2010, p. 307). While the attributes of the information itself are important for decision making, Sprinkle (2003) also refers to previous literature and notes

that other properties of MA (such as performance measures being either financial or non-financial or the organizational uniqueness of the measures) also affect its decision-improving performance.

2.2 Distribution operations as a part of supply chains

Distribution works as the final step in industrial operations where products are manufactured and then delivered to customers. Distribution and the associated challenges therefore play an essential role in supply chains. This chapter presents key concepts and challenges related to the management and development of supply chains. Previous literature is presented primarily from the perspective of inventory and distribution management. Chapter 2.2.1 presents general concepts of supply chains and distribution, highlighting the key associated challenges. Chapter 2.2.2 then presents previous ideas and findings regarding the measurement and development of supply chains.

2.2.1 Distribution and inventory as part of supply chains

Stevenson (2011, p. 663) defines a supply chain (SC) as a "sequence of organizations - their facilities, functions, and activities - that are involved in producing and delivering a product or service". The integral role supply chains play in delivering any given offering results in supply chains having a significant influence on the value creation of companies. SC practices can thus significantly impact an organization's competitive advantage and performance (Li et al. 2006). No one SC fits all, however. A SC strategy should be devised based on the type and variety of products it creates, and the demand characteristics of those products. Examples of these characteristics are product life cycle, demand predictability, and market standards for lead times and service. (Fisher 1997)

Tsiakis et al. (2001) present the two basic processes of a (manufacturing) supply chain as (i) production planning and inventory control process (i.e. manufacturing and storage), and (ii) distribution and logistics process (i.e. retrieving and transporting products). These can be considered being the two interrelated subjects of development. These processes should be organized based on the type of product sold. According to Fisher (1997), a SC process should be efficient for functional products with lesser demand uncertainty, such as toothpaste, and responsive for innovative products with higher demand uncertainty, such as fashion clothing. Of the previous processes, inventory and distribution are the main objects of the discussion below.

Distribution is the process of getting products from a company to its customers. Simchi-Levi et al. (2008) list the two fundamental distribution strategies as *direct shipping* and distribution using *intermediary inventory storage points,* such as warehouses or distribution centers. Simchi-Levi et al. (2008) also list some more sophisticated strategies, such as cross-docking and transshipment, which can be used to replace or complement the more traditional warehousing and transportation options. In a pure logistics sense, the

tools utilized are nonetheless different inventory facilities and transportation methods. SCs also commonly utilize more than one of these distribution strategies (Simchi-Levi et al. 2008). Direct shipping from factory to customers can, for example, be utilized to lessen the demand fluctuations of distribution centers, as was done by some of the case companies in Baker's (2008) research article. Baker (2008) also found demand fluctuations to be the most significant reason requiring the establishment of agile SCs. He focused his research on retail distribution centers.

Distribution centers are often a part of strategies based on intermediary inventory storage points (Baker 2008). In such a distribution model, the associated decisions include the number, size, and location of facilities, and if they should be owned, leased or outsourced (Baker 2008, originally from Lambert et al. 1998). Simchi-Levi et al. (2008) highlight that it is also important to consider the interplay between transportation costs and the cost of carrying inventory. Similarly, lead times, service levels, and demand variability should also be considered (Simchi-Levi et al. 2008), as the industry requirements and other characteristics can affect distribution-related decision making. A short lead time requirement may require a manufacturing company to set up local warehouses near its customers, from where orders can be fulfilled with short order-to-delivery times. Distribution facilities, such as all other parts of SCs, need to always be considered as a whole. They therefore need to be fully integrated with the planning and operations of SCs so that different levels of SCs can support in managing distribution related challenges (Baker 2008). As described by Baker (2008, p. 38), "the supply chain and business unit levels are important for planning, smoothing throughputs, resolving issues and restructuring the supply network, whilst the distribution network and distribution centre levels need to be designed to handle the true variances that remain".

Inventories and inventory management are a significant part of every manufacturing organization and its distribution network, especially as it is closely tied with the customer service provided. Inventories have many functions, ranging from increasing service level to supporting efficient production and distribution. The two concerns of inventory management are customer service level and costs of ordering and carrying inventory, between which balance needs to be found. (Stevenson 2011) To this end, Gunasekaran et al. (2001, p. 81) highlight that "it is essential that costs associated with inventory should be evaluated, and proper trade-offs, with suitable performance measures, should be implemented".

Gunasekaran et al. (2001) refer to previous literature, listing the total costs associated with holding inventory as

- opportunity costs consisting of warehousing, capital, and storage,
- costs associated with inventory as incoming stock level, work in progress,
- service costs, consisting of costs associated with stock management and insurance,
- costs held up as finished goods in transit,

- risk costs, consisting of costs associated with pilferage, deterioration, and damage,
- costs associated with scrap and rework, and
- costs associated with shortage of inventory accounting for lost sales and/or lost production.

These costs can be divided into physical costs related to production, transportation, and inventory, and market mediation costs, relating to supply not matching with market demand (Fisher 1997). Costs that initially may not seem important may nonetheless end up being significant in the overall picture. Annual inventory holding costs, for example, can typically range from 20% to 40% (or even more) of the value of the item being stored (Stevenson 2011). Inventory costs should also be understood from an operational standpoint and not just from the basis of financial documents. The physical size of the component works as a great example. A low-cost component may be large in size, and therefore have a large space requirement (Gunasekaran et al. 2001). This space requirement can, in turn, generate costs. While costs associated with lost production are easier to observe, lost sales can work as a more elusive cost component. A stockout can result in delivery delays, which can cause lost sales that are not observed. As mentioned by Tan and Karabati (2004), lost sales may go unobserved if no trackable transactions take place. Such can be the case, for example, in a classic retail environment with lost sales being caused by products missing from the shelves. On the other hand, lost sales caused by, for example, extended delivery times can potentially be observed due to the customer interaction required. In addition to lost sales, delivery issues can also result in backordering or substitution, which may or may not be observed. (Tan & Karabati 2004)

The important role of inventory similarly highlights the role of inventory policies. Inventory policies should reflect the uncertainties and impacts of those uncertainties on a per stock keeping unit (SKU) level. These policies should also be regularly adjusted to changing uncertainties. (Lee & Billington 1992) Lee and Billington (1992) note that transaction volumes do not necessarily reflect the associated uncertainties leading to the need to use more detailed methods in analyzing uncertainty. Understanding the uncertainties can then allow significant reductions in inventory investment (Lee & Billington 1992).

As with distribution facilities, inventory management should also be considered in the wider context of the supply chain, as inventory policies of individual links also affect other parts of the SC (Watson & Polito 2003, originally from Blackburn & Millen 1982). Modern information technologies can be used to communicate end user demand to the upstream of the SC (Watson & Polito 2003), which can then manage their inventories accordingly. This can be used to combat the well-known bullwhip effect in SCs. The integrated nature of SCs also shows in inventory-related decisions, which are influenced by the associated logistics decisions (Stevenson 2011). In essence, slower and less reliable logistics methods can often require larger inventories and safety stocks. These decisions are a result of the SC strategy employed, which should be determined based on the type of product being sold (Fisher 1997).

Higher product variety commonly increases inventory levels due to a higher level of stock keeping units (Zipkin 2000). Higher product variety can increase demand variability and forecast errors, which can lead to either overstocking or stockouts, or in other words, "market mismatch" related costs (Fisher 1997; Ramdas 2003; Wan et al. 2012). Increased product variety can, for example, lower fill rates (Wan et al. 2012). Forecasting bias, i.e. systemic error in forecasting, has also been found working as a mediator between product variety and increased inventory levels (Wan & Sanders 2017). Wan and Sanders (2017) therefore suggest that battling forecast bias can be used to mitigate the indirect effect of product variety on inventory levels. Considering forecasting the sales of configurable products, Salvador and Forza (2004) refer to earlier literature and argue that studying past configuration demand can add value in planning and forecasting. Paul et al. (2015) similarly suggest that precise estimates of market preferences for modular options can be even more valuable than forecasts for aggregate market demand. Appropriate support systems may support in utilizing past information on configuration demand (Salvador & Forza 2004). The inverse relation between product variety and forecast accuracy can potentially be considered another marketing and operations trade-off. Increased variety could increase sales but would result in a decline in forecasting accuracy, leading to increased costs. (Paul et al. 2015) The role of forecasting can nonetheless be considered important for efficiently managing distribution. As in a case example discussed by Watson and Polito (2003), failing to forecast changes in demand could result in unforeseen demand changes causing stockouts in distribution centers. This can then lead to lost sales if customers are not willing to backorder.

The lead times of inventory orders also naturally affect inventory management. Levy (1997) discusses how longer lead times due to longer distances can increase the "volatility" of inventories, with inventory levels being either too high or too low. This can then increase overall administrative costs and costs due to lost sales (Gunasekaran et al. 2001). Similar fluctuations in inventory levels can also be caused by other vulnerabilities in inbound logistics. Svensson (2002) proposed that these vulnerabilities in inbound and outbound logistics of a SC could be assessed using four dimensions: service level, deviation, consequence, and trend. It is important to understand the uncertainties and variations in logistics and lead times, as greater uncertainty leads to the need to hold larger stocks for upkeeping the required service level. Uncertainty makes forecasting and inventory management closely linked. (Stevenson 2011) Lee and Billington (1992) generally list incomplete shipping method analysis as one of the pitfalls of SC inventory management. They note that transportation decisions should also include considerations about operational factors in addition to economic ones. Higher response time and smaller inventory investment can sometimes outweigh the higher cost of faster transportation. It can similarly be suggested that increased flexibility created by a faster transport can support in combatting other vulnerabilities in distribution logistics. The general focus on transportation costs is nonetheless not totally unjustified, as transportation costs are commonly the most significant single source of logistics costs (Gunasekaran et al. 2001). This makes transportation

costs and lead times one of the most significant influencers of distribution decisions (Stevenson 2011). Gunasekaran et al. (2001, p. 80) state that "the financial performance of a supply chain can be assessed by determining the total logistics cost". They highlight the role of logistics driven cost accounting systems for identifying sensible trade-offs in SCs, which allows identifying costs of activities and their impacts on other activities. This is important from a profitability perspective, as logistics policies also strongly affect capital requirements and return on investment (Gunasekaran et al. 2001). Direct financial implications should still not be the only point of consideration in distribution decisions. Stevenson (2011) reminds that distribution decisions should also take into account other considerations, such as ones related to capacity and quality issues.

2.2.2 Measurement and development of supply chains

Supply chains and the associated distribution operations can be assessed and developed based on a vast number of different performance measures, as presented by Gunasekaran's et al. (2001) literature review. They focus on measures for managing suppliers, delivery performance, customer service, and inventory and logistics costs in a SC. Similar, yet a more high-level approach is taken by Tsiakis et al. (2001), who state that in a highly competitive environment a SC should be managed efficiently with the objectives of

1. *minimization* of costs, delivery delays, inventories and investment, and
2. *maximization* of deliveries, profit, return on investment (ROI), customer service level, and production.

While these objectives can be considered intuitive to any business involved in manufacturing operations, the list nonetheless displays some of the performance dimensions through which SCs can be assessed.

As can be expected, different performance dimensions are sometimes in conflict. Maximizing customer service can, for example, require increases in inventory, thus leading to larger investment and lower profitability. Faster transport can, in turn, increase customer value at the expense of transportation costs. These conflicts, especially related to service level and inventory, need to be balanced appropriately (Stevenson 2011). In addition to balancing different performance metrics, the main metrics also need to be adjusted based on what matters in the marketplace. Focusing too greatly on capacity utilization and inventory turns could be dangerous if the customer requirements are more oriented towards responsiveness and product availability, as discussed by Fisher (1997). Externally visible non-financial measures should thus also be considered in addition to internal (and often financial) measures. Lee and Billington (1992) similarly mention how SC metrics should be linked to customer satisfaction for performance evaluation to be effective. Measures such as customer service should even be considered in numerical SC optimization models

(Chen et al. 2003), even though it would be difficult to monetarily quantify its impact on the model (Guillén et al. 2005).

SC measures can also conflict when comparing the performance of an individual link and the overall performance of the SC. While the previous performance dimensions can easily be assessed for each individual link in a SC (such as suppliers, factories, warehouses, or fulfillment centers), it has been often discussed that SC performance needs to be considered as a whole (e.g. Lee & Billington 1992; Watson & Polito 2003; Simchi-Levi et al. 2008; de Souza & Pires 2010). De Souza and Pires (2010) state that traditional SC performance measures fail when they assume that separately maximizing the performance of individual links will lead to the maximal performance of the whole chain. Lee and Billington (1992) discuss how different SC links pursuing their own operational goals independently can result in inefficiencies for the whole SC. Many companies have nonetheless previously had no performance measures for the whole SC (Lee & Billington 1992). In general, performance measures of individual links should guide towards serving the end customer of the SC, instead of the next downstream link (Watson & Polito 2003). High-level performance measures, such as ones listed by Tsiakis et al. (2001), should, therefore, mainly be considered from the perspective of the whole SC. Watson and Polito (2003) exemplified the different measures at different levels. Measures such as net profit and ROI should be used at a global/management level to align objectives with organizational goals. Measures such as throughput, inventory, and operating expense should be used in the middle management and stocking location level. Measures such as throughput dollar days, inventory dollar days, and local operation expense should then be used at the local level to control the local processes. (Watson & Polito 2003)

SCs are affected by a variety of strategic, tactical, and operative factors, details, and priorities. It is therefore not surprising that, as mentioned by Guillén et al. (2005), most SCs include a variety of technical and commercial uncertainties. These uncertainties can originate from multiple sources, such as suppliers, manufacturing processes, transit times, customer demand, and market developments (Lee & Billington 1992). This can make analyzing potential SC and distribution options challenging. Managing SC uncertainties requires SC managers to understand sources and the potential impacts of these uncertainties (Lee & Billington 1992). Not doing so can lead to multiple issues, one being investments in the wrong resources for performance improvement (Lee & Billington 1992). Gupta and Maranas (2003, p. 1220) remind that “underestimating uncertainty and its impact can lead to planning decisions that neither safeguard a company against the threats nor take advantage of the opportunities that higher levels of uncertainty provide”. These uncertainties can then induce costs associated with lost sales or scrap and rework (Petkov & Maranas 1997). Identifying the true underlying sources of uncertainty is important when analyzing potential SC and distribution options, as it is required for creating a representative but limited number of scenarios (Tsiakis et al. 2001) for analysis. Simplifying the analysis in a setting of multiple sources of details and considerations is also briefly

discussed by Berman & Wang (2006). They refer to Daganzo (1999), mentioning that a two-step solution approach will often prove suitable for logistics problems. The first of the two steps focus on a few details and uses approximations in obtaining broad solution concepts. The second step is then to fine-tune the previous concepts by including all the relevant information that was left out in the first step. This leads to more specific solutions being obtained. (Berman & Wang 2006)

Uncertainties can generally be modeled with a scenario-based approach or a distribution-based approach. In a scenario-based approach, uncertainty is described using a set number of scenarios about the future realization and impact of the uncertainty. These are then associated with a probability that represents how likely the scenario is to realize. Distribution-based approaches, on the other hand, are based on assigning a profitability distribution to a continuous range of possible outcomes for the uncertain variable. (Gupta & Maranas 2003) As discussed in the context of accounting information, only previously recognized sources of uncertainty can be managed this way.

In addition to seeking to model and understand uncertainty, companies can naturally also seek to manage its effects. Fisher (1997) lists three basic tools for managing demand uncertainty of SCs used for innovative products. First, companies can strive to reduce uncertainty with methods such as forecasting. Second, companies can avoid uncertainty by shortening lead times and making operations more flexible. Third, companies can hedge against uncertainty with inventory buffers and excess capacity. Gupta and Maranas (2003), on the other hand, describe two strategic "modes" for battling uncertainty. An enterprise can either work as a *shaper*, actively seeking to restructure the demand distribution to limit the associated downside risk while holding on to any potential upsides. An enterprise can alternatively work as an *adapter*, controlling its risk exposure by constantly adapting its operations to the actual demand that is realized. (Gupta & Maranas 2003) The three tools of Fisher (1997) can be considered a part of the adapter mode of responding to uncertainty.

2.2.3 Management accounting in supporting distribution development

As previously described, MA can be considered as a key tool in SC development. MA displays continuously in SC related performance measurement (Gunasekaran et al. 2001). Different accounting objects can and should be utilized for making proper SC related trade-offs, as described by Gunasekaran et al. (2001). Accounting information can work as a common language (Hall 2010) for relating the different SC and distribution-related considerations (such as transportation costs, inventory holding costs, customer service, and facility-related aspects) mentioned by Stevenson (2011), Simchi-Levi et al. (2008) and Baker (2008). Here MA can support in analyzing decision alternatives with a large

number of affecting factors (Wouters & Van der Veeken 2002; Hall 2010). MA can similarly also further support in reconciling sales, marketing, manufacturing, and distribution-related perspectives.

As a SC should be measured as a whole (Lee & Billington 1992; Watson & Polito 2003; Simchi-Levi et al. 2008; de Souza & Pires 2010), focus should naturally be given to creating performance measures that properly direct towards optimizing the operation of the whole SC towards the right organizational objectives. This can sometimes be difficult, as cited in Baker's (2008) research article. Prototyping (Wouters & Wilderom 2008; Wouters & Roijmans 2011) and cooperative development (Fry et al. 1995; Wouters & Roijmans 2011; Laine et al. 2016) can here be used to assist in achieving measures that best direct SC members towards the right organizational objectives.

MA can similarly be utilized in managing SC related uncertainties. MA and the associated knowledge integration can be utilized in communicating (Laine et al. 2016) underlying uncertainties and the identified financial implications, which are important to understand for proper managerial decisions to be made (Lee & Billington 1992). Here, the roles of accounting presented by Burchell et al. (1980) go hand in hand in SC related uncertainties. The answer and learning machine role (Burchell et al. 1980) of MA can, for example, display as the scenario analyses discussed by Tsiakis et al. (2001) and Gupta and Maranas (2003). Accounting can similarly be utilized for assigning costs for actions seeking to reduce uncertainty (such as ones presented by Fisher 1997), therefore providing decision-makers with information about the financial rationale behind the potential actions.

3. RESEARCH PROCESS AND METHODOLOGY

The third chapter will present the research methodology used and the research process. General methodological decisions will be presented first, after which both quantitative and qualitative methods and analyses are presented. The last chapter will present the research process and its development.

3.1 Research methodology

The research methodology is discussed by utilizing the *research "onion"*, first presented by Saunders et al. (2009). It depicts research philosophies and approaches as an onion, in which philosophies and approaches decided in outer layers affect the research related decisions made in the inner layers. (Saunders et al. 2009) The research "onion" is presented in Figure 5.

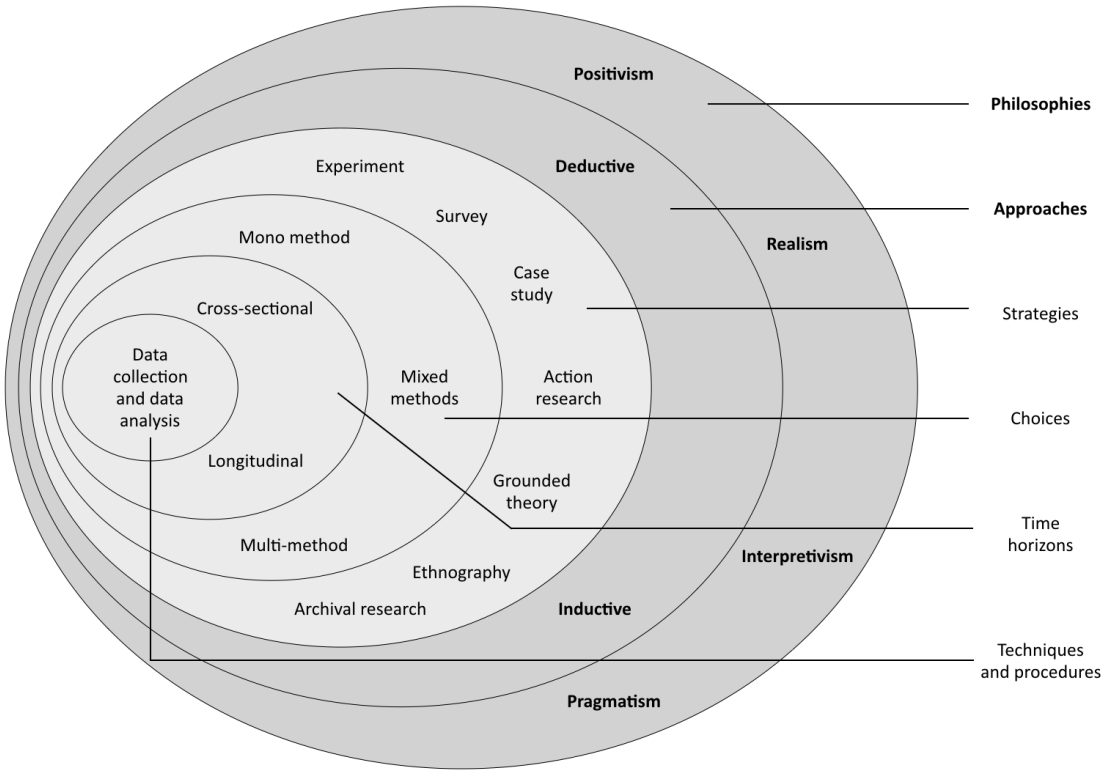

Figure 5. *The research "onion" adapted from Saunders et al. (2009).*

Decision making in industrial operations and company strategy can be considered being multidimensional. Often both case company independent data (such as procurement costs) and company dependent subjective information (such as factors affecting customer value) can be seen contributing to both daily and strategic decision making. The first research question was similar from the perspective of a suiting research philosophy, with

the question not purely aligning with a positivistic (focus on observable, research independent data) or interpretivist (focus on understanding subjective, social phenomena) philosophies. *Pragmatism* was thus considered a suitable philosophy for answering both of the research questions. According to Saunders et al. (2009), "pragmatism argues that the most important determinant of the epistemology, ontology and axiology you adopt is the research question – one may be more appropriate than the other for answering particular questions". As in industrial decision making in general, it was not seen beneficial to "tie the hands" of the author by adopting one of the stricter research philosophies. The author also considered that this would best allow for the creation of *actionable information*, which can be more easily utilized by different parties, including the management of the case company.

The *inductive research* approach was selected, as both of the research questions seek to establish new theories or findings instead of applying previous theories to practice. The research questions require determining a new logical offering for the case company's LC based on accounting information and studying how the management uses the new accounting information. This research setting naturally requires the theory to follow the data instead of the other way around, making the research approach *inductive* (Saunders et al. 2009, p. 126).

Interventionist research, described in detail by Jönsson & Lukka (2007), was selected as a research strategy. Interventionist research can be considered a form of case research, in which the researcher works inside an organization to gain insider (emic) perspective, and then crosses to the outsider (etic) perspective for formulating a more general, academic view from the issue at hand. This constant crossing between insider (emic) and outsider (etic) perspectives is thus at the heart of interventionist research. (Jönsson & Lukka 2007)

Interventionist research was considered the most suitable research strategy for the thesis for two reasons. First, the close involvement with the case company during the research period was considered beneficial for obtaining a thorough understanding of the company's current and future operations, objectives, and the use of accounting information. This allowed the author to better identify all the relevant variables and aspects affecting the research questions. This also allowed the author to better align accounting development with company objectives and business needs, following the related literature presented in chapters 2.1.2 and 2.1.3. Second, the author was already employed as a Business Analyst in the case company during the research and was thus also part of the daily operations in the company. This made the author a constant actor in the case company. This clearly separated the research setting from a pure case study, in which the research focuses on interviews and observations as the data gathering techniques (Jönsson & Lukka 2007; Suomala & Lyly-Yrjänäinen 2012). The previous employment was also seen as a strength of the research setting, as it allowed the author to both utilize a deeper understanding of the current operations of the case company and also eased the author's access to relevant information.

Interventionist research as a research strategy also supported the author's objective of creating *information with practical relevance*, as creating information with practical relevance has been suggested as of the strengths of interventionist research (Malmi & Granlund 2009). The relative youth of interventionist research as a research strategy is also partly a reason for it not being a part of the original research "onion" presented by Saunders et al. (2009), which is also why it is not present in the list of research strategies shown in Figure 5.

The decisions related to the inner part of the "research onion" were primarily made based on the available information and the timetable that was set for the research. Considering the first research question, which is supposed to help in operation expansion related challenges, a *cross-sectional* study was considered most suitable. A cross-sectional study is a study performed as a "snapshot" at one point in time, whereas a longitudinal study is performed over a longer period (Saunders et al. 2009), such as multiple years. While the study could have been performed as a longitudinal research (with the ability to assess both of the research questions more closely), the timetable given for the research did not allow for that.

The research methods included both quantitate and qualitative methods, as both were considered essential for capturing all the important aspects related to the first research question. This was considered essential, as many aspects of the first research question (such as operations and demand management related aspects) were hard to truly quantify, while quantitative information (such as past demand information) was also required for supporting qualitative information and for better analyzing business implications. As with the research strategy, utilizing multiple research methods were also deemed necessary for responding to the MA development challenges presented in previous literature. Previously identified challenges relating to the communication of processes (Wouters & Roijmans 2011) or alignment of MA with business needs and order winning criterion (Fry et al. 1995; Chapman 1997) were seen requiring a wide range of research methods. Both quantitative and qualitative methods were thus needed to completely understand the different aspects of the first research problem. Deciding to utilize both qualitative and quantitative data and to analyze them separately thus meant that the author used *mixed-method research* as a research choice, as described by Saunders et al. (2009, pp. 152-153). The actual data collection techniques used were

1. formal interviews with case company employees and management,
2. informal talks with the company personnel about subjects related to the research questions,
3. observations made by the author during his past work in the case company and during the thesis work, including observations made during different meetings,
4. quantitative analysis of data found in the enterprise resource planning (ERP) system of the case company, including sales order and cost data, and
5. manual gathering of cost data from sourcing contracts.

Formal interviews were the main method for identifying relevant variables affecting the first research question. Formal interviews were also the primary research method used for the second research question. The key points from each interview were compiled to a spreadsheet in which each column represented a question or topic, and each row represented an interviewee. This eased the comparison of key points found in the interviews. The interviews were conducted in either English or Finnish, depending on the interviewee's preference. Any quotes of interviews conducted in Finnish have been translated into English by the author. Manual cost data gathering was, at some point, seen necessary, as the cost data found in the company's ERP system was not always completely accurate. This was especially the case with components with lesser demand.

In addition to the traditional research methods, the author's prior knowledge of the company, its operations, and the market environment was also thoroughly utilized. As using the author's prior knowledge and potential personal views can be considered potentially affecting the objectivity and thus reliability of the research, the author sought to also confirm the most critical pieces of his prior information from another source in the company. This was done to minimize the potential personal biases related to interventionist research that could affect the research findings.

3.2 Qualitative and quantitative analyses

Chapter 3.2 describes the actual data gathering performed and the different decisions made during the data gathering. The different analysis methods are described in a reasonably detailed manner.

3.2.1 Data gathering

Quantitative research of the demand focused on the two main product families (product families A and B) of the case company. The two main product families were selected for two main reasons. First, the product families were somewhat different in terms of characteristics: the product family A was intended for single person use and was approximately half the price of the product family B, which was mainly intended for the use of small groups. Second, the sales of both product families were roughly equal, establishing their equal importance in the case company's offering. It was thus considered beneficial to study both product families separately, as the product families could potentially differ from an offering planning standpoint. As an example, the author was keen on finding out if the different price levels of the product families affected the customers' interest in any of the paid options that are offered by the case company. The other two product families were either very new (with only very little sales data available) or a very small part of the total sales of the case company, which is why these product families were not included in the research.

The quantitative data consisted of detailed order data, which was available from the case company's ERP system. The ERP system also contained detailed data about the different product variants (i.e. product configurations), which allowed "dissecting" each automatically created product variant back to the feature option selections made in the configurator. Different feature options are referred to as "feature option XYZZ", with X representing the product family, Y representing the feature, and ZZ representing the number of the feature option. For example, Feature Option AA03 refers to PF A's feature A, with option number three. The default feature (i.e. feature not altered in the configurator) is referred to as option number one (e.g. feature option XY01).

As the case company's offering, IT systems, and market were all rapidly developing during the research period, it was seen best to only analyze order data from 1st of January 2018 to 30th of September 2018. The author also considered analyzing a rolling 12 months of data (from 1st of October 2017 to 30th of September 2018) for obtaining a full year of data and therefore to include the last quarter of 2017 (which was clearly the busiest time of the year for the case company) but decided against it. This was because of changes made to the offering at the beginning of 2018. These changes included new feature options and changes to the previous standard products. The changes to the offering and (consecutively) pricing of different options was seen impacting the customer ordering patterns, justifying the analysis of just nine months of orders. The dataset included a total of 880 sales orders with 1145 order lines. 594 product variants were present in the sales data.

On top of the feature option offering refresh of January 2018, some completely new configurable features and options were also introduced later in 2018. To clarify, the new features were already present in the product families, but there were not any variable options offered with which the features could be altered. The new features were not included in the study for two reasons. First, there was too little sales data for a reasonable demand analysis, and second, the new feature options were seen being too new for any representative, long-term ordering patters to display in the order data. This assumption was also supported by the Head of Product's comments about one feature's option offering, as he estimated that changes to that option offering would start showing in sales only after approximately six months.

The quantitative analyses were done with European (excl. Nordic[1] countries) sales data, as those were considered giving the most representative picture of what the future US demand could be like. When compared to European demand, the historical US demand had a higher share of large inventory orders. This was seen as a result of both lower intercontinental shipping costs of full container load (FCL) shipments and the quicker end customer deliveries when the reseller had a local US inventory. Due to the larger share of inventory orders, it was also assumed that the most popular default configurations (later

[1] The case company defines Nordics as Denmark, Finland, Iceland, Norway and Sweden.

referenced as standard products) were overrepresented in the historical US demand, comparing to the potential future demand. This was both seen in the sales data and verified by the case company sales personnel, who confirmed that the standard products were "safest to keep in stock and easiest to sell by the reseller". One US sales manager (with previous work experience in one of the case company's resellers) also pointed out, that the act of stocking standard products in reseller warehouses could also have made those configurations "a standard" in the US market, consecutively lowering the end customer interest in different feature options.

Sales in the Nordics were excluded because a large portion of the Nordic sales was to one Finnish reseller, whose ordering patters were generally considered being somewhat exceptional. The case company also had a relatively high percentage of direct end customer sales in Finland, which were not considered being representative of the future US demand (which will always involve the presence of local distributors). The sales personnel and the Head of Product of the case company also agreed that analyzing current European (excl. Nordics) sales would give the best indication of the future demand.

When analyzing the demand of different configurations, the author decided to disregard information about the wall socket related feature, as the demand for different sockets was seen being driven by the power distribution standards of the nations the products were shipped to. The configurability of the wall socket can thus be considered being an attribute related to the customer location, and the wall socket option demands were thus not seen to be caused by the customer-specific value created by the options. All future US orders were thus assumed having a US wall socket. This assumption was also validated by looking past order data, which showed that (without a few exceptions) all orders made by US resellers included a US wall socket.

The qualitative data were mainly obtained with half-structured interviews with both the sales and supply chain organizations and many informal "coffee break talks" with the company personnel. Formal interviews were divided into two sets. The first interviews regarding the first research question were held at the beginning of the research. The goal was to gain a deeper understanding of both the customer perspective and the supply chain and to identify different factors that could affect the research question. The second round of interviews discussing about the use of accounting information was held at the end of the research. There was a total of ten interviews made in the first interview round, five with members of the supply chain organization, and five with the members of the sales organization. Six interviews were held during the second round of interviews, four of which were with the two members of upper management leading the LC project. A list of the case company personnel interviewed can be found in Table 3.

Table 3. *Case company personnel interviewed for the research.*

Interviewee	Areas of responsibility	Number of interviews
Head of Supply Chain	Overseeing all supply chain related matters, such as production, order processing, customer service, and sourcing.	3
Sourcing Director	Managing all sourcing and sourcing development operations.	1
Chief Financial Officer (CFO)	Forecasting process and the overall financial performance of the company.	2
Head of Products	Product offering and product development. Worked previously as Head of Sales.	2
Customer Service & Delivery Director	Responsible for customer service, order processing, and production planning.	1
Supply Chain Development Manager	Responsible for supply chain related development.	2
US Operations Manager	At first responsible for coordinating sourcing projects, incl. the logistics center project. Later responsible for the US operations.	1
VP of Sales & Global Accounts, Americas	Responsible for global accounts and the sales organization in the Americas.	1
Sales Director, North America Central	Responsible for all sales in central North America.	1
Sales Director, Central Europe & Denmark	Responsible for the sales in central Europe.	1
Sales Director, North America West	Responsible for the sales in west USA.	1

The questions of the half-structured interviews can be found from appendixes A and B. The author would like to note that the question lists worked mainly as a basis for discussion, with the interview discussion also moving to questions not present in the premade interview question list. All the formal interviews were recorded for allowing accurate quotations and a more thorough post-interview analysis of the responses. One of the interview recordings with the CFO of the case company was corrupted for an unknown reason, resulting in the last approximately 20 minutes of the recording being lost. The CFO was responsible for the thesis project on behalf of the case company. He was therefore frequently participating in research related discussions during the thesis work.

3.2.2 Cost structure analysis of the logistics center

The general cost structure of the logistics center was analyzed using a simple excel model, which allocated all the inbound shipping and operating costs of the logistics center to each of the subassembly classes found in the product families. These costs could then be summed to get the total cost per unit of a product. The model similarly allowed analyzing the sources of the costs. The main objective of the analysis was to find out which cost factors were relevant when looking at the profitability of the logistics center, and how the different decisions made could affect the profitability.

For the sake of simplicity, it was assumed in the cost model that only one product variant would be sold, which would also reflect in inventory turnover times. In total, it was quite straightforward to gather all the cost data since many cost factors were transaction-based and originated from the subcontractor of the logistics center. The cost of each action done in the logistics center was thus clearly stated in the contract made with the subcontractor. The costs included in the analysis and the source of the cost information is displayed in Table 4.

Table 4. *Cost factors found in cost structure analysis.*

Cost factor	Driver	Source
Cost of assemblies	Multiple drivers	Company costing model
FCL shipping (freight) to the logistics center	Transaction	Company personnel handling first subassembly shipments to the logistics center
Receiving to the logistics center	Transaction	Logistics center subcontractor contract
Logistics center storage	Storage time	Logistics center subcontractor contract
Logistics center packaging and shipping	Transaction	Logistics center subcontractor contract
Fixed costs of packing	Area reserved in square feet	Logistics center subcontractor contract
Outbound freight to customer	Transaction	Analysis of logistics costs by the supply chain development team
Cost of Capital	Capital employed, cost of capital percentage	Cost of assemblies, authors assessment

The cost of capital was also recognized in the analysis to better contextualize the other cost factors and capital requirements. It was mainly used to calculate the residual income later in the what if analysis. It is also important to recognize that the company shareholders did not impose any specific targets for capital return, making it a lesser focus in the company's operations. The cost of capital used in the analysis was relatively high due to

the very high ROI of the current company operations combined with the generally high returns the company's current shareholders were presumed seeking.

The labor costs related to container packing when shipping from the factory to the logistics center were not included in the analysis. This was mainly due to relevant cost data not being available. The previous, combined with the fact that the offering decision was not seen affecting the container packing cost (per subassembly), made including the cost factor in the study too laborious considering the value gained.

3.2.3 What if analysis

A what if analysis was done for investigating the financial implications of different option offering decisions. The four scenarios included were

1. only offering one variant (configuration) per product family, with other variants being supplied from the case company's European factory,
2. storing all the subassemblies required for all available feature options in the logistics center and thus offering all the options in a short 2-4-week delivery time,
3. offering all the possible feature options from the logistics center by stocking some of the more complex options and locally sourcing the options which did not require production activities, and
4. a middle solution, in which only some (but not all) product configurations were offered from the logistics facility.

For each of the scenarios, an indicative profit and loss (P&L) statement for the year 2019 was calculated. The P&L statements were used to compare how the different inventory levels and increased margins from non-standard configurations would affect the company's profitability, and to conclude if a larger offering would have any direct financial benefits to the case company. The company management was also interested in seeing the effect of local sourcing, which would allow the company to order parts for some of its configurations based on customer orders received. This was seen as one of the 2019 objectives for the company's US operation, as local sourcing would allow the company to both reduce the amount of working capital tied to the inventory and reduce the inventory obsolescence risk.

The what if analysis was done as follows. First, the management provided the total product family sales estimates for 2019, which were used as a basis for all of the four scenarios. The total quantity of product sales (of each product family) was considered being the same in all scenarios, as the sales personnel of the case company were unanimous in their view that any potential option offering would not significantly affect the company's sales quantities but would instead only affect the quantities of different options sold. This is discussed in more detail in research results in chapter 4. Second, the past European sales data was used to calculate the relative demand for the options of all features. The relative

demand percentages of the options were then multiplied with the forecasted total product family sales to get the forecasted amount of sales of different options. In essence, the what if analysis assumed future US feature option demand being the same as it has been in Europe, but with scaled to fit the total forecasted sales of each product family. Figure 6 illustrates how forecasted option demands were determined.

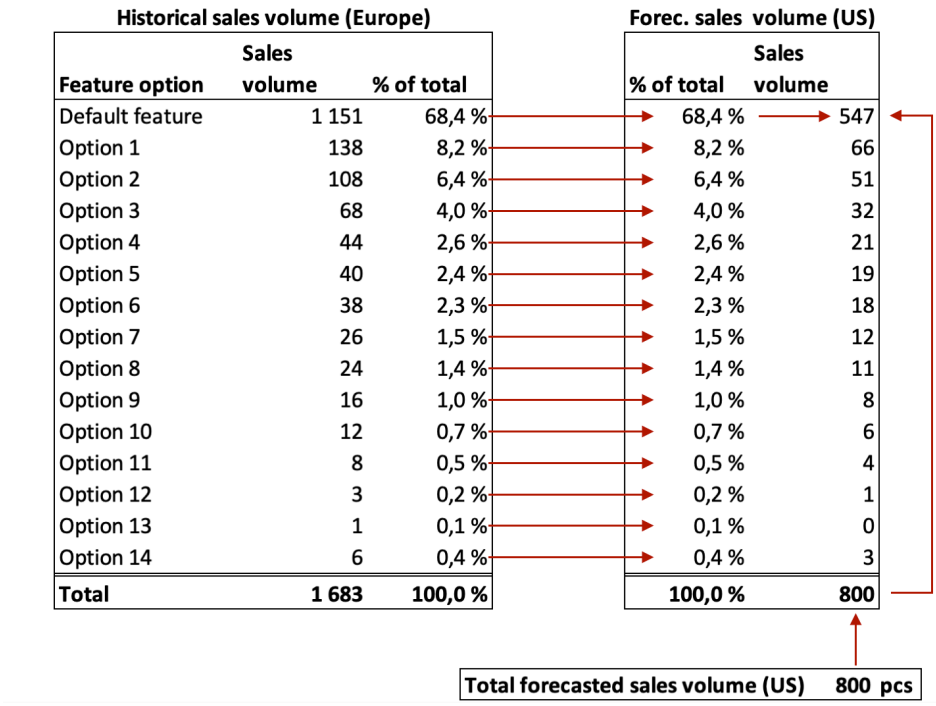

Figure 6. *The method used to forecast feature option sales in the what if model.*

The model assumed that the demand would spread evenly throughout the year, as modeling the seasonal changes in demand levels was not seen bringing enough value when acknowledging all the other factors that could not be modeled, and which could also affect the model. One example of a factor that was seen difficult (and also insensible) to model was that the logistics center could (and most likely would) be used to balance the manufacturing workload of the company's European factory. This would potentially result in larger than required inventory levels held at the logistics center. This was not seen as an issue, as any resulting LC related cost increases would most likely be offset by cost reductions resulting from the balancing of the manufacturing workload in Europe.

As some of the current feature options were decided to be permanently terminated from the offering, the author also rectified the demand forecasts of different options to accommodate this. In essence, the author assumed that the forecasted demand for soon-to-be terminated options would be reallocated to other options using the ratio in which the other options had been ordered in the past. The same methodology was also used in scenario 4: the forecasted demand for the options not being offered was assumed being redirected to the options (including the default option) offered using the already present ratio of feature option demand. This decision thus implied the assumption that if a customer preferred

option was not available, there would not be a higher chance for that customer to order another option instead of not ordering any option at all.

The inventory levels of different subassemblies held in different scenarios were determined by roughly estimating the average turnover times for each of the subassemblies and using that turnover time to calculate the average inventory held at any point in time. The general guideline for the estimates was that the less an option (and the corresponding subassembly) was ordered, the longer its turnover time would be due to demand uncertainties. It was also assumed that an eight-week (the lead time for logistics center inventory orders) demand worth of subassemblies would constantly be in transit from the factory to the logistics center. All of the inventory-related assumptions were initially scrutinized with the Supply Chain Development Manager (who was also in charge of launching the logistics center operation) to ensure that all the assumptions made sense and were plausible. Later, the related assumptions were also reassessed in a workshop-event with the Sourcing Director, US Operations Manager, Sales and Operation Planning Specialist, and Order Management Specialist.

The same cost data (found in Table 4) used in the cost structure analysis was also used in the what if analysis. Here, the cost of capital was used to obtain residual income for quantifying the impact of different inventory levels and capital requirements in each scenario. In addition, the costs of different feature options were separately calculated. This, combined with the list price information, allowed calculating the marginal profit of each feature option. This was done by hand, as the current case company costing system was not able to capture feature option level cost or profitability information.

It was also recognized that a broader offering (in terms of feature options available) would most likely increase the overhead costs related to the logistics center, as a broader offering would result in more “hassle and inefficiencies” at the operational level. Despite this, the overhead costs used in the what if analysis (related to the logistics facility) was kept almost the same in all scenarios. This was partly due to the fact that the case company’s current costing system was unable to generate information about the potential increase in overhead labor costs. Talks with the company CFO also resulted in a unanimous view that any potential differences in overhead costs would not have a significant impact on the results of the analysis. As an example, if scenarios 2 and 3 would require one (or more) extra full-time employee working on the logistics center, this would result in a yearly cost of approximately 40 000 € (or 45 600 $) per person. This was not seen impacting the results of the analysis in a significant way. In general, the author saw it more plausible that “hassle and inefficiencies” would more likely show as the increased number of situations in which different feature option subassembly inventory levels of the logistics center would either be too low (potentially resulting in a stockout of some of the subassemblies) or the option subassembly inventories would grow too much, increasing the risk and impact of any inventory obsolescence. Regardless of the size of the feature option offering, the shipping load factor was assumed to be constant.

The local sourcing scenario (scenario 3) assumed that some of the feature option subassemblies/components (for feature options AA, AB and AC/A) would be sourced locally, thus eliminating the overseas shipping costs and lowering the required inventory held. The scenario assumed a 25% price increase for the said subassemblies/components, which would include shipping to the logistics center. Potential quality (ensuring) costs related to local sourcing were not included in the scenario but were acknowledged when going through the results of the analysis. It was assumed that the company would continue to keep a small inventory of the default feature subassemblies at the logistics center to ensure the timely deliveries of standard products (which were planned to be shipped in two weeks from receiving an order). The default feature inventories equaled 1,5 times the average monthly demand for both product families A and B.

3.2.4 Interviews on accounting information in decision making

While the work regarding the first research question granted an excellent viewpoint for observing the use of ex ante accounting information and the associated quality requirements, more detailed interviews were also considered necessary. Interviews were used for obtaining a more comprehensive view of the issue, and for catching any details that had previously been left unnoticed. Interviews also allowed analyzing the first phase of the LC project (in which the author did not take part in). This deepened the understanding of the research issue by allowing the comparison of two different ex ante accounting situations and identifying potential differences and similarities in the situations. A comparison of the two phases was also considered fruitful for analyzing the use of accounting information, as two persons of the upper management (the CFO and the Head of Supply Chain) were involved in both of the phases.

The interviews were divided into two parts, one for each phase of the LC project. In total, the interviews consisted of six interview sessions with four people of the case company. The interviewees were selected based on their affiliation in the phases of the LC project and their role in the final decision making in the two phases. The first phase of the LC project was discussed with the Supply Chain Development Manager, the Head of Supply Chain, and the CFO of the case company. They were the main actors in the first phase of the LC project. The second phase was discussed with the Head of Supply Chain, the CFO, and the Head of Product, who were closely associated with the second phase of the LC project. The CFO, the Head of Supply Chain, and the Head of Product were all part of the case company's management team.

Based on the previous accounting literature, the interviews were divided into three sections. The first section addressed the use of accounting information in the respective phases of the LC project. The objective was to better understand how and why management utilized accounting information, and what added value it provided in terms of decision making. The second section addressed the quality requirements for the accounting objects. The objective of the second section was to understand what quality requirements

were the most important in different accounting objects and the different phases of the LC project. Understanding the different quality requirements and their relative importance was also sought for identifying, how resources for accounting development should be allocated for obtaining the most value. The last section addressed other sources of information used in decision making and their role in relation to accounting information. The objective was to better the understanding of how managers utilize accounting information in relation to other sources of information. This also enhanced the understanding of the use and quality requirements for ex ante accounting information by making it possible to relate the previous uses and requirements to the other sources of information available to managers.

3.2.5 Summary of the analyses

Figure 7 displays a summary of the main data sources and analyses done for the first and second research questions. Rectangles with a white background represent analyses done. Rectangles with a grey background represent source data gathered. The dotted rectangles with a white background represent analyses done during the first phase of the LC project by other people of the case company. Information was gathered partly in concurrence with the making of the analyses.

The bottom area with grey background concerns solely the second research question. Interviews about the use of accounting information were about the analyses and the related accounting objects shown in the top part of the figure. Similarly, observations made during the thesis work (i.e. phase two of the LC project) were used as a data source for analyzing the use of ex ante accounting information and the related quality requirements.

The analyses represented as the dotted rectangles were done by the LC project team during the first phase of the LC project. While not part of the first research question, the use and requirements for accounting objects during the first phase were also analyzed. This was done to widen the understanding of how the upper management used accounting objects during the different phases of the same project. Analyzing the potential differences was seen to add value, as both of the phases had different objectives and experienced different uncertainties.

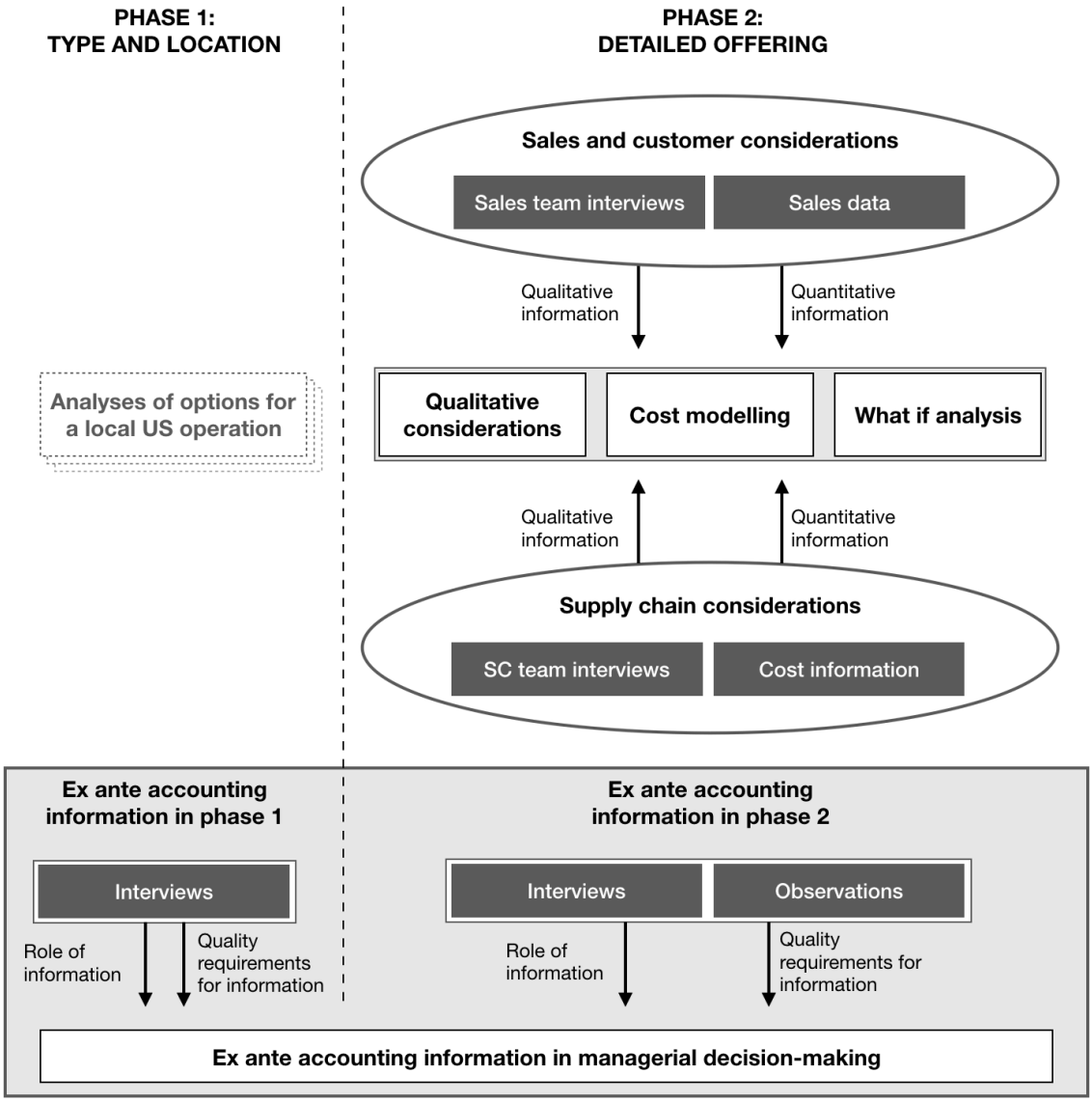

Figure 7. *The two phases of the LC project, with the related data sources and analyses done in the thesis.*

3.3 Research process

The thesis was completed in two phases. The first phase focused on the analysis of the first research question and was completed in the winter of 2018 and 2019, with only some minor tweaks made to the calculations afterward. The second phase included the second round of interviews and the final writing of the thesis, which were initiated in the spring of 2019 and were completed in the autumn of 2019.

The work began with the initial research questions still being slightly blurred, as the relevant aspects of the first research problem were still unknown to the case company. This is why the research was initiated with general interviews with personnel from both the sales and the supply chain. The aim was to identify the most important aspects that could affect the decision about the future offering in the forthcoming logistics center. It was

considered important to obtain both the customer view of the offering (by interviewing sales personnel) and the possible challenges and limitations arising from the supply chain.

To obtain a more thorough general understanding of the problem space, a general quantitative analysis of the sales orders was then conducted. The primary objective of this analysis was to see what kind of product variants (i.e. configurations) were ordered and in which quantities. Before the analysis, it was widely understood that only some of the feature options offered were widely popular and that the current offering included many feature options that were only rarely ordered. However, it was not known which feature options would be *popular enough* for the increase in the availability of those options to make sense. The author also considered important to find the causalities which affected the order quantities of different feature options, as there could have been some underlying reasons for some feature options being more popular than the others. For example, it was hypothesized that a longer than normal (four weeks) delivery time for specific feature options could have significantly lowered their demand, although the need for the specific options might also have not been present in the customer base.

With the information gathered, the focus moved to building the cost structure analysis and later the what if model, which then allowed analyzing the different potential scenarios for the LC offering. This initial focus on the case company's research question was mainly driven by the case company's need to obtain results as soon as reasonably possible. Previous literature was thus reviewed in more detail starting from the early spring of 2019. The interviews about the use of accounting information were done during the summer of 2019. While not the primary reason for the time of the interviews, this allowed the decisions regarding the LC offering to be made before the interviews. Requirements for accounting information could thus be considered after the second phase of the project had roughly concluded.

4. RESEARCH RESULTS

The research results are divided into different sections based on the topic the results focus on. First, results regarding the case company's sales and customers, and cost and operations are presented in chapters 4.1 and 4.2. These work as the basis for the what if analysis, presented afterward in chapter 4.3. Chapter 4.4 then presents the proposed feature option offering for the case company's LC. Finally, the findings regarding the use of accounting information created in this thesis and in the first phase of the LC project are presented in chapter 4.5.

4.1 Customer demand

This chapter addresses the findings from the perspective of the case company's sales team and customers. Qualitative considerations are first presented, followed by an analysis of the historical sales data.

Interviewing the company sales personnel revealed that the current market view was quite unanimous in the sales team. This was in part expected due to the relatively young and previously small team, and partly surprising due to the geographical separation between Europe and the United States, which could have shown as market-related differences.

The interviews with the sales personnel revealed a somewhat surprising view, and in some ways a partial mismatch, in the current market demand and the company offering. Discussing the value drivers and decision factors of customers revealed that for the customers, the most important factors of the case company offering were the product family related *design, quality, and technical/functional performance.* These quality factors mainly relate to the product family as a whole, and not the different feature options with which the products can be configured. This was interesting because, as previously mentioned, the case company had put much effort into marketing the configurability of its product families. It would thus seem that while mass configuration is at the heart of the company's production system, market offering, and brand, it is not as critical for the customers.

Discussing this mismatch further revealed the reason for the core properties of the product offering being the most important decision factor for customers. According to the sales personnel, the case company was a clear leader in all of the value factors previously mentioned, lowering the importance of other parts of the offering. In other words, the mass configurability and feature option offering are of lesser importance, as the case company clearly excels in the core properties of the products when compared to the competition. This notion was also the reason why the total sales quantities of different product families were later kept the same in the different scenarios of the what if analysis. Despite the

previous, mass customization and feature option offering were still seen as having an important role in branding and marketing. Many of the salespersons agreed that mass customizability is an essential part of the company's premium brand. It was mentioned that it is important for the customer to be able to configure exactly the kind of product that he or she wants, even though he or she would most likely still end up ordering a default product with no feature options. This "playing with the colors and options" was also seen as important when considering architects and the design community in general. Having a large feature option offering, and especially color offering, was seen beneficial for catering to the design community and keeping the designers interested in the products.

The discussions also showed the general view that the role and importance of the feature option offering would grow when the competition would get closer to achieving the level of design, quality, and technical/functional performance of the case company's products. This was generally seen as a logical proposition, as partially losing one differentiating factor will require the company to create other means of differentiation.

On top of the core aspects of the product families, order-to-delivery times were unsurprisingly seen as one of the key aspects of the company's market offering. While the feature option offering (or the lack thereof) was not seen affecting sales, long order-to-delivery times were generally seen as a potential reason for losing sales to competitors. Interestingly, the order-to-delivery times were also considered more important than pricing, as the sales team rarely considered any deals to be lost due to pricing. This was found interesting as it was generally known that the case company's products were the most expensive ones in the market.

The European sales representative interviewed considered that (for European orders) order-to-delivery time was already a strength of the case company and that any improvements to that would not significantly increase sales. While being only one person's view, this can be considered as an indication for the target order-to-delivery times when fulfilling orders from the US logistics center. As most European orders were (in 2018) shipped in 2-4 weeks of ordering (when ordering product variants with options that did not affect the feature AB or BB), it could be considered that a similar lead time would also suit the logistics center. Other sources also confirmed that approximately three weeks was the order-to-shipping lead time norm in the industry. Normal shipping times were 1-2 weeks for European customers, making the total order-to-delivery time 3-6 weeks. It is worth mentioning that at the time of writing, the offering planned for the first months of the logistics center (with only a minimal offering in terms of feature options) was promised to be shipped within 2-4 weeks from ordering. Maximum order size limits were also set.

When discussing the feature option offering and its role, it quickly became clear that the "visual options" (mainly different color elements in the exterior and interior) were seen

as the most important ones for the customer, and clearly triumphing any "functional options" (such as the option for feature AD). According to the Head of Product, this was largely because of the interest of the designers. Interestingly enough, it was still not seen critical to offer any specific feature options (on top of the default ones) from the logistics center. Instead, many in the sales team considered it to be best to just offer "the most popular options", which could mean 2-3 most popular options offered for each feature. One of the salespersons stated that the customers would not mind having a more limited set of options (when compared to the factory offering) for each feature. For example, it would make sense to offer 2-3 most popular option colors from the logistics center, and then have the rest be fulfilled from the factory in Finland (with a significantly longer order-to-delivery time). It was also mentioned that any "special feature options" (which could clearly be separated from "regular options meant for regular orders"), could easily be shipped from the Finnish factory with a longer lead time. According to one salesperson interviewed, the customer would understand the special requirements of such options. An example mentioned was one of the feature options for feature BC, which can generally be seen as more of a "special option" from the point of a regular customer in the industry.

When considering the actual decision of options to offer, some general guidelines emerged from different sales personnel. First and foremost, any options offered should have continuous demand. The author saw this as an important notion, as the company has previously had large orders with less popular options, which, when looking at demand at a yearly level, would look like options with significant demand. It was thus seen important to look "past the number of units ordered" and to focus on the general market interest. In practice, this means that selling 100 units with feature option X in 50 orders is a vastly better demand indication than selling 100 products with feature option X in 2 orders. The Head of Product thus suggested that it would be better to look at the number of *orders with a feature option x*, instead of the absolute number of units sold with a feature option x, when determining the market demand for any one option.

Another thing pointed out by the sales personnel was that the option offering should be generally coherent, meaning that similar options should be available for all product families. For example, the same color options should be generally available for all product families. While it was seen sensible to offer a reduced list of color options for product families with lesser demand, it was seen important to not offer completely different color options for different product families (for example offering a yellow color option for product family A but not product family B and a red color option for product family B but not product family A). While this is partly obvious, it was noted because there were a few examples in which some particular color was more popular in only one of the product families. One of the salespersons also mentioned that whatever the offering, if the case company is promising shorter lead times, then the supply chain should be "bullet-proof" in providing it. This did not require much explanation, as it was generally seen

that the company's brand image and market position as a high-end supplier demanded that the company would also be reliable in its delivery times.

When discussing the role of the downstream value chain, the role of the resellers was considered tremendously important when considering which feature options were actually sold to the end customers. Quoting the Head of Product, "we must first be able to sell the feature option offering to the reseller, who must then in turn sell it to the end customer". Even though the case company always showcased the different feature options in its marketing and offered a product configurator for the potential end customers, the resellers were still generally seen as a kind of "gatekeepers of the option offering". They generally had a strong influence on what feature options were actually sold in the value chain. As mentioned by the Head of Product, "some dealers may grow to like one specific color, which could show in our sales". Another example mentioned was from the US, in which one of the case company's larger resellers had "grown accustomed" to selling mainly two product variants with different colors. According to one salesperson, this was mainly because the reseller had an already mass customized and packed product variant inventory of their own (due to the otherwise longer end customer experienced order-to-delivery times). This led them to focus on the most popular product variants (with the most popular color features) that were easiest to sell.

Some of the interviews also included discussion about how easy it is to implement changes in the offering to the reseller network, and if there would potentially be any challenges involved. The main question of the author was that if one set of feature options would first be offered from the logistics center and thus adopted by the resellers and their sales force, would successfully communicating any expansion of the option offering to resellers and especially their sales force be as easy as in the first place. Alternatively, could the resellers' own sales force alternatively "grow accustomed" to selling only the feature options that are first offered. As the resellers commonly sell a plethora of different office furniture solutions, the author considered if it would be possible that the reseller salespeople would not keep themselves appraised of the changes in one of their product manufacturer's offering. This question strongly related to considering if there would be any reason for the case company to already start offering feature options that did not currently have enough demand to qualify as a feature option to offer. Such feature options could potentially qualify after a year or two thanks to the overall increase in product sales. The salespeople with whom this issue was discussed with were not able to say if this was an issue or not, mainly saying that "it is possible". It was nonetheless agreed that implementing and communicating changes in the offering in the value chain is challenging. This was also yet again mentioned by the Head of Product during the second round of interviews when he mentioned that any offering decided should be one where there is no risk of needing to pull back some parts of the offering. The challenges associated with discontinuing feature options were observed in the case company during the spring of 2019, during which requests for feature options already discontinued at the end of 2018

were still coming in. Orders for those feature options were still being fulfilled in the summer of 2019. The LC offering should thus generally be a long-term offering, which would not be constantly changed.

Analyzing the historical sales of different feature options and product variants clearly showed that while the case company offered multiple different feature options to configure the product families with, the majority of features were left to default options. The data showed that visual features (such as the different color options) displayed as the most common features configured. The volume of standard product variants was nonetheless surprisingly low. The most common product variant (i.e. the standard product) of PF A was responsible for 38 % of all sales of the product family. The volume of the most common product variant of PF B was significantly lower, totaling 20 % of all sales. The majority of product variants sold thus contained at least one feature option.

Figure 8 displays the proportion of PF A's orders with the default feature and feature options for different features. The default feature is represented by a green column. Red dotted columns represent fully custom feature options (e.g. a feature option made to order with a customer determined color). White columns with lines represent product variants in which the feature is not available due to dependence on other feature option selections. Other columns represent different feature options. The data shows that a feature option is more often selected for visual features as opposed to functional features.

Interestingly enough, the majority of feature AB configurations were still left to default, even though the interview with the sales personnel indicated the relative importance of options for features AB. Additionally, only one feature option was ordered in a significant quantity, leaving other options to little demand. This was somewhat surprising, as the number of feature options offered is almost the same as with feature AA. This can be seen supporting the view that either the steeper price tag or the greatly longer lead time required for orders with options for feature AB are affecting sales. Feature AE was also somewhat surprisingly little configured, even though it is also a visual element. What can also be clearly observed is that each feature generally has one or two feature options with a significant share of sales (on top of the default feature), with other feature options forming a long tail of option demand. This is best exemplified by feature AA and feature AC/A, to which the most visual feature options are offered. What the data also displays is the relatively large portion of fully customized features of feature AC/A, as opposed to the already offered feature options. Looking at the data more closely displays that 60 % of the sales of the custom feature originated from three major sales orders. This indicates that the custom feature demand is more a characteristic of large special orders, than ordinary and stable customer demand.

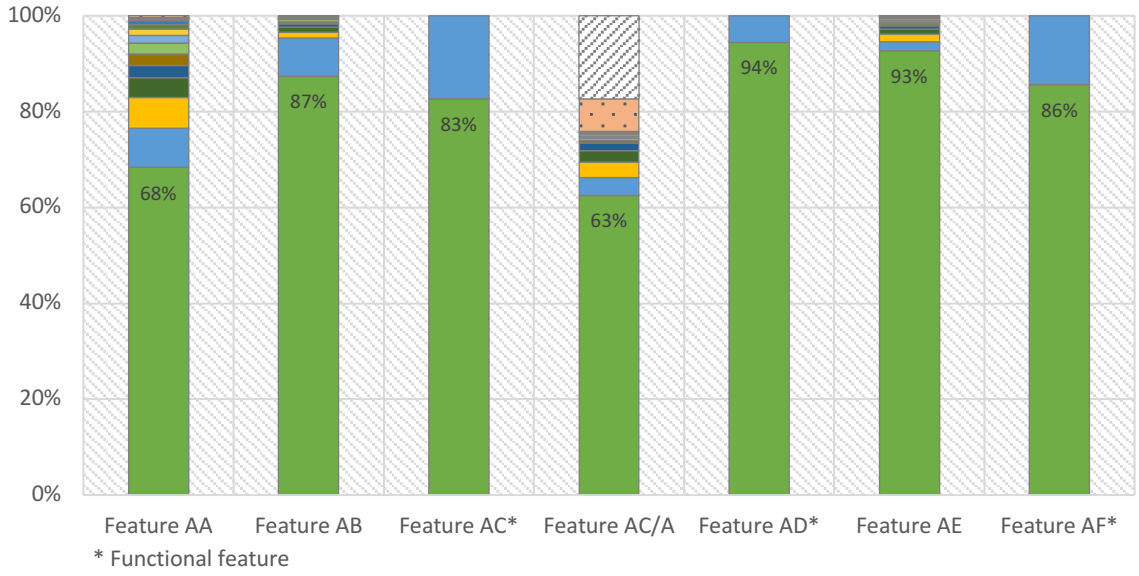

Figure 8. *Proportional sales of product family A's feature options.*

As previously mentioned, the company also offers a less expensive "budget package" for the more price-conscious customers. It includes a different option for feature AF (the one feature option offered) and has feature AC removed (the only options offered), making the feature AC/A irrelevant. While different feature options are also available for the "budget package", hereafter "budget package" is generally referred to when considered the "budget package" with no additional feature options. This is because the "budget package" variants with feature options can be considered being like any other product variant with a different product configuration.

After removing the "budget package" sales from the data (to see if the default options of the majority of orders have been changed), the lesser role of functional features was more clearly seen. The data showed that the feature options of features AC and AF (both displayed as blue columns in Figure 8) are generally only ordered when some variant of the "budget package" (with or without additional feature options) is ordered. In both cases, disregarding all of the "budget package" sales (with or without feature options) shows that less than 1 % of other sales have a feature option selected for either of the features. The price-conscious customer-oriented "budget package" (without feature options) is nonetheless a significant part of sales, covering 8,6 % of all sales of PF A.

While the proportional sales of feature options are somewhat descriptive of the demand, a more detailed analysis of the options ordered was necessary. The sales data shows that there are significant differences in the demand for different feature options. As Table 5 shows, the feature option demand can generally be described as having a few popular options (of which the default feature dominates the demand), with a long tail of less popular feature options.

Table 5. *Feature AA option demand of product family A in European sales orders.*

Option	Sales (pcs)	% of total	# of orders
Default AA	1151	68,4 %	438
Option AA01	138	8,2 %	48
Option AA02	108	6,4 %	42
Option AA03	68	4,0 %	29
Option AA04	44	2,6 %	11
Option AA05	40	2,4 %	15
Option AA06	38	2,3 %	22
Option AA07	26	1,5 %	18
Option AA08	24	1,4 %	16
Option AA09	16	1,0 %	6
Option AA10	12	0,7 %	11
Option AA11	8	0,5 %	6
Option AA12	3	0,2 %	2
Option AA13	1	0,1 %	1
Option AA14	6	0,4 %	4

A similar option demand distribution can be found in other features as well. The data clearly displays that in general, there are 3-5 options (including the default options) with noteworthy demand (on average at least one order a week), after which the demand of the feature options steadily falls close to zero. While the case company is offering a wide range of different options, it is clear that the customer demand mainly focuses on just a few. As a side note, the well-known Pareto principle seems to also display in the sales data: 3 of the most sold feature options (equaling 20 % of the feature options) are responsible for 83,0 % of the unit sales, as displayed in Table 5.

As suggested by the interviews and seen in Table 5, there are some noticeable differences in the sizes of the orders of different feature options. A more detailed way to analyze the demand was therefore deemed necessary. A suitable data representation was suggested by the Sourcing Director and refined by the author. This representation is shown in Table 6, which displays a more detailed feature option sales data for PF A's Feature A. The feature option sales are divided into columns based on the size of the order of a given feature option. If a single order contains multiple product variants with the same feature option, all of the feature options are included in the order size. The column headers display the size of the variable option order. The table cells display how many feature options (i.e. product variants with the feature option) were ordered in total in a given group.

Table 6 shows that the vast majority of orders have under ten units in them, with the default feature having a larger variability in the sizes of orders. As can be seen from the

table, orders larger than eight pieces are generally one-off orders for all the feature options. It can also be seen that the overall sales of options AA04 and AA05 are greatly affected by single larger orders. One 24 pcs order is responsible for 55% of the overall sales of feature option AA04. For AA05, one large order was responsible for 43% of sales. It is worth noting that the default feature orders with over 20 pcs are not stock orders by resellers, but large orders by single customers. It is also important to point out that the case company sometimes split large orders to separate sales orders in the ERP system. This eased the management of large orders, especially when the customer requested units to be shipped into multiple locations at separate times. Information required to automatically combine the separate (virtual) sales orders into one was nonetheless not available. It is thus generally likely that there are more large orders than is displayed in Table 6. Overall, while it can be confirmed that single large feature option orders can significantly affect the observed demand of the feature options, single orders do not seem to greatly affect the proportion of orders with feature options and orders with the default feature. Similar results also show in other features of PF A as well.

Analyzing the feature option demand of product family B shows that the product family is more extensively customized. As previously mentioned, the most popular product variant of product family B was responsible for 20 % of sales. Figure 9 displays the proportional sales of feature options for product family B. Again, green columns represent the default features (if one exists) and red dotted columns represent custom features (e.g. feature with a non-option color determined by the customer). White columns with lines represent product variants in which the feature is not available (due to dependence on other feature option selections). Other columns represent different feature options.

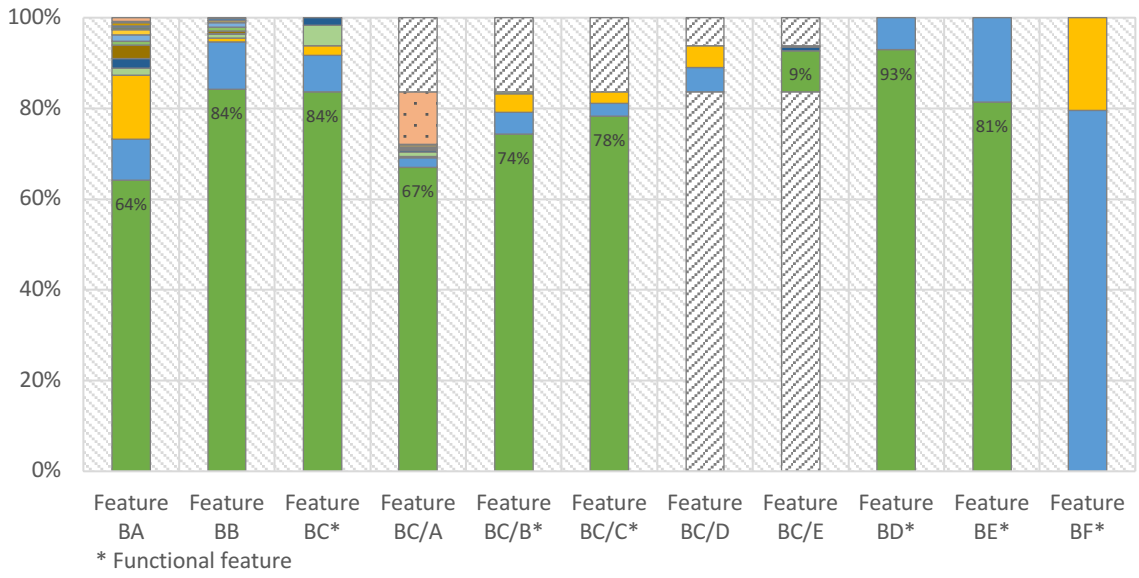

Figure 9. *Proportional sales of product family B's feature options.*

Table 6. *The number of feature options ordered for feature A of product family A, split into columns by order size. Cells are colored on a per-row basis, with larger groups shown in a darker color and smaller groups shown in a lighter color. Order size groups refer to the quantity of a given feature option in a single order, and not the number of the product family's variants in a single order.*

	Order size (pcs)																						
Feature option	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**20<**	**Total sales (pcs)**	**% of total**
Default AA	218	200	129	140	30	42	49	24	27	30	11		13		30			18	19	20	151	1151	68,4 %
Option AA01	11	46	21	8	5			8		10	11							18				138	8,2 %
Option AA02	24	8	12	12	10	12	7				11	12										108	6,4 %
Option AA03	13	20		12			14		9													68	4,0 %
Option AA04	8			4				8													24	44	2,6 %
Option AA05	7	10	6														17					40	2,4 %
Option AA06	15	6	9					8														38	2,3 %
Option AA07	11	12	3																			26	1,5 %
Option AA08	9	12	3																			24	1,4 %
Option AA09	4				5		7															16	1,0 %
Option AA10	10	2																				12	0,7 %
Option AA11	4	4																				8	0,5 %
Option AA12	1	2																				3	0,2 %
Option AA13	1																					1	0,1 %
Option AA14	2	4																				6	0,4 %
																						1683	**100,0 %**

Table 7. *The number of feature options ordered for feature A of product family B, split into columns by order size. Cells are colored on a per-row basis, with larger groups shown in a darker color and smaller groups shown in a lighter color. Order size groups refer to the quantity of a given feature option in a single order, and not the number of the product family's variants in a single order.*

	Order size group																						
Variable option	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**20<**	**Total demand**	**% of total**
Default BA	156	80	60	48	10	30	14	32	9	10	11							18				478	60,8 %
Option BA01	25	16	3	8		6			9													67	8,5 %
Option BA02	21	16	12	16	20		7							14								106	13,5 %
Option BA03	8		3																			11	1,4 %
Option BA04	12	4																			41	57	7,3 %
Option BA05	10			12																		22	2,8 %
Option BA06	6																					6	0,8 %
Option BA07	6	2	3																			11	1,4 %
Option BA08	8																					8	1,0 %
Option BA09	1	2																				3	0,4 %
Option BA10	2	2																				4	0,5 %
Option BA11		2	3																			5	0,6 %
Option BA12	1																					1	0,1 %
Option BA13	1																					1	0,1 %
Option BA14		2		4																		6	0,8 %
																						786	**100,0 %**

While the features of product family B are again left to default in the majority of cases, a feature option is selected to a product more often than to product family A. This can be attributed to multiple causes. PF B is more expensive (and the options generally less expensive relative to the non-configured base price) than PF A, which could increase the interest in configuring the product. PF B also has more features to which options are offered compared to PF A. Lastly, the feature options offered can be seen being more significant compared to the default option (in terms of impact to either the use of the product or the visual appearance) compared to PF A.

An interesting observation is also the relatively large demand for custom features of feature BC/A. While the feature only affects a color element (making them relatively easy to order), the share of custom options was a significant surprise. The raw data about the custom feature options was double-checked by the case company personnel for identifying any potential errors in the source data. While some errors were found and rectified, the sales of custom features were nonetheless significant. Discussing the finding, the Head of Product attributed the high number of custom orders to the fact that the feature was a significant and eye-catching visual element of the product. A more detailed analysis of the orders also displayed that a 33 % of the demand for the one option of feature BD originated from one sales order. While the demand for the feature options is not huge, the options were nonetheless seen as having significant potential in the future by the VP of Sales & Global Accounts, Americas.

Feature BA's option demand is again presented in more detail in Table 7. Feature BA is used as an example, as it is equivalent to PF A's Feature A. The differences of the product families can be thus more easily presented. Similarly, the different feature options of feature BAXX match the PF A's feature options AAXX. Table 7 shows how almost all orders are less than ten units, with only four orders having more units. The issue with looking at the total demand without order related information is again exemplified by feature option BA04. 74 % of the feature option BA04's sales are from one single order. What can also be observed is that the vast majority of all feature option sales are for orders of one to five units. The greater price of PF B (approximately double the cost of PF A) and the different ways of using the product can be considered reducing the order sizes. Similar results can also be seen with other features. Contrary to expectations, feature option orders do not greatly differ from other orders in terms of order size. The initial hypothesis of feature options being more common in large "project like" orders was thus incorrect.

When looking at the demand of feature options for both PF A and PF B, it can be seen that feature options can generally be divided into three groups based on demand. First, the top group consists of mainly the default features, with demands of over 20 % of all product family sales. The middle group generally includes 1-3 most popular feature options, with each consisting of 5-15% of all product family sales. The bottom group creates the long tail of many feature options with little demand each. Each feature option in this group is generally responsible for 0-5% of the sales of the product families. These feature

options are also always ones to which subassemblies are built to order (and to which components are often ordered after a customer order has been received). What can also be observed is that the majority of feature option sales are for small 1-5 pcs orders in both product families.

As previously mentioned, in addition to the prices of most feature options, the case company had also set special delivery terms for the majority of its option offering. The company offered a four-week manufacturing lead time for product variants in which no feature options were selected for feature AB and BB, and no custom features were ordered. An eight-week manufacturing lead time was offered for products in which the feature options were selected for features AB and BB or for product variants with custom features (e.g. customer company colors). The latter lead times can be considered long, as one of the company sales personnel (earlier employed by one of the case company's resellers) stated that a three-week order-to-delivery time is the norm in the industry. As the industry-standard lead times have generally been seen as one of the key aspects affecting customer decision making, it is not surprising that the longer lead times seem to show in the sales of options for features AB and BB. As seen from Figure 8 and Figure 9, features AA and BA (with all the option colors available in the same manufacturing lead time) had more options ordered compared to features AB and BB (with any feature option ordered increasing the manufacturing lead time to eight weeks).

4.2 Case company operations and costs

This chapter addresses the findings from the perspective of the case company's supply chain. Findings from interviews are first presented, after which findings from cost structure analysis are presented.

Most of the interviews with the case company's supply chain personnel generally brought up many similar points relating to the offering decision. A somewhat surprising observation was that the supply chain personnel seemed to be just as concerned about the "true customer requirements" as the sales personnel. The author assumed that this was a result of the fact that it is the supply chain organization that will have to deal with all of the "more special" orders (with less popular feature options or completely custom options and product variants). Oppositely, it is all the same to the sales organization if the customer is, for example, ordering a black or a white product. Many of the supply chain personnel brought up dividing different options by their relative importance and demand. In general, the supply chain personnel saw that the options offered should be divided into "important options" (with a more critical role in fulfilling the customer requirements) and to more marginal, "nice to have" options (with no significant impact on overall sales). While the interviewees did not provide a clear rule to separate the options into two different categories, the Sourcing Director of the case company considered options with order frequencies of less than "one per week" being too cumbersome to manage considering the profit gained.

The ordering frequency (and general demand characteristics of options) strongly relate to the company's forecasting process, which was also brought up multiple times in the interviews. While in some ways an obvious statement, the forecasting and its success naturally affected both the costs of the company (via inventory management and order fulfillment related costs) and customer value (via the ability to fulfill orders in time). This naturally raised the question of how an increased option offering would affect forecasting and its role in both inventory and cost management. While forecasting had already been one of the key processes in the company, its role was naturally seen growing due to the long lead times associated with the internal supply chain (i.e. subassemblies being shipped from the factory to the LC).

The author noted that the current forecasting process would most likely be unsuitable, or at least challenging, when forecasting feature option demand. The current forecasting process only focused on the demand of the main product families and not the feature options, which also displays in the current methodology of forecasting. The only minor exception to the previous was forecasting the demand of one specific feature option that was a non-visual option of product family A. This was done because the option was more important for the company's overall product strategy, and could even have been considered a separate product family of its own. While the forecasting of feature option demand was not necessary in the company's Finnish factory due to relatively short lead times from component suppliers, this was not the case in the US logistics center, which was (initially) fully supplied by the Finnish factory. Any warehousing would thus most likely require a more sophisticated inventory and purchase order management.

Capital requirements and the associated risks were mentioned often during the interviews. This also displayed as discussions about the obsolescence risk, which was also generally brought up. This was because of a larger option offering (and thus the required inventory) was considered increasing the obsolescence risk faced. The potential obsolescence risk was seen especially relevant to the case company, as product development was fast-paced. Additionally, there were not any policies established for releasing new versions of subassemblies or feature options (either to the public or as internal incremental updates). These version updates were generally related to either bettering the design of the product (from terms of quality or manufacturability) or were in response to quality issues found in the designs. While this was seen challenging, its effects were previously mitigated. As the company had only had production in one location (Finland) and was able to keep a relatively small subassembly and component inventory, the obsolescence risk had previously not been a priority for the management. During the thesis work, the new Head of Product Development established a new release schedule for (non-critical) changes in the product families and related feature options. Changes to the product families would thus only be done a maximum of three times a year. This would lessen the risk for unexpected obsolescence but would not remove it, especially when considering subassemblies or feature

options with smaller inventory turnovers. The fast pace of product and offering development in the case company also showed in the supply chain interviews. For example, the Head of Supply Chain noted that “changes need to be able to be done in a specific time, and inventories sold in, for example, six months”. When discussing the significance of the obsolescence risk, the Sourcing Director stated that “as a rule of thumb, half of the basic inventory could be thrown away due to obsolescence”.

The author observed that the case company had not established processes for quickly selling inventories that needed to be sold. For example, the case company previously had an outsourced warehouse in the US, in which the case company stored ready-to-ship packages of standard product variants. This was done earlier as a first market test for the shortened delivery time and its effects. Approximately six months after the external warehouse was decided to be terminated (in favor of establishing the larger logistics center operation), there was still inventory left at the old warehouse. The same issue was also later voiced by the Head of Product. It was generally known that this was not due to market-related issues, but internal challenges of selling the old inventory. Similarly, an accidentally ordered inventory of a feature option (affecting the color of certain parts) could not be sold by the sales team even though they were pushed to do so. This led to a write-off of tens of thousands of euros.

While both examples are financially of relatively little consequence, the examples were generally seen as an indication of the inventory management challenges of the company. It would also therefore act as an indication of the potential inventory management challenges the case company could face in the logistics center, considering its current processes (or the lack thereof). The author assessed that the previously rapid growth of sales combined with the relatively small financial impact of either obsolete or slow inventory had previously made inventory issues of little interest to the company management. As having a larger feature option offering in US using a local inventory (instead of sourcing all the variable parts on a per order basis as is done in the Finnish factory) required a greatly improved process for inventory management, obtaining these organizational capabilities was seen as a necessity by the author for growing the offering of the logistics center.

The author also noted that there had been challenges relating to inventory management, not only from the sales perspective (i.e. aiming to sell old product inventory instead of “forgetting” about it), but also from purchasing perspective (i.e. ordering the right amount of the right components). The current tools used in the purchasing process and the related forecasting were manual in the sense that little IT was used to assist in the process. This was a result of multiple factors, such as sometimes incorrect bill-of-materials information stored in the ERP system and the fact that the currently provided purchasing tools were incompatible with the configurable products of the company. In addition, the component inventory numbers were often wrong and inventory information thus somewhat unreliable. Component stockouts thus happened from time to time. This often resulted in too

large purchase orders being made “just for safety”. As an example, the Sourcing Director mentioned that many component purchase orders were generally made by copying the previous purchase orders, which included components required for the production of a specific number of subassemblies. This was mainly done because of the large number of inaccuracies in the inventory numbers and the resulting mistrust of the information shown in the ERP system. According to the Sourcing Director, the previous resulted in a situation where the company had an excess of some components (enough for a few months of production) while having little inventory of some components (enough to last for a few days or weeks).

Again, while the company was able to cope with the challenges thanks to a relatively short supplier lead times and agile organization, the logistics center could be considered being greatly more affected by the challenges in the internal processes. These challenges, especially related to the inventory numbers, would nonetheless most likely be mitigated by the fact that the LC was operated by an external organization with ready working processes and direct financial interest in correct inventory numbers. Similarly, the IT integrations required for the operation required the inventory information to be correct.

When it comes to the manufacturing of the feature options, the type of the option (i.e. whether it was a colored wood or an upholstery option), and thus the ease of production and sourcing, were generally seen important by the supply chain interviewees. In practice, this meant separating options into groups based on how easy they were to offer. This included considerations of where the feature option “differentiation” was created. As an example, the metalwork required for a supplier to produce the exterior plating of the products was more challenging compared to just painting the exterior plating to the color of the feature option. In such a situation, having the exterior plating just painted locally would most likely be easier and result in fewer quality issues. Oppositely, if the feature option color elements of the products were a part of a wooden subassembly (which required assembly operations itself), the option was seen as more challenging to offer via other ways than warehousing. This was due to the fact that these feature options required both local woodwork and coloring to be done and local subassembly manufacturing operations – both of which require investments and are subject to increased quality risks.

Discussing about the lead times offered, the Supply Chain Development Manager assessed that moving between two-week to four-week order-to-delivery times would not significantly affect the feasibility of offering any specific feature options. This was because there would generally not be enough time to react to any surprises in demand or inventory quality. Only an eight-week order-to-delivery time would, according to his assessment, induce benefits from cost and supply chain management standpoints. The previous could, however, affect the feasibility of air freight, which could be utilized in lowering the safety stocks, as noted by the Sourcing Director.

Discussing the associated costs, the SC personnel interviewed generally saw transportation-related costs being the most significant in the operation. This general view was obtained earlier during phase one of the LC project. It was also noted that as a derivative of the previous, optimizing the load factor would be an important part of optimizing costs. What was nonetheless also noted was that optimizing inventory and costs should not be focused too much at the expense of service level. In essence, the SC personnel thought it would be better to overstock subassemblies that were warehoused instead of trying to optimize inventory and costs and risking ending up with a surprise stockout.

The initial plan for restocking the LC was to use two kinds of FCL shipments. One was planned to be a "standard shipment" which included all subassemblies required for a set number of assembled final products. A "standard shipment" FCL would only have full subassembly sets for either PF A or PF B. The second type of FCL shipment was to be a "variable container" which included a mix of subassemblies (either feature subassemblies or subassemblies used in all product variants of a given product family). This container was supposed to be used to refill single subassemblies that had either had quality issues (and were thus discarded) or were used shipped to customers as spare parts. Additionally, the second FCL was supposed to include restocks of feature subassemblies which did not fit the "standard shipment". The nature of the container meant that the associated load factor could potentially be lower compared to the "standard shipment".

Studying the direct cost factors related to the logistics center revealed that when looking at the total cost structure, the costs originating from the logistics center activities can be considered almost insignificant. Table 8 displays the total cost structures and capital requirements of the default variants of both product families A and B. These costs were obtained by calculating the cost structures for all subassemblies and then adding those together. The last row ("Of which LC related costs") displays all costs except the *cost of goods sold* and *shipping to the customer (transport)*, which is itself closely tied with the LC to customer shipping prices of the case company.

Table 8. *The cost structure of a standard variant of product families A and B shipped from the logistics center.*

This table has been removed from the public version of the master's thesis in order to protect the confidential information of the case company.

Studying the cost structure, it quickly became clear that the costs related to the operation inside the logistics center (which are mainly transaction-based costs charged by the logistics center operator) are almost insignificant when considering the total cost structure associated with product families A and B. Instead, what is of interest are the shipping costs from the factory to the logistics center (done using FCL sea freight), and the amount of capital required in the operation of the logistics center.

The majority of the cost of capital is caused by the long lead time from factory to logistics center (8 weeks), which causes the majority of capital costs. While this cannot be changed without moving manufacturing or sourcing to the US, what is of interest is the role of inventory turnover at the logistics center. The cost of capital shown in Table 8 assumes that the logistics center inventory turnovers would be approximately 1,5 months for both product families A and B. It can thus be seen that from a capital efficiency standpoint, it is more important to focus on successful forecasting and efficient inventory management (to allow smaller turnover times while sustaining an acceptable service level) than to try to optimize the operating costs of the outsourced logistics center. It is also interesting to note that the actual costs of warehousing and LC activities are greatly smaller than the calculated cost of capital.

The second major logistics center related cost factor, transport from factory to the logistics center, is clearly also the second biggest single factor in the total cost structure, being only second to the cost of goods sold. This was largely discussed with the Supply Chain Development Engineer responsible for the LC related logistics. It was seen that little more could be done to increase the FCL packing efficiency, considering the current restrictions. The main restrictions were the requirement to only have the same inventory items per pallet, and the inability to pack some subassemblies on top of others. In general, it was seen that the FCL packing efficiency of product A would be hard to increase any further, whereas the packing efficiency of product family B could be increased by little. It is also worth noting that according to the Supply Chain Production Engineer, there is little efficiency difference in shipping completely prepacked product variants (that are ready to be shipped to customers) compared to shipping only subassemblies used to pack (and thus determine) the final product variants.

There were no significant differences found with the LC related costs associated with different options of the same feature. This was due to the same or almost the same dimensions associated with different feature options. The costs of offering different feature options were thus more closely tied with the inventory holding costs and the increased obsolescence risk, which was due to both lesser demand and higher inventory turnovers as opposed to the default feature. This means that selling a feature option itself does not often drastically change the associated costs (excluding direct material costs) of a product variant. This also means that from a profitability standpoint, large feature options which are additive in nature (i.e. adding something completely new to the product variant) are of more importance, as they directly increase the costs of a product variant served from the LC.

Considering different feature subassemblies altogether, there were differences as can be expected. Larger subassemblies were found to have significantly greater LC associated costs due to higher logistics and holding costs. The large feature subassemblies were also often more expensive, increasing the capital tied to the operation. A good example of the

previous were subassemblies for feature BC. These subassemblies are therefore potential targets for cost management initiatives.

What also contributed to the relatively low amount of LC related costs was the fact that some subassemblies to be held at the LC were assembled to include selections of multiple feature options. PF A's features AD, AE, and AF were combined to a single subassembly. This was done for removing the need to establish local subassembly manufacturing, as incorporating options from those features required manufacturing operations. Similarly, PF B's features BC, BC/A, BC/B, BC/D, and BC/E were combined to a single subassembly due to the current process specifications of the LC. These features, with the exception of BC/A and BC/B, can nonetheless be later separated into different subassemblies by expanding the packing operations. The author would also like to remind that only one product variant was considered in the cost structure analysis. This means that a larger offering and potentially lower inventory turnover will partially increase the per unit costs. This can also affect the marginal profitability of different feature options.

It was also noted that the relatively low price level of the LC partner could open new operational possibilities in the LC. The low prices for services could, for example, be potentially utilized for increasing the overall load factor in intercompany transportation. Similarly, expanding the packing operation to reduce the number of LC SKUs also seems like a potential option for the case company. These operational possibilities are nonetheless not studied further in this thesis.

To summarize, the LC related costs will not limit the size of the offering itself, at least when some reductions in marginal profitability of feature options are allowed. The following what if analysis provides more detailed information about how different offerings could impact the case company's profitability.

4.3 What if analysis

The what if analysis of the four different scenarios showed interesting results. In summary, the offering decision does not have a significant impact on the case company's profitability, but it still significantly affects the inventory levels and, subsequently, the obsolescence risk of the company.

Table 9 shows the (partial and indicative) P&L statements for each of the scenarios. The table also includes residual income (RI), inventory turnover, and return on investment (ROI) for better comparability of different scenarios. As expected, the scenarios differ in some quite obvious ways: the larger the option offering (with a relatively larger part of the orders including premium-priced feature options) the larger the revenue. This naturally shows in costs as well, with both the cost of goods sold (COGS) and logistics center related costs growing as the size of the feature option offering and the number of options ordered grows.

Table 9. *Partial P&L statements of the logistics center in four different scenarios.*

This table has been removed from the public version of the master's thesis in order to protect the confidential information of the case company.

What struck quite interesting to the author and the CFO of the case company was that there is not a significant difference in the EBITDAs of each scenario. The biggest difference in EBITDAs was (not surprisingly) between the *one variant* and the *all variants* scenarios, with the greater being 1,9 % over the other. This difference was considered small, with other scenario related considerations (such as product strategy, inventory risk management, quality management, and operational efficiency) being considered more important than a potential 1,9 % difference. It was also worth noting that including all the currently incalculable operational overhead created by the larger offering would bring the difference down even further.

Interestingly enough, the *all with local sourcing* scenario was not significantly different from *all variants* -scenario. It was assumed that options sourced locally would cost 25% more (price premiums including the shipping to logistics center) compared to the costs of the options when being purchased by the Finnish factory. This gives a good indication to the company's purchasing team: if local sourcing can be done with a price premium (incl. shipping) of under 25%, it can generally make sense for some options. Larger price premiums can also be seen being justified when including considerations such as service level (due to lesser risk of stockouts), lesser obsolescence risk, and smaller capital requirements.

While the differences shown are not big, it is not surprising that the *middle solution* resulted in the best EBITDA. Looking at the revenues and costs shown in Table 9, it can be seen that the *middle solution* excels largely by not only because of larger revenues, but also because the costs of the offering have grown only little compared to the *one variant* scenario. At the same time, the *middle solution* allowed a revenue growth equaling 67% of the revenue growth of *all variants* scenario when comparing to the *one variant* scenario. When analyzing the scenario differences more closely, the reason for the previous quickly became apparent. In general, most of the options of any given feature have the same price. For example, the extra price charged for ordering a unit with yellow exterior color is the same as ordering one with a blue exterior color. This results in a situation in which (looking from a purely financial standpoint) *it does not matter which feature option is being sold as long as one is sold*. This same principle applies to most other features for which options are offered. As fewer feature options are offered, and each of the offered feature options is ordered more, cost savings due to increased volume can be obtained. It is worth pointing out that the previous phenomenon is based on the assumption that when a feature option is not offered, any potential demand for that specific feature option is divided into the other feature options (including the default feature) in proportion to their historical sales. If potential demand for a feature option that is not offered reallocates to

the default feature (with no price premium), then the differences would be more significant. It is also worth mentioning that some feature options also lower the price of the product variant compared to the standard product. Such feature options of product family B were only included in *all variants* and *all with local* sourcing scenarios, contributing to the relatively small differences of the scenarios.

The profitability differences of each scenario are also lowered when considering the residual income shown in Table 9. As can be expected, a larger feature option offering and thus a larger inventory requires more working capital, which can also be considered a cost from the perspective of the shareholders. The same can be observed from the ROIs of each scenario. While the use of ROI supports in describing the differences in each scenario, it is important to recognize that the ROIs shown are not absolutely accurate. This is because no general overhead (such as product development, sales, and administrative costs) is allocated to the LC in the P&L statement shown. The RIs were therefore considered working as a more approachable metric for comparing the scenarios. In general, it can be said that there are no major differences in the different scenarios when looking from a purely P&L standpoint.

Discussing the impact of inventory turnover moves our focus to the larger difference in each scenario: inventory size and inventory composition. Table 10 displays the average inventory sizes in each scenario. The inventory sizes displayed include both LC inventory and inventory-in-transit. The data in Table 10 has been multiplied with an unknown constant in order to protect the confidential information of the case company. In Table 10, common subassemblies refer to subassemblies that are included in all variants of any product family. Inventory levels of common subassemblies are thus not affected by the feature option offering decision as long as the total product family demand stays the same. Configurable subassemblies refer to subassemblies that have features to which options are sold. The size of the configurable subassemblies inventory can thus be considered more strongly affecting the inventory-related risk associated with each scenario. Feature option subassembly inventories are also displayed in Table 10. These subassemblies are considered having a higher inventory obsolescence risk compared to the default feature subassemblies. This is due to the general difficulties related to flash selling inventory the company would like to get rid of (e.g. before a product or subassembly refresh) and their significantly larger inventory turnover time originating from lesser overall demand and greater demand uncertainty.

Table 10 shows some fairly expected results: a larger option offering requires a larger inventory (less local sourcing, which allows ordering option parts for each customer order separately). In general, it also becomes clear that while the company sells standard products, to which options are sold, common subassemblies constitute a surprisingly small portion of the total inventory requirements. As seen in Table 10, common subassemblies of PF A only constitute 36 % of inventory value in *one variant* scenario. For PF B, com-

mon subassemblies represent 45 % of total inventory in *one variant* scenario. The majority of the stored subassemblies will nonetheless be ones used to build standard products (i.e. most commonly sold variants). In *all variants* scenario, feature options of PF A represent 21 % of the total inventory of the product family. For PF B, the same feature option inventory represents 20 % of the total product family inventory.

Table 10. *Average inventory (incl. in-transit inventory) in each what-if scenario.*

	One variant	All variants	All with local sourcing	Middle solution
Product family A	**$3 566 060**	**$4 027 324**	**$3 777 912**	**$3 701 368**
Common subassemblies	$1 301 608	$1 301 608	$1 311 569	$1 301 608
Configurable subassemblies	$2 264 455	$2 725 719	$2 466 343	$2 399 760
of which feature options	$0	$832 299	$675 482	$436 192
Product family B	**$4 286 505**	**$4 674 580**	**$4 489 774**	**$4 434 070**
Common subassemblies	$1 925 093	$1 925 093	$1 939 829	$1 939 829
Configurable subassemblies	$2 361 412	$2 749 487	$2 549 945	$2 494 241
of which feature options	$0	$914 727	$791 831	$602 194
Total inventory	**$7 852 568**	**$8 701 904**	**$8 267 686**	**$8 135 438**

In general, there is a fairly small difference in the inventory levels of different scenarios, with the difference being at most +11 % (including both product families) when comparing *one variant* and *all variants* scenarios. As a somewhat surprising finding, the *middle solution* only increases the required inventory by +4 % in total when compared to the *one variant* scenario. The difference between the inventory levels can largely be explained by the fact that the subassemblies stocked for options with less demand (in *all variants* scenario) require a significantly larger inventory compared to the average monthly demand. As an example, if an option is forecasted to be ordered six times during a year, the case company would still have to keep an average option subassembly inventory of six pieces to be able to cater to orders that might include four to five pieces of that option. The small differences in *one variant* and *middle solution* scenarios are therefore caused by the assumption that inventory turnover times would not grow significantly in the *middle solution* scenario. The average inventory levels were considered being “expected levels”, which means that there would be noticeable inventory increases if the average inventory level estimations would not hold up. The author considered this a potential risk due to the current need to develop operational processes, as described in chapter 4.2.

The previous is also partly a result of the case company’s current subassembly structure: to allow logistics center operation to truly focus on just packing different subassemblies in a crate (to form the final product variant to ship), the case company had to combine some subassemblies used in the factory to larger subassemblies to be stocked at the logistics center, as described in chapter 4.2. This naturally increases the required inventory by increasing the number of SKUs stocked. As a future reference, it is important to note

that the case company only stocked configurations with electric components suitable for US markets. If electric components suitable for other markets were to be offered, this would increase the number of SKUs by one to four per electric type for PF B, and by one to 52 per electric type for PF A. In such a case, changes in the product modularity could potentially be later used to lower the number of SKUs. The previous figures depend on the product variants offered and assumes that all subassemblies would be stocked with the current subassembly warehousing model. While the number of feature options offered has a noticeable impact on inventory levels, this is partly dissipated by the demand strongly focusing on only a few options per feature. This results in feature options with little demand having high turnover times, but also a small average inventory limiting the effect on the overall operation.

The previous findings show that the majority of profit can be captured by a relatively small increase in the inventory held and feature options offered. A larger option offering thus focuses more on the customer service provided and the marketing aspect of the offering. Local sourcing would work as a viable option for the case company but would most likely not have a significant impact on the company's profitability, at least with the current assumptions. Instead, the benefits of local sourcing center in inventory risk management by allowing smaller inventories to be held. It was nonetheless observed that local sourcing would only work as a partial solution. This is because only a few feature options are likely simple enough to be ordered directly from one supplier in the intended timeframe, with locally sourcing other feature option subassemblies potentially more steeply increasing the costs and the associated quality risks.

A more detailed analysis of the inventory also shows that only a few features with options are responsible for the majority of the feature subassembly inventory. Table 11 shows a decomposition of feature subassembly inventories for product families A and B in each of the aforementioned scenarios. The data in Table 11 has been multiplied with an unknown constant in order to protect the confidential information of the case company. The scenario inventory decomposition reveals that the feature inventories vary greatly, with features such as AC, AC/A, and BD having only small (absolute) differences in inventory values. On the other hand, feature subassemblies such as AD+AE+AF and BC+BC/A+BC/B+BC/D+BC/E greatly affect the value of the inventory.

The previous features were found to have two significant differences. First, the feature options with small inventory impacts were naturally quite inexpensive (and often more profitable) compared to other features with options. Second, the features with small inventory impacts did not generally offer many options. For example, PF A had only one feature option for feature AC with 13 associated options for AC/A (which were quite inexpensive). PF B's feature BD only had one option.

Table 11. *Feature subassembly inventory decomposition in each scenario.*

		One variant	All variants	All with local sourcing	Middle solution
Product family A	Feature AA	$177 956	$280 086	$62 387	$226 017
	Feature AB	$1 543 219	$1 795 181	$1 795 181	$1 611 142
	Feature AC	$108 251	$92 626	$92 626	$92 626
	Feature AC/A	$54 882	$49 247	$7 570	$45 844
	Features AD+AE+AF	$380 146	$508 580	$508 580	$424 133
	Total	**$2 264 455**	**$2 725 719**	**$2 466 343**	**$2 399 760**

		One variant	All variants	All with local sourcing	Middle solution
Product family B	Feature BA	$201 044	$259 647	$60 108	$251 027
	Feature BB	$680 776	$869 891	$869 891	$817 132
	Features BC+BC/A-E	$592 758	$828 166	$828 166	$634 302
	Feature BD	$74 147	$88 207	$88 207	$88 207
	Feature BE	$321 707	$361 387	$361 387	$361 387
	Feature BF	$490 981	$342 185	$342 185	$342 185
	Total	**$2 361 412**	**$2 749 487**	**$2 549 945**	**$2 494 241**

The features with larger inventory impacts were generally more expensive, physically larger, and had a larger number of option subassemblies. This was again partly due to the production and logistics center system, which required some feature option components and subassemblies to be combined into larger subassemblies. It was also noted that these option subassemblies were generally not as profitable as the other feature options, but this was partly due to the fact that some of the feature options offered were less expensive and thus priced less than the default option. An example of this was the "budget package" of product family A, which affected features AC, AC/A, and AF, and options for feature BC with smaller price tags offered for product family B. As a core part of the case company's overall market offering, most of the previous were still part of the offering in all scenarios except in the *one variant* scenario.

Studying the costs of the different feature options proved to be somewhat time-consuming and difficult, as the case company had previously not generated information about the costs of different options. This information was also obscured by multiple irrelated past changes to inventory items used in bill of materials (BOMs), changes in the BOMs which could or could not have reflected changes in actual components used in production, the use of multiple vendors with different pricing, and the fact that the company ERP system did not contain a 100% reliable average component cost information. The author therefore decided to only use the latest BOMs found in the company ERP, and for many of the options, manually search for the component prices for the items found in the BOMs. This was considered being the best method for obtaining the component prices (and the price differences) of different feature options. It was also assumed that the manufacturing labor

required for each option subassembly of any given feature would be the same. While this is not 100% accurate, it applies to the majority of options – especially to ones with only aesthetic (such as color) differences. The similarity of different feature options of any given feature also justified the decision that the different feature options would not be burdened by any extra manufacturing overhead.

The manual go-through of costs and list prices of different options also revealed clear differences in the profitabilities of different feature options, including some clear outliers. As an example, the majority of options for feature BA (offered for product family B) cost exactly the same as the default option but were still charged a premium price from the customer. These options thus had a marginal gross margin of 100 % and were greatly profitable (even when including extra LC related costs). These options were nonetheless still not recognized in any special way in the company operations (such as delivery times). Another option which was recognized as a potentially greatly profitable one was the feature option BD01 offered for product family B. It was approximately 7% of all European demand. Combining its comparatively high price with a marginal gross margin of 83%, made it stand out from a profitability standpoint. The feature option was a clear addition to the logistics center offering, from which it had previously been excluded.

The previous analysis is based on two key assumptions. First, no sales would be lost due to a smaller feature option offering. This can also be considered to include situations where a product is ordered from the Finnish factory when the required variant is not available from the LC. The feature option offering would, therefore, only affect the gross margins of units sold, but not the number of units sold. This assumption originated from the sales personnel interviews. Second, the load factor of the FCL's used in the internal SC of the case company would not change due to the feature option offering. Relaxing these assumptions and analyzing the results provides insight into how SC and offering related development work should be prioritized.

Relaxing the first assumption shows how profitability changes if sales are lost due to a smaller offering. The small amount of fixed costs associated with the LC operation combined with the finding that the vast majority of gross margin is created from the sale of the product family itself results in lost sales almost directly translating to smaller profits. A -10% change in forecasted sales would result in -10,13% change in net income in one variant scenario and a -10,27% reduction in net income in the medium solution. The resulting changes in residual incomes would be -10,13% and -10,40%, respectively. These profitability calculations do not include any resulting impacts on the case company's Finnish factory. This shows that while considering the feature option offering is reasonable from the point of profit margins and practical operations, the actual sales volumes of the product families are the key driver of profitability.

Relaxing the second assumption originates from the thought that shipping non-standard FCLs could significantly lower load factors compared to the standard FCLs. These non-

standard FCLs are usually filled with feature options and other subassemblies that are used to replace subassemblies with quality issues or single subassemblies sent to customers. In addition to the previous, the non-standard containers need to be used for increasing overall inventory levels of feature options, which is to be expected due to the case company's sales growth forecasts. The standard FCLs will nonetheless be the majority of intercompany SC shipments, as those can generally be used to refill all the different subassemblies offered. Assuming a 50 % reduction in the load factor of non-standard FCL shipments, and that one in every 15 shipments is a non-standard shipment, the overall load factor in internal SC would drop by 3,3 %. This 3,3 % drop in the all configurations scenario would amount to an annual cost increase of approximately $25 000. This can be considered being small compared to other cost uncertainties associated with the operation.

4.4 Suggested offering for the US logistics center

The suggested offering presented here applies to the first one to two years of the LC. The empirical findings show that while the feature option offering is an important part of the marketing and branding, it is not currently critical from the perspective of customer value or company profitability. Instead, the case company should primarily focus its efforts on ensuring a high service level and designated short lead times for the most common product variants it sells. The feature options mainly work to support the overall sales of the product families, with the direct profitability impact of the feature options being noticeable but limited in the grand picture. The feature option offering proposal is therefore driven more by the overall financial and operative considerations.

While having a larger feature option offering would support the case company's position as the product leader in the US market, a larger feature option offering requires greater working capital. It was also considered that any larger feature option offering requires a noticeable amount of new capabilities to be created. These capabilities include forecasting, internal supply chain management, and inventory management. This is highlighted by the high pace of product development and the rate in which new feature options, versions of product families, and revisions of the overall offering are released. This can currently be seen increasing the obsolescence risk and thus limiting the inventory that is sensible to keep. As found in the demand analysis, it is nonetheless clear that a majority of customer orders can be fulfilled with a limited number of feature options per feature. As the feature options are not critical from the perspective of customer value and a larger offering would increase inventory and operations challenges without a significant upside in profitability, it can be concluded that a full feature options offering (via warehousing subassemblies) in the LC is not an optimal solution. A middle solution with a limited feature option offering is therefore required.

The challenges related to communicating the changes in the offering to the downstream SC was found to require that the overall feature option offering would be a long-term one. This advocates for a larger offering due to the fact that the strong continuous increase in

overall sales will make some options more sensible to offer in a year or two. This long-term view was balanced with the challenges and "hassle" related to a larger offering and the associated profit potential. The role of the LC as a regional distribution center also allows the case company to seek operational efficiencies by intentionally directing demand by offering a limited number of feature options from the LC. This can increase ease of operations management and profitability while simultaneously upkeeping a reasonable number of feature options with which the company can seek to differentiate itself in the market.

Because of the previous findings, it is suggested that the case company adopts an extended but a limited offering for the US LC. This allows the case company to increase customer service by offering a larger number of feature options while balancing the operative requirements of a larger option offering with the profitability potential. The feature option offering suggested is presented in Table 12. The suggested offering includes 25,9 % of all potential product variants but allows fulfilling 67,1 % of forecasted product variant demand. While the previous metric is only as good as the actual forecasting accuracy, it is a good indication that the offering allows the case company to minimize the possibility of lost sales. At the same time, the offering allows the total gross margin of the unit sales to be increased with the increased sales of feature options. The feature option selection generally follows similar guidelines for all of the options with the exception of feature option AA05, which was left out due to concerns about the option related quality control.

As seen by the local sourcing scenario in the what if analysis, local sourcing could work as a potential way to lower costs of offering the feature options, lower the associated inventory risks, and potentially increase service level. It should be therefore studied further by the case company, especially if a larger number of feature options per feature is to be offered. These efforts should begin by locally sourcing or customizing feature BC/A. Feature BC/A (and by extension feature BC) has a high transportation and storage costs due to the large size of the subassemblies combined with a high feature option demand. This is also emphasized by the fact that a large portion of the feature option sales for BC/A are custom options (i.e. custom colors). This necessitates a local sourcing or production operation if those orders would be filled from the LC. This would nonetheless be a relatively simple sourcing operation according to the Sourcing Director, as the customization required is generally typical in the industry of the case company. The financial analysis indicated that local sourcing efforts could later be directed toward options of features AA and BA. These options can nonetheless be warehoused with a reasonable investment, making them a lesser priority compared to feature BC/A.

Table 12. *Suggestion for the logistic center's feature option offering.*

Product family A	
Feature	**Feature option**
Feature AA	Default AA
	Option AA01
	Option AA02
	Option AA03
Feature AB	Default AB
	Option AB01
	Option AB02
Feature AC	Default AC
	Option AC01
Feature AC/A	Default AC/A
	Option AC/A01
	Option AC/A02
Feature AD	Default AD
Feature AE	Default AE
Feature AF	Default AF
	Option AF01

Product family B	
Feature	**Feature option**
Feature BA	Default BA
	Option BA01
	Option BA02
	Option BA03
Feature BB	Default BB
	Option AB01
	Option AB02
Feature BC	Default BC
	Option BC01
Feature BC/A	Default C/A
Feature BC/B	Default C/B
Feature BC/C	Default C/C
Feature BC/D	Option BC/D01
	Option BC/D02
Feature BC/E	Default BC/E
Feature BD	Default BD
	Option BD01
Feature BE	Default BE
	Option BE01
Feature BF	Default BF
	Option BE01

The analysis also displays that other feature option offerings (both different and larger) are also feasible, if such an offering is considered necessary by the case company management. This nonetheless requires that a larger option offering can be managed from an operations standpoint. As displayed by the what if analysis, all different offerings are generally possible from a financial standpoint, especially considering the company's strong financial status. While a larger feature option offering could slightly lower net income while increasing inventory costs and the associated risks, the direct costs are not too significant to overpower strong qualitative considerations. This is partly supported by the fact that the strong forecasted growth of the case company will likely increase inventory turnovers of feature option subassemblies with lower demand. This growth in economies of scale partly supports future profitability. This nonetheless requires operative capabilities, meaning that the final decision of feature option offering is more closely tied with the case company developing such capabilities. A larger offering will require more sophisticated processes for managing intercompany logistics, purchasing, and inventory management. As such, any larger feature option offering increases the risk of overstocking, stockouts, and lowering perceived customer service. Similarly, a larger offering can

potentially increase operating costs if subassemblies are needed to be sent, for example, via air freight in a stockout situation.

When considering product families and feature options not included in the study, general guidelines for LC distribution can be identified. First, and not surprisingly, all parts of the case company's core offering should be offered in the LC. In practice, this means the standard products of all product families and feature options that are significant enough to act as if they were product families of their own. All of the case company's product families are similar in terms of type, cost, and profitability, justifying investments in shorter lead times using the LC. Second, all parts of the offering that can be seen driving sales should be included in LC offering. In other words, if an absence of the feature option in the LC (resulting in longer lead times of the feature options) could potentially cause lost sales of the product families, they should generally be included in the LC offering. This is due to the significant gross margin decrease caused by lost sales of product families. For example, losing a sale of one unit of PF A approximately equals a loss of gross margin that is enough to cover shipping 30 pcs of one option of feature AA, holding these in LC inventory for six months, and then discarding 11 pcs (37 %) of the inventory due to obsolescence. Of the associated costs, 91 % are caused by the obsolescence. While this guideline can generally be seen applying, expensive feature options should be looked into more carefully. This is especially the case with options of feature AB, which are generally about 5,6 times more expansive than options for feature AA. Here small feature option demand makes inventory (and obsolescence risk) management of greater importance and therefore requires sufficient operational capabilities.

If possible, considering the operational capabilities of the SC, other feature option subassemblies should generally be included in the LC offering if they are part of the top or middle demand groups (as discussed in chapter 4.1). Here the word subassembly is highlighted due to the fact that it's not the demand for the feature options that is of importance, but the demand for the subassemblies containing the features. This is due to the fact that limiting the LC to a packing only operation required some feature options to be combined in one subassembly. Generally, if a subassembly is included in over 5% of the sales of a product family, it could be worth including the said subassembly (and the associated feature options) in the LC offering. Lastly, it can generally be said that small and inexpensive feature options could generally be included in the LC if required, as the associated costs (especially transportation) and obsolescence risks are not significant in the overall picture.

As a final and separate thought, the LC offering decision should also be considered as an opportunity to assess how a different feature option offering affects demand and the ratio of orders made to the LC and to the company factory. This is especially the case with features AB and BB, which have previously had very little feature option demand. Following the development of feature option demand for those features (and particularly, if the feature option demand increases) can improve understanding of the case company's

customer demand. This can, in turn, potentially support in future demand directing and decisions regarding company offering and the listed lead times.

4.5 Ex ante accounting information in managerial decision making

The empirical findings regarding the use of ex ante accounting in decision making are presented here. The findings are divided into two subchapters. Chapter 4.5.1 presents the findings regarding the use and role of ex ante accounting information. Chapter 4.5.2 then presents findings regarding the quality requirements for ex ante accounting information.

4.5.1 Role of ex ante accounting information in decision making

The role of accounting information was found to differ significantly in the two phases of the LC project, following the different needs of each phase. The first phase of the LC project had two significant characteristics driving the use of MA. First, the LC project was a completely new endeavor for all of the people involved, and second, the decision making was mainly driven by purely the financial performance of decision alternatives.

Accounting objects played a significant role in the decision, as none of the people involved had any past experience in initiating similar operations in the US. This meant that instead of only using accounting objects to assess the costs of different operative decision alternatives, accounting objects were also used to identify and assess different cost factors affecting each decision alternative. This allowed the project team to identify the most significant cost factors, to which focus should be moved in later analysis. While mainly working as an “answer machine” (following Burchell's et al. 1980 definition) by allowing the financial comparison of different decision alternatives, accounting objects were also used to support the management in learning about the new problem at hand. Accounting objects thus supported in getting a better understanding of “what mattered” from a decision-making perspective. An example of the latter was the role of labor and real estate costs when analyzing the costs related to establishing a manufacturing operation during the first phase of the LC project. These costs were initially thought to be significant and thus influence the comparison of potential factory locations but were later found to be of little importance compared to the role of in inbound and outbound logistics costs in different locations. Recognizing this allowed the management to redirect analysis to factors that had the most significant impact on the decision.

The significant role of cost comparisons and financial considerations in the first phase was also found to be partially rooted in the fact that accounting figures were the main source of directly comparable information the project team had. This can also be seen being linked to the fact that the LC project was a new endeavor for everyone involved, which highlighted the role of quantitative accounting information over more qualitative

considerations of the team members. The use of accounting information was nonetheless initially hindered by the limited knowledge of all the factors affecting the decision alternatives. This was partly why the group of US graduate students was first commissioned to do a study. As described by the CFO, "we would have known how to do the calculations ourselves, but we did not know all the factors that impacted the calculations". In spite of the previous, accounting information nonetheless worked as a significant driver for decision making. This was due to the general objective of finding the most financially efficient way of establishing the LC operation. While the type of operation to be established changed significantly during the first phase (moving from a self-run factory operation to an outsourced warehousing and packing operation), the general objective in terms of market offering and minimization of costs did not change. The role of financial information over other qualitative considerations in the decision making was exemplified by the CFO. He mentioned that (in the first phase of the LC project) a 5 % difference in costs of the selected plan wouldn't have affected the decision, but a 10-15 % change would have already been significant and affected the decision.

Accounting was also used as a tool for assessing the risks of each scenario or decision alternative in terms of investment and commitments. This information also played a significant role in decision making, as the SC organization of the case company has always sought to maximize operational flexibility. Operational flexibility was generally considered in terms of small commitments and a high ability to "change direction" if required by a change in the market, supply chain, or strategy. This was highly valued due to the fast growth and change that both the case company and its market were experiencing.

Accounting was thus used as a strongly directing activity (instead of being only informative) during the first phase of the LC project. Other managers similarly highlighted the role of financial information as the key decision driver, with more qualitative considerations being more important after a small enough cost difference between decision alternatives had been reached. While financial information was the key decision driver, it was nonetheless preceded by the strategic objective of establishing a local operation in the US.

The role of accounting information changed significantly in the second phase of the LC project due to very different uncertainties related to the decision of the feature option offering. Unlike in the first phase, a large part of all cost factors (i.e. sources of costs and unit costs of different activities) and the general operating model of the LC were known at the start of the second phase. What was unknown, however, was the financial impact of different potential feature option offerings and the general idea of what the company *wants* to offer. Quoting the Head of Product, the analyses of the second phase supported in dividing the feature options into ones "which we want to sell, and [to ones] which we offer". The analyses were thus not only financial in nature, but also supported the qualitative decision making regarding the positioning the case company wanted to take in regard to its option offering and demand steering. The analysis of financial impacts aimed

to clarify the actual costs of offering the different feature options and the required investments each potential offering required.

In addition to providing direct financial information about the LC related costs per feature option or product family and the related inventory requirements, the analysis also allowed assessing the annual costs of offering specific feature options. This could then be related to the risk of losing sales if the said options were not available from the logistics center. This then allowed the case company management to better assess the financial impact of different scenarios in demand. This was considered important especially by the Head of Product. He highlighted the newfound possibility of assigning an approximate cost to reducing the risk of lost product sales due to some feature options missing from the LC offering. This aspect was increasingly important, as the major driver of the case company's profitability was the sales of the product families as a whole. The feature option sales, on the other hand, had a relatively small absolute impact on the overall profitability. The case company management was similarly generally interested in relating the potential profit increases associated with larger offering to the "hassle" created by offering any specific feature option. This included both the potential setup costs of the associated SC, and the daily management of the new options in the internal SC. Similar considerations were made in regard to the required inventory in each scenario, and thus the inventory obsolescence risk associated with different decision alternatives.

In addition to learning about different decision options, the accounting objects were also used to learn about the different cost factors in the LC. Unlike in the first phase, where the cost structures were modeled at a higher level (as only product family level was considered, with subassembly level cost considerations being omitted), the accounting objects in the second phase allowed analyzing the cost structures on a per subassembly level. This allowed a better understanding of the sources of costs and the related causalities. This aspect of the analyses was nonetheless left mainly to the author and the SC development personnel, with upper management being more interested in the scenario analysis. This was assumed being mainly due to the fact that while the cost structure analysis provided insight into the operation and was necessary for the what if model, the key findings could be summarized in a few bullet points without needing to dig into exact costs of different activities for different subassemblies or options.

The cost structure model was nonetheless used to assess the impact of unforeseen changes in the sources of costs. This happened during the spring of 2019 when the LC partner had suddenly realized that they had underestimated their costs of running the operation and were thus enduring losses (or at least not making their required profit). These costs were related to the lesser than expected efficiency of packing the product variants at the LC. The LC partner initiated a conversation with the case company and proposed a packing related price increase to compensate for the additional unexpected costs. After hearing about the proposed price increase, the Head of Supply Chain went to the author to discuss the financial implications of the cost increase. The new cost was inputted to the cost

model, and it was quickly analyzed that the resulting annual cost increases would only total some tens of thousands of euros. The author and the Head of Supply Chain had a short discussion and agreed that the change in costs would be little compared to the overall benefits of the good cooperation that had been established and the overall fit of the two organizations. The price increase was thus not considered a major issue, although more detailed negotiations took place before changing the contract. It was also considered that the term of notice in the LC partnership contract was six months, which would likely be a challenging time to establish a similar operation elsewhere.

The accounting objects were also strongly linked to qualitative considerations regarding sales and SC, as the case company management was generally unsure of what the company's option offering should be from a sales and SC standpoint. Sales and SC aspects (both qualitative and quantitative) were thus considered concurrently with the accounting information. These considerations included many different aspects. Market competition and competing offerings were considered, as the case company wanted to upkeep its product leadership in the US market. This meant that the company should either have a comparable or superior offering to local competitors. SC's capabilities were considered, as a larger option offering required more resources and capabilities to successfully maintain smooth operations, sensible inventory levels, and overall control of the SC processes. This was seen especially important by the author, as the case company's purchasing and production processes were still under significant development due to some previous challenges related to scaling manufacturing operations. Additionally, moving from a vendor managed inventory type of sourcing operation with small local inventories (as in the current factory) to a warehousing and packing operation (required by the LC) naturally required new capabilities to be developed. These capabilities to be developed included both internal supply chain processes and forecasting.

As previously described, accounting objects worked as a complementary source of information to qualitative information during the second phase of the LC project, with all sources of information being considered simultaneously. Accounting objects generally worked as a tool for learning about the problem at hand and the different financial implications of decision alternatives. Accounting objects also provided financial information to frame other considerations and their implications. An example of the latter was assigning a potential financial profit to the "hassle" and work required for offering a specific option in the LC. The former role of the accounting objects was nonetheless clearly more prominent among managers and the author. The latter was directly observed as a general interest toward the calculated marginal gross margins and forecasted demands of different feature options. This was during the offering workshop, in which the initial decision regarding the option offering of the LC was made. The concurrent role of financial considerations, sales considerations, and SC considerations were also highlighted by the interviewed management, as all of them worked to create a holistic understanding of the ana-

lyzed phenomenon. Accounting objects thus worked as *learning and rationalization machines* (following Burchell's et al. 1980 description), allowing both learning about the new distribution system (with uncertainties regarding the financial effects of different feature option offerings) and potentially rationalizing different holistic views the management had about suitable offerings (uncertainty about what should be offered). Accounting thus worked as an informing activity that was considered together with the other sources of information.

While the ex ante accounting considerations did not end up establishing any strict boundaries to the decision, accounting considerations were nonetheless seen working as a boundary creator for the forthcoming decisions. The interviews uncovered that accounting objects were generally seen providing finance-driven boundaries to the range of potential decision alternatives. In the second phase of the LC project this meant alternative offerings. Inside these boundaries, focus would move to qualitative considerations, which would then be more dominantly employed for reaching the final decision. Ex ante accounting thus provided information on the range of financially sensible decision alternatives. Strong considerations such as competitive position or strategic considerations could nonetheless have overruled these financial boundaries. This was not surprising, as the whole endeavor was considered having a high strategic importance. In practice, the previous was most clearly observed when the author considered the potential increases in profits created by a larger LC offering against the required investments for creating the said profits. Such an analysis allowed setting up (an albeit partially subjective) bound for what made financial sense, and what did not.

The role of offering different scenarios was recognized as playing an important role in the decision-making situation. The role of scenarios was mentioned when discussing both phases of the LC project. The interview discussions indicated that offering multiple scenarios allowed managers to better obtain a good understanding of the financial implications of different scenarios. Instead of only highlighting single points of importance found in an accounting object, offering alternative scenarios allows a more holistic consideration of the implications of the different variables in a given scenario. This also allows, for example, the ex ante consideration of different levels of performance, as mentioned by the Head of Supply Chain. Separating potential "optimal scenario" from a "realistic scenario" (in terms of performance) allows assessing a situation where the analyzed operation is not performing optimally, or "as planned on paper". Scenarios thus allow identifying potential vulnerabilities resulting from costs or process performance. An example of the previous was the estimated load factor of FCL restocking shipments, which was assumed being relatively high but obtainable during the first phase of the analysis. The actual load factor ended up being smaller, resulting in a 20 % increase in transportation costs of product family A. This change in costs was quite significant, as intercontinental transportation was already the most significant cost factor in the LC operation. While anticipating the previous would most likely not have changed the outcome of the overall

ex ante analysis in the current case (especially as the load factor can later be potentially increased), this difference could have had significant implications in a different situation.

The second way scenarios support decision making is by painting a more comprehensive picture of the subject of analysis. As mentioned by the Head of Product during the phase two interviews, “we don’t know what good looks like”. There were generally many decision alternatives which could be considered good in the case company’s situation, especially as any (sensible) local US operation would almost certainly have a positive impact on the case company’s profits. Providing different scenarios (i.e. analyses on decision alternatives) therefore allowed managers to get a better understanding of the decision alternatives by allowing the comparison of different scenarios and relating them to each other.

As can be expected, accounting objects were generally used to gather and integrate the knowledge of different organizational actors. Accounting objects therefore also worked as a medium for communicating information of different parties. This was done both by sharing the already created accounting objects and filling information to accounting objects in the format required by the accounting objects. Accounting objects therefore also partly directed conversation in workshop-like events where different variables used in accounting objects were discussed and inputted. This communicational role of accounting objects also displayed in its natural role as a conversation starter. One such example was a brief discussion initiated by the Head of Sales when he questioned the need to have any larger feature option offering in the LC after seeing the relatively small differences in overall profitability.

Discussing about the ways creating accounting information can be improved revealed that an even larger focus could be given to analyzing the rigidity of the cost factors. The Head of Supply Chain mentioned that it would be important to understand which cost factors can later be influenced, and how difficult it is to influence the said cost factors. Such an analysis could then provide more information on the most prominent future development actions. This could, in practice, also mean quickly assessing how much there is to gain financially by improving the load factor of the FCL container, and then comparing the cost saving potential to other potential targets for development.

To summarize, the role and use of ex ante accounting information were found to differ greatly in the two phases of the LC project. These differences were driven by the different type of uncertainties faced, and the different roles of financial information vis-à-vis other considerations. During the first phase, ex ante accounting was used more as a directing source of information for identifying the best way of setting up the LC. Qualitative considerations were generally considered after financial ones, working more as a second gate for the decision. Accounting objects were also generally used to assess the significance of different factors affecting the decision. During the second phase, ex ante accounting worked more as an informing source of information. Accounting information was used

to learn about the issue at hand by improving the overall understanding of the causalities in the forthcoming operation. Additionally, accounting information allowed qualitative considerations to be framed with financial information. Despite the differences, accounting objects were used in both phases as tools for integrating and communicating the knowledge of different actors, limiting the number of decision alternatives, and for learning about the problem at hand. The requirements set for the accounting information differed as well, as discussed in the following chapter.

4.5.2 Quality requirements for ex ante accounting information

The different roles of accounting information and the different decision-making situations were also strongly reflected in the quality requirements for accounting information, and how different quality factors were emphasized. As can be expected, the quality requirements for accounting information were found to be contingent on the decision-making situation, potential financial liabilities associated with decision alternatives, and the cost of obtaining better information.

The inherent uncertainties associated with both of the phases of the LC project were especially prominent in the first phase of the LC project, which naturally displayed in the accuracy of the accounting objects. The project team therefore focused on obtaining "rough [cost and labor] estimates" (as described by the CFO of the case company) for each of the decision alternatives. The aim was to obtain ballpark level estimations, which were generally found the be enough for decision making. This was because the project team sought to learn about the problem at hand and to find out what was the general level of the costs and investments required for a local US operation. Similarly, the project team sought to understand which of the affecting factors were the most significant ones. This rough financial comparison of decision alternatives allowed the case company to effectively limit the number of decision alternatives, and to focus on ones which seemed most potential.

Requirements for accuracy were somewhat different in the second phase of the LC project. General accuracy requirements were greater, as there were already reliable data on different unit costs and operational processes. It was nonetheless noted that the analysis would still include major assumptions about variables that were still unknown, which can be considered reducing the accuracy requirements for the accounting objects. As with the first phase, the need for accuracy improvements was closely tied to the actual information value of the improvements. An excellent example of this was during the development of the what if model, when the author had noted that he had forgotten to include inbound transportation costs in the subassembly inventory valuation. This issue was quickly discussed with the CFO of the case company, who strongly felt that fixing the issue would not be worth it, as it would not change the outcome of the what if analysis. This exemplified how the accuracy requirement of accounting information is closely tied to its impact on decision making. This also showed in the decision-making situation as described by

the Head of Product, who felt that a -/+ 5 % error in cost calculations would not have a significant impact when dealing with product families with high gross margins. The previous indicates that the requirement for better accuracy can be seen being limited to (i) factors and processes which are already known (such as unit costs that are based on an existing contract) or (ii) factors in which further accuracy adds significant value from the point of the forthcoming decision-making situation.

Instead of accuracy, believability was considered as one of the more important aspects of ex ante accounting information. While being recognized as important in both of the phases, the believability of information was highlighted when discussing the second phase of the LC project, in which decision-making managers were not directly involved in the actual analysis work. The believability of accounting information was seen being affected by a number of factors. The accounting information and numbers presented should naturally be in the realm of general expectations of the receiving manager for the accounting information to be taken seriously. Similarly, also relating to the previous, believability is affected by the given preconditions and the ability to clearly explain both the working logic of the accounting objects and the relevant aspects of it. This, therefore, also highlights the role of communication (including representation) in establishing believability. The believability of accounting information was also found being closely linked to the reputation of the accounting information and its makers, with less reputable information being more susceptible to less believability. The interviews and observations indicated that the previous quality factors worked as important elements affecting the trust given to the accounting objects. This, in turn, naturally directly impacts the actual use of accounting information and the way it is related to other sources of information by the users of the information.

This displayed in the first phase of the LC project, as the interviewees recognized issues affecting how different accounting objects were treated and trusted. These challenges seemed to greatly relate to the communication and understanding of the underlying assumptions in accounting objects, which were made by separate people of the project group or by outside actors. As described by the Head of Supply Chain, the project team needed to take time to make sure all of the separate accounting objects (created partly concurrently) were based on the same assumptions, thus making the analyses comparable. Communicating and establishing these shared assumptions were thus seen as a challenge slowing down the work and (before clarifying the assumptions) affecting how the accounting objects were received and trusted. It was also noted that communicating the assumptions also included detailed things such as if a given input (for example, a freight price quotation) was taken from one source (i.e. one vendor quote) or was a result of multiple pieces of information (e.g. averaging quotations from multiple vendors). When discussing the challenge, the Head of Supply Chain and the CFO of the case company both agreed that a single person should be the “owner” of the accounting objects. This

would ease establishing the shared assumptions and would ensure that accounting information would be easier to communicate in the project team. The Head of Supply Chain also highlighted that there should be one shared accounting object (e.g. a spreadsheet), where the used assumptions would be clearly stated, and to which analyses would be done.

Similar challenges were faced when assessing the study received from the group of US graduate students. The study had a strict timetable, which forced the work forward. This became a challenge when there was a significant error found a few days before the end of the study assignment. While the error was successfully rectified, it significantly impacted the outcome of the analysis. This left the Head of Supply Chain wondering, what other errors could there be in the study. Additionally, the case company management did not end up having a full understanding of where the authors had taken their input data, which was seen as an issue by both the Head of Supply Chain and the Supply Chain Development Manager. The previous, combined with the fact that the LC project was halted for a few months after receiving the study (for unrelated external reasons), resulted in the case company utilizing the study more as a qualitative source of information. It was then used as a study in which the main factors affecting the actual decision were identified. Some analyses found in the study were then redone by the case company's project team. When discussing about the issue, the CFO of the case company mentioned that people end up recalculating analyses they don't trust. The CFO also later mentioned that the project team could have technically just called the authors of study but ended up not doing so. Establishing believability and trust seemed to not only be an issue when external parties were involved. Similar trust and believability related challenges were also present when different analyses (i.e. accounting objects) were brought together by the case company's internal project team during the first phase of the LC project, as previously described.

Discussions with the Head of Supply Chain also displayed how the trust given to accounting information affected how it was related to other sources of information. He mentioned that when comparing the costs associated with setting up a self-run operation and an outsourced one, both of the operations were found to have similar overall costs. He mentioned that it thus made sense to select the outsourced option, as cost estimates associated with that were more likely to be accurate compared to estimates made for a self-run operation. This was because there was a third party whose business case was depending on the estimates being correct. While an outsourced option would have nonetheless made sense considering the opportunity cost of setting up a self-run operation and the associated risks, the comment displayed how uncertainties associated with accounting information could affect decision making.

Similar challenges were mostly absent during the second phase of the LC project. This can be considered being due to the different ways the accounting objects were constructed. Instead of having multiple people doing analysis, creating accounting objects,

and then combining their findings, the second phase of the project was conducted by the author with the CFO of the case company guiding the work. While all of the people participating in the project team of the first phase provided insights for the accounting objects in the second phase and later received the final findings, the analysis work and consolidation of information was done by the author. The work was thus more centralized compared to the first phase of the LC project. The only believability issues identified were associated with the use of past European sales data in forecasting US sales, and the associated challenges. This issue was recognized to originate mainly from the communication of the findings and the underlying assumptions.

The centralized way of creating the accounting objects in the second phase was nonetheless not without its issues. The biggest issue recognized was the organizational separation of the analysis making (lead by the author and the CFO in the finance department) and the SC development personnel. The SC development personnel were, at the time of the analysis, establishing the actual LC processes and ramping up the LC packing operation. This was because the LC initially worked solely as a warehousing operation of a few prepacked product variants. The previous led to a situation where some information about the changes in the actual processes or costs did not find its way to the author and to the accounting objects. Similarly, while the SC development team was made aware of the findings regarding the study, this did not lead to any more detailed reviews of the findings.

This general need to link quantitative analyses to the work of the SC development team (who were able to provide great qualitative insights) was also acknowledged by the CFO of the case company, who was initially responsible for the first phase of the LC project. The CFO had also recognized the issues in the planning and ex ante analysis of the LC operation happening without the strong involvement of the SC personnel who are (and would be) actually responsible for the daily operation of the LC. This was seen being a challenge due to the fact that the project was initially led by the CFO, instead of both the CFO and the SC personnel. Quoting the CFO, “it is different to get input when asked, compared to the source of information being at the driver’s seat [of the project or analysis]”. While it was difficult to estimate how this affected information quality, it was seen as having an impact. Both phases of the LC project could have thus benefitted from closer interdepartmental cooperation in creating the accounting objects. The comments of the Head of Supply Chain also later supported the previous conclusions regarding the importance of tight communication and involvement of both accountants and the SC personnel.

A closer interdepartmental workshop session was held after the main empirical data gathering of the thesis. The author and the US Operations manager held two day-long workshops about the possible ways a larger color option offering could be arranged in the LC. This was done by analyzing the financial performance and operational considerations of two new potential operating models (in addition to warehousing all the feature option subassemblies). Contrary to the previous accounting objects, both of the models were

analyzed in a workshop event, for which both of the participants had prepared by either gathering data or preparing the accounting object to be created. Both of the operating models were then modeled into a spreadsheet together, which allowed the expertise of both parties to be effectively utilized in the analysis. The author noted that this way of working allowed the US Operations Manager to greatly better understand the financial consequences and causalities in different operating models. Similarly, key factors affecting the performance of each model were identified. Revelations were had, as previously considered issues did not seem as significant as previously thought (at least using the preliminary assumptions for costs and processes). While such a setting could solve some of the challenges identified previously, it is clear that such a setting is often not possible due to scarce organizational resources, i.e. time.

There was considerably less attention given to believability during the second phase of the LC project. While this could have been due to the fact that there were no major believability related issues seen by the management in addition to the ones previously mentioned, this could also have been due to other reasons. The smaller uncertainty related to unit costs in the accounting objects could itself have increased the trust given to the accounting objects. The relatively small differences between different scenarios of the what if analysis could also have lessened the interest given toward assessing the accounting objects. This could have been reinforced by the fact that, at the point of the decision making, there were no differences in the long-term contractual commitments in each of the scenarios. Lastly, the different role of the upper management as the receiver of accounting information (instead of working as the creator and consolidator of accounting information and analyses, as in the first phase) likely also affected the way accounting objects were assessed. While not really observed during the thesis work, all of the interviewees nonetheless identified believability as one of the key quality factors for the accounting objects in the second phase of the LC project. The author suspects this was mostly due to the fact that there was a reasonable amount of concrete information available about the unit costs and upcoming operational processes, and because the case company management was not directly involved in the creation of the accounting information. They instead only worked as the receivers of accounting information, with the exception of the CFO who directed the thesis work.

The second major quality factor that emerged in the interviews was the *completeness* of ex ante accounting information. The requirement for the completeness of ex ante accounting information originated from the role of ex ante accounting working as a tool for learning about the problem at hand. During the first phase of the LC project, it was seen as imperative to have all (quantifiable) factors affecting the decision included in the accounting objects. This originated from the uncertainty related to the way different factors affected the financial performance of the forthcoming US operation. As described by both the CFO and the Head of Supply Chain, it is more important to have the analysis (or accounting object) include all the factors in some way than to have a limited number of

factors analyzed very accurately. This notion does not only limit itself to the complete analysis of one decision alternative but also includes the complete analysis and identification of potential decision alternatives. In the context of the first phase, this meant analyzing all the potential alternatives for a local US operation. As an example, the interviewees generally recognized that the initial idea of setting up a self-run factory operation to the US was set as the objective too early, resulting in the outsourced study (made by the US graduate students) to be defined as only looking into issues regarding a future manufacturing operation. The CFO, reflecting the study, described how it would have been better to have a wider set of operational alternatives that were analyzed in less detail, instead of having only one analyzed in great detail.

The requirement of completeness was also found to necessitate that all factors affecting the decision alternatives would somehow display in the accounting object as "factors that have been considered". In practice, this means that work toward completeness of accounting information should be effectively communicated by displaying all the factors considered, whether significant or not. The requirement for completeness can be considered intuitive, as effective comparison of decision options requires that all (significant) factors affecting the decision have been taken into account. Completeness was seen as important by all three members of the project team, as it was seen as a precondition for the accounting objects to successfully support decision making. Similarly, the perceived completeness seemed to work as a strong precondition for trusting the accounting objects and thus as a precondition for the accounting information to be actually used. This was especially relevant in the first phase of the LC project. "We asked ourselves multiple times if we had considered all the factors", described the Head of Supply Chain when discussing about the issue, also noting how it adversely affected the trust given to the analyses. The Head of Supply Chain mentioned how they "had only sketched the model on a whiteboard" before starting gathering data for the analyses. He noted that it would have been beneficial to focus more on first designing the accounting objects (and to identifying all relevant factors) before actually starting to gather the relevant data.

Representational quality factors were also recognized as being important for the successful knowledge integration when creating the accounting objects and for establishing believability and trust in the accounting objects. This was recognized in both phases of the LC project, even though the organizational situations in terms of communication were very different. As mentioned, the case company's upper management was part of the project team of phase one, thus also participating in the creation of accounting information. Oppositely, the upper management mainly acted as the receiver of the accounting information and the accompanying analysis in the second phase of the LC project.

The case displayed that the actual representational qualities in terms of the accounting objects themselves (i.e. the understandability of spreadsheet calculations and the accompanying visual elements) were seen important. This was due to (i) the cooperative work

required to create the accounting information, and (ii) the potential need for the management (not taking part in the actual creation of the accounting objects) to dig deeper into the accounting objects. The former originates from the observation that as accounting objects are created together with other parties (of whom most were not accountants), it is required that all parties involved understand the accounting object to a reasonable degree. This includes understanding the "kind" of information required for different fields in the accounting object so that proper input could be given. This was found to be a challenge when the case company personnel participated in workshop-like sessions where different assumptions were discussed and inputted into the accounting objects. During the second phase of the LC project, it was observed that issues such as bad naming of different fields and the overall clutter in the accounting objects could lead to the need to spend significant time explaining the accounting object to the people participating in the events. This slowed down the process and potentially hindered the participants' ability to contribute to the accounting objects.

Similar issues also surfaced when discussing the first phase of the LC project, but in the context of presenting the different accounting objects created by different people. The Head of Supply Chain considered it to be important for the accounting objects (i.e. most commonly spreadsheets) to be clearly presented and different parts described in an understandable manner. This was so that different parties participating in the decision could familiarize themselves with the accounting objects before, for example, a meeting. The Head of Supply Chain described how a noticeable amount of time would otherwise be required for explaining the different variables and workings of the accounting object. He mentioned how people participating in decision-making situations commonly want to understand the working of the accounting objects and the different assumptions associated with them. The CFO of the company was, on the other hand, fairly confident that people rarely familiarize themselves with different materials before a meeting. The communication of the accounting information seems to nonetheless be a significant matter when discussing accounting objects (and not only limited to presenting the findings from the accounting objects) in decision-making situations. Similar points were also found to apply when accounting objects were handed to other people, as was previously found when discussing about the analysis done by the US graduate students.

The cooperative work required in creating the accounting information was recognized as being a more prominent driver for representative quality during the LC project. The potential need for managers to dig into the accounting objects (instead of just settling for more compact presentation material) was only mentioned in interviews, with the case company management not actually analyzing the actual accounting objects in more detail. This could have been due to the fact that upper management led the first phase of the LC project (thus making the relevant personnel already familiar with the accounting objects) and due to the relatively small differences found in the scenarios analyzed in the what if

model during the second phase of the LC project. If significant financial differences had been found, the analysis might have been scrutinized in more detail.

Representational considerations were also found to be important when presenting ex ante accounting information to an audience not involved in the creation of accounting information. When discussing the communication and presentation of accounting information, the interviews revealed that great emphasis should be given to communicating the different assumptions used in the accounting objects. This was emphasized by the Head of Supply Chain, who mentioned that "some accounting objects are based on glaring assumptions". He thus underlined the importance of communicating the said assumptions, allowing the managers to obtain the best understanding possible about the accounting information presented. The CFO partially agreed, stating that displaying only the assumptions with the largest inherent uncertainties would be sufficient, especially if the creator of accounting information is close to the decision-maker. He stated that all other "smaller" assumptions, which there often are many, can generally be assumed being sensible by default.

The CFO still mentioned that any executive summary should nonetheless be the same, regardless of the creator of accounting information and his/her credibility. What was also mentioned multiple times was the presentational emphasis on the *results* of ex ante accounting analyses (in terms of the key measures that were analyzed), instead of presenting the accounting object or model used to obtain the results. The focus should thus be given to showcasing the results and the key underlying assumptions, with a later possibility (or backup slides) allowing the managers to dig deeper into the accounting objects. The author and the Supply Chain Development Manager had both noticed that the upper management often did not ask to see the accounting objects created, settling just for the results of the analyses. This indicated that it is sufficient to limit the presented information to the key results.

The last greatly emphasized requirement for accounting information creation was the understanding of the business context in which accounting information was created. This understanding extended to company strategy, current operations with their limitations and potentials, and general customer behavior. This understanding also displayed as knowing the different phenomena that displayed in the historical data used in the accounting objects. As an example, understanding the roles of different delivery times and prices, and their potential impact on historical demand data was seen as particularly important by the Head of Product. Similarly, other interviewees also mentioned the role of combining different qualitative considerations with the actual accounting information for obtaining a more complete picture of the analyzed phenomenon. This should naturally also display in the communication and presentation of accounting information.

This was discussed with the Head of Supply Chain, who mentioned about the importance of communicating the fact that the authors of the accounting objects understand the business context as a whole, i.e. the “big picture”. This, as interpreted by the author, links to the credibility of the creators of the accounting objects and the accounting objects themselves, thus increasing the believability of the accounting information. Similar ideas were also conveyed by the CFO, who mentioned that the accounting objects need to be “sold” to the management. This indicates that accounting objects might not always be trusted by default, requiring the accountants to proactively further the creation of trust.

5. DISCUSSION

The discussion is divided into two sections. First, the findings regarding the distribution and offering decisions are discussed in chapter 5.1. Then the use of ex ante accounting information as a more general phenomenon is discussed in chapter 5.2. Chapters 5.3 and 5.4 present the limitations of the thesis and the conclusion, in which topics for future research are also suggested.

5.1 Distribution of offering

The case exemplifies the importance of understanding the role of different parts of an offering, both in the offering as a whole and as contributors to the overall financial performance of a company. In the case, it was found that the projected sales of the feature options would not have a significant impact on the profitability of the case company. Similarly, the number of different feature options offered had no drastic impact on the net income, let alone the residual income. Feature options therefore worked more as a tool for increasing the sales of the product families as a whole instead of themselves boosting profitability in a significant manner.

Understanding this dynamic and role of different parts of the offering naturally influences the SC strategy used and the associated distribution decisions. While the type of product (new and innovative) directly indicates that a flexible SC should be pursued (Fisher 1997), the way profitability is built can also be seen working as a clear indication for the selection of the type of SC. In the case company's situation, aiming for operational efficiency with the feature options can, at worst, be counterproductive if it risks that a sale of the product family is lost. Flexible SCs would therefore be more appropriate for the feature options that significantly affect the sales of the product family. Efficient distribution methods could, on the other hand, be utilized in the common subassemblies, in which relative volume is larger, and the associated volatility is lower (when comparing to feature options). In addition to assessing distribution strategy based on the type of the product (Fisher 1997), the role of different parts of the offering can be seen influencing the tactical distribution decisions made. If the case company wanted to offer the full range of feature options, it could look into establish two types of distribution modes: efficient for the subassemblies with major demand, and a flexible one for the subassemblies more volatile demand.

Understanding the true demand characteristics associated with different product families and feature options can be seen as being more challenging in a mass customization environment. Storing information about sold product variants may include sufficient infor-

mation to analyze the demand for single feature options. Sufficient IT systems are required to enable the later "decomposition" of a product variant into the selections made in the configurator, which can allow analyzing the demand for different feature options, which may or may not be correlated. Such information will be increasingly important for analyzing potential sales, as suggested by Salvador and Forza (2004). It was demonstrated that understanding the demand required good data to be available. As demonstrated by the feature option BA04, it is important to see and understand what the total observed demand is composed of. Large demand with a reasonable number of orders may not equal constant demand and high overall customer interest. Similarly, there could be multiple medium-sized sales orders in the system originating from one major project sale, further obscuring the true nature of demand. While statistical measures such as average, median, and variance can support in identifying demand characteristics, the representation used in this thesis can potentially convey more information about the demand. The representation used here can also be considered being greatly more approachable by non-engineers.

Understanding the associated demand both from a quantitative standpoint (by looking at the information found in the organizational IT systems) and from a qualitative standpoint (by understanding drivers of customer value) is also important for managing profitability. Qualitative information needs to be considered in tandem with the analysis of cost structures in a distribution decision (highlighted by Gunasekaran et al. 2001) for properly supporting long-term profitability and organizational objectives (Fry et al. 1995). As was found, the case company's core products (i.e. products without any feature options) were both the primary source of customer value and the primary source of financial contribution. The latter was simply due to its high price and gross margin. Different feature options, while providing the same or higher gross margin ratio, thus had a greatly smaller impact on the overall absolute profitability of the product variants. It was therefore found that the primary role of the feature options was to *induce sales* by offering both visual and functional customizations, instead of only working as gross margin increasing parts of the offering. This differs from the often-used model of selling a base product with a small gross margin and using different variable options with high gross margins to increase the overall gross margin.

When evaluating the profitability of any single part of the offering, it is therefore important to understand the method by which any single part of the offering contributes to the overall profitability of a company. In the context of configurable products and feature option sales, the profit-generating role of different options can differ. Option sales can affect profitability by increasing the gross margin of the product variant, by increasing the overall sales of the product family as a whole, or both. This can result in a situation where option profitability may sometimes be irrelevant when considering the product family as a whole. In the context of the case company and other companies alike, the findings of this thesis lead to the general conclusion that determining a variable option offering should begin by assessing which of the feature options are necessary for inducing

more sales of the product family. This initial priority rises from the notion that the profitability of feature options themselves are of lesser importance if they can induce more sales of the product family with a high price and high margins. Only after this, should the profitability and offering positioning (in terms of brand and other factors) be assessed.

Another similar finding was that for most feature options, it generally doesn't matter which feature option is sold, as long as one is sold (assuming the feature options increase the gross margin of the product variants). Any increases to the feature option offering should therefore increase the proportion of feature options sold, instead of only shifting the demand from one feature option to another. The previous points are also important to understand when considering the "hassle and difficulty" of offering specific feature options. Only considering the gross margin of a single feature option can thus sometimes give an incomplete picture. This highlights the notion that that when considering the profitability implications of different management choices, it is important to always consider accounting information together with a qualitative understanding of the SC, the market, and the roles of different parts of the offering. This is to ensure that potentially less profitable feature options that drive overall sales are not discontinued. While all of the feature options are greatly profitable, this may not be the case in other companies offering mass customizable products.

More generally, it should be well understood what the roles of the different parts of the offering are before starting to analyze distribution-related decisions. Different parts of the offering may be more susceptible to lost sales if customers are not willing to backorder, while some may be the opposite. Similarly, the role of service level and lost sales need to be understood in the context of a feature/subassembly affecting a range of product variants, instead of assessing the feature/subassembly as a product itself. If a feature is financially insignificant but drives the sales of a product family for customers not willing to backorder, then resources should be devoted to ensuring the high-enough service level for that feature option even if the said feature option would then be unprofitable when observed as a single "product". This can, at its extreme, require focus to be given to parts of the offering that are seemingly less profitable than others. These considerations highlight the knowledge integration between MA, sales, marketing, and SC organizations. A wide and shared understanding of different business aspects is prudent for an organization to obtain a complete picture of the drivers of profitability in a distribution setting. Short-term financial considerations should not be considered without the associated long-term considerations that ensure organizational competitiveness (Fry et al. 1995). A thorough understanding of the short-term financials is nonetheless important, as truly understanding the associated profit structure (including both revenue and costs structures) allows development efforts to be directed in a way that can improve profitability both in the short and long term.

Lost sales and impact of overall customer service may nonetheless be difficult to observe in a setting where distributors work as gatekeepers of the demand of the end users and

simultaneously prevent observing the end users' decision-making processes. This can, therefore, make it difficult to assess the effects of changes in the offering, lead times, or service level, especially when comparing the effects to the associated investments and costs. This can be considered applying whether determining a demand matching offering or just seeking to steer customer demand with tools such as pricing. Identifying cause and effect may be difficult, increasing uncertainties related to distribution-related decision making. This challenge highlights the need for knowledge integration not just between interorganizational parties, but also between SC organizations. Such customer demand related uncertainties can be seen increasing the role of sales personnel as a source of information in distribution-related decisions. When the effects distribution and service level improvements have on sales and profitability are difficult to quantify, providing only costs for the proposed changes may already itself support decision making. This cost information can be used with qualitative considerations to subjectively assess if the resulting service level or distribution improvements are worth the required investment or costs. Such information, even if incomplete, could potentially already support in assessing distribution related options.

The case also suggests that a general term of "lost sales" may be partially inadequate for considering the risk of lost sales of mass configurable products. Instead, the findings suggest that it could be beneficial to distinguish between *the lost sales of the product families* and *the lost sales of the feature options*. This is because a reason (e.g. a stockout) associated with a feature option could either cause a lost sale of a feature option (i.e. customer just selecting another feature option or none at all) or a lost sale of a product family as a whole. Considering the profit structure of the case company, considering such a distinction may prove valuable when considering the impact of different aspects of distribution and service level.

Another way to assess the potential effects of distribution decisions in an uncertain situation is by scenario analysis (Gupta & Maranas 2003). Scenarios analysis can, at its simplest, allow "forking" potential impacts decisions, for example, by seeking to assess the upper and lower bounds of effects on demand. This can be especially beneficial when a company seeks to steer demand (or employ a shaper strategy discussed by Gupta & Maranas 2003). Scenarios can allow assessing the potential benefits and downsides of developing such strategies and allow relating them to the bigger picture of organizational resource allocation. Scenarios are similarly beneficial for analyzing the potential benefits and risks associated with any action, which can then be used to assess whether any action should be initiated. For example, in the sample case, knowingly limiting the number of feature options and steering demand that way would likely be beneficial from the point of operational efficiency (with easier management of operations and inventories) and result in smaller obsolescence costs. This would nonetheless require that no product family sales are lost. This option could be especially relevant for the case company, as current organizational capabilities may potentially limit the size of the potential offering. The

case also displayed how, before seeking to steer demand, it is important to understand where potentials for such actions can be found. In the case, the high cost and particularly long lead times of PF B's feature options for feature B worked as a straightforward example of a situation where the potential for demand steering could exist.

The same ideas apply when seeking to assess future potentials for lowering costs, which was suggested by the Head of Supply Chain during the second round of interviews. Scenario analysis can be used to assess the potential upper and lower bounds for such developments. This is especially relevant when seeking to compare different decision alternatives with a longer time frame, as initially less profitable alternatives may become most profitable after foreseen opportunities for lowering costs have been exploited. Overall, scenarios were therefore found to work well for seeking to assess these potentials in a distribution and offering determination situation. What should nonetheless be highlighted is the assessment of risks in any scenario.

While a potential range of scenarios (as decision alternatives) can be formulated, it is also important to remember that things don't always go as planned. It is therefore important also understand the potential for things to not go as initially planned and the impacts of such situations. An example of such can be a situation where inventory rework costs are higher than expected (as mentioned by Lee & Billington 1992), or where obsolescence was not expected in the first place. This notion should be remembered in distribution-related decision making, as some decision alternatives (such as flexible distribution methods) allow coping with these potential risks better than others.

The distribution related challenges and findings display how the accounting considerations are intrinsic to distribution-related decision making. This similarly gives a sample of ex ante accounting in a specific decision-making situation. The role of ex ante accounting information in managerial decision making is discussed from a more general perspective in the following chapter.

5.2 Management accounting in managerial decision making

The research results paint a clear picture of the main uses of accounting information in two different decision-making situations and the respective quality requirements in those situations. The findings are discussed in two phases, first focusing on the use and role of accounting information, and then considering the qualitative requirements for accounting information. Practical implications and potential guidelines are also discussed for both topics. Finally, a simplified four-step process model for effectively creating impactful ex ante accounting information is presented.

Ex ante accounting information was found to generally play two key roles. First, accounting information was used as a source of financial information for assessing the financial performance of a given decision alternative, and to provide financial boundaries inside

which a given decision alternative should reside. Second, ex ante accounting information was used to learn about the issue at hand (by both identifying underlying causalities and key determinants of financial performance) and to prioritize and direct analysis work. While the use of ex ante accounting information for assessing financial performance was not a surprising finding, what was considered interesting was the way the accounting information was used. Instead of only directly determining a decision choice or working as a general information point in addition to other considerations, accounting information was found to potentially work more as a boundary setter for the range of potential decision alternatives. These financial boundaries, as they are called here, were used to limit the potential decision alternatives to ones that make financial sense. This displayed as accounting information providing information about financial conditions which would work as a decision alternative disqualifying boundary.

The findings suggest that in financial performance driven decision-making situations (such as in the first phase of the LC project), the boundary role can be considered stricter, resulting in accounting working more as a directing activity. On the other hand, in decision-making situations requiring more holistic considerations (such as in the second phase of the LC project), the boundaries created by accounting information were seen as more flexible, working more closely hand in hand with other qualitative considerations. This made accounting work more as an informing activity. The different roles can be considered intuitive. Finding the most cost-effective distribution operation was a key objective of the phase, whereas considerations such as product strategy, customer demand, risk tolerance, and organizational capabilities (mostly displaying in operational capabilities) were also strongly considered during the second phase. In either situation, financial information was generally seen as the first "gate", which all decision alternatives should pass. After passing this rough financial "gate", the focus could move more closely to the qualitative aspects of the decision alternatives.

The findings also describe the interplay between quantitative accounting information and qualitative considerations. In holistic decision-making situations, accounting information generally provides qualitative considerations with a financial context. This allows management to better assess the qualitative considerations' impact on the overall phenomenon being analyzed. An example would be framing consideration about a local sourcing operation with the associated profit potential. Additionally, accounting information allows managers to relate their views on potential operations to financial feasibility, providing a financial context to the development ideas presented.

Similar contextualization also works in the other direction, as quantitative accounting information is also contextualized with qualitative information. In practice, this could mean augmenting accounting information with information about the associated real operations. This integration of ex ante accounting information with the qualitative considerations seems to potentially work as a powerful way of combatting the incompleteness of accounting information (Chapman 1997; Wouters & Verdaasdonk 2002) and the potential

uncertainties (categorized by Burchell et al. 1980) associated with decision-making situations. Similarly, qualitative contextualization can support in directing decisions towards the long-term organizational objectives, therefore limiting the potentially short-term focus of financial accounting information. The case suggests that the respective roles and the relation between accounting information and any qualitative information are dependent on whether accounting works as a more informing or as a more directing activity. The findings suggest that the latter is more likely the case when financial considerations (such as costs) work as the main driver of a decision, or when financial risks associated with a decision increase. In either case, both sources of information are ultimately considered together, with their respective weights being determined by the properties of the decision-making situation. The conceptual role of accounting information as a boundary creator seems to nonetheless remain.

The use of accounting information to learn about the issue at hand was one of the most significant uses of accounting in the LC project. In addition to responding to uncertainties in both the underlying causalities and organizational objectives (Burchell et al. 1980) by generally modeling the financial implications of decision alternatives, accounting also worked as a tool to holistically understand the issue. This not only means understanding the potential underlying causalities, but also understanding (and even communicating) the factors that affect the modeled phenomena. Displaying different scenarios can work as a potential way of communicating these findings to the intended recipients of the accounting information. Multiple scenarios can allow management (and the other personnel) to better understand *why* and *how* a specific scenario excels, and why it is better than the others. Such information can also better the understanding of the underlying processes and causalities which influence the feasibilities of different decision alternatives.

While not directly observed, the findings gave an indication that in addition to general presentation material, accounting objects themselves can also work as the main medium in which potential affecting factors are listed and communicated. This would highlight the role of accounting as a way for communicating the factors included in the analysis, in addition to just the results of the analysis. More research would nonetheless be required for drawing conclusions on the previous. The key role of accounting information seems to nonetheless be to provide a financial context for the decision alternatives by educating managers about the financial implications of given decision alternatives and the associated factors. This can then allow managers to relate other qualitative and operative considerations into the proper financial context. Accounting information can similarly be used a boundary for limiting the number of decision alternatives in decision making.

The role and use of ex ante accounting information should always affect its creation. Instead of just seeking to generally model a forthcoming phenomenon, management accountants should primarily seek to identify the key insights and information relevant to managers. This requires a good understanding of the decision-making situation and the associated managerial uncertainties. In a situation similar to one described in this thesis,

the previous means (i) providing financial boundaries for the decision alternatives which allow narrowing the decision-space, and (ii) actively seeking to identify and respond to the key managerial uncertainties associated with the decision.

In a finance-driven decision-making situation, the boundary setter role requires identifying the decisions which best perform over the financial measures set. This provides financial boundaries inside which other decision alternatives should reside for a more detailed analysis to be made. In a more holistic consideration, such as the second phase of the LC project, this would require identifying the key differences between the decision alternatives and providing information on these key differences in financial performance. This allows identifying general financial boundaries for the decision with which the number of decision alternatives can be limited. Focusing on the key managerial uncertainties, on the other hand, requires the accountants to actively direct analysis in a way that responds to the (developing) managerial uncertainties, while simultaneously seeking to limit the possibility of over-analyzing factors with little decision-swaying importance.

A key method for achieving both objectives in a resource-efficient manner could be to actively seek to identify key factors that most significantly affect the financial performance of decision alternatives. Identifying and roughly analyzing the key factors can be used to limit the number of factors analyzed thoroughly to the most significant ones. This allows the differentiation of decision alternatives with the least amount of resources possible. While the previous may not drastically change the act of creating accounting objects that support decision making, it changes the mindset from "creating accounting objects to analyze and describe a given phenomenon" to "creating accounting objects for resolving the key uncertainties and differentiating decision alternatives from each other". This can then influence the prioritization of different activities when creating ex ante accounting information, as focus moves to analyzing factors that have true decision-swaying importance. Similarly, focus then moves away from factors that are too insignificant when related to the inherent uncertainties associated with the ex ante accounting objects and the decision-making situation. Scenarios could here be used as an effective way of communicating the financial implications of the identified key factors. Offering a limited but representative set of scenarios can potentially allow a better understanding of the key factors, as managers can then relate the single factors and their roles to the overall decision alternative. Similarly, scenarios can support in communicating the future (non)potential and (in)significance of different previously identified possibilities for development.

As suggested by the Head of Product, the utility value of ex ante accounting information is created by supporting decision making. As such, "better" (e.g. more accurate or more complete) accounting information is not inherently valuable. Actively focusing on the key managerial uncertainties allows the focus to be kept on supporting managers in their work instead of fully modeling the underlying causalities of the phenomenon, as described by Hall (2010). In addition to MA developing to suit changes in external factors

and managerial objectives (Korhonen et al. 2013), effectively supporting decision making also requires MA work to be actively developed to align with the key managerial uncertainties. This is also critical for answering to the uncertainties in a resource-efficient manner. The previous can be considered working as an extension of the ideas of Wihinen (2012), who discussed about relating MA to the contextual needs of managers.

The empirical findings also display that the objective of identifying key factors affecting decision alternatives does not only affect the act of creating accounting objects, but it also strongly influences the design of accounting objects. New and uncertain situations require that great emphasis is put into identifying all factors affecting the decision, after which the actual weighing of these factors can begin. This growing importance of the "design phase" also emphasizes the role of knowledge integration in the design of the accounting objects. Knowledge integration should not equal filling input cells in an accounting object, but instead work as a key activity in the design and preparation of the accounting objects. The role of knowledge integration and interdepartmental cooperation in tackling the often incomplete translation of operational activities into accounting information (Chapman 1997; Chapman 1998; Wouters & Verdaasdonk 2002) is highlighted in an ex ante accounting situation, where uncertainty also affects the details of the operational activities being translated. This uncertainty can increase the possibility of communicational challenges regarding the modeled phenomenon. In practice, knowledge integration in accounting object design means that different parties actively contribute to identifying the different factors affecting the later modeled phenomenon and the underlying causalities that might exist. This can be, as indicated by the interviewees in chapter 4.5.2, seen requiring close cooperation between the accountants and the people closely affiliated with the modeled phenomenon. The findings display that knowledge integration focusing on the design of the accounting objects (by seeking to map relevant factors and causalities) is important for the accounting objects to be both complete enough and trusted by the management.

The challenge of facilitating knowledge integration nonetheless exists. In an ex ante accounting situation (such as the one in this thesis), effective knowledge integration in accounting object design and creation could be achieved by sharing the responsibility for the analyses. This could even mean having the non-accountants lead the analysis (as suggested by the CFO). Committing different departments to the creation of accounting information could better the flow of information to and from the accounting objects. In such a situation, non-accountants could focus on identifying and assessing the different factors affecting the phenomenon, and accountants could be responsible for the creation of the accounting objects themselves. This could also ensure that sensible and shared assumptions are established. Regardless of the actual way such ex ante accounting objects are created, it is clear that interdepartmental cooperation and knowledge integration should be both continuous and bidirectional. In addition to supporting the creation of accounting information, it also allows the trust and legitimacy of the accounting object to be increased

(Abernethy & Bouwens 2005; Chenhall & Euske 2007), supporting the "information feedback" towards the respective departments participating in the creation of accounting information. While it is clear that knowledge integration between accountants and non-accountants is not easy (Wouters & Roijmans 2011; Laine et al. 2016), a shared responsibility for the output of the analysis in which the accounting objects are used could work to commit different parties into the creation of accounting objects. This could similarly support establishing a shared understanding of the different viewpoints different parties have on the analyzed phenomenon, as suggested by Laine et al. (2016).

Hall (2010, p. 308) refers to previous literature, stating that "when mobilised as part of an organisational system, accounting information can prompt discussions by signalling that something must be looked into more carefully". The empirical findings indicate that the previous role of accounting information is even more prominent in ex ante accounting. Instead of passively using accounting information to potentially signal about something that must be looked into, ex ante accounting information should be proactively utilized for prioritizing issues and their worthwhileness for a more detailed inspection. This view should be present already in the design and creation of accounting information. The previous quote by Hall (2010) nonetheless still applies, as accounting information also prompted unforeseen discussions about organizational objectives and things that "must be looked into more carefully". The findings here strongly echo the earlier findings of Laine et al. (2016), who describe how "boundary objects play a key role in focusing on the most critical aspects of complex, uncertain and ambiguous phenomena" (p. 324). The findings of the thesis expand the work of Laine et al. (2016) by describing the associated quality requirements for boundary objects in a new decision-making situation, and how the said boundary objects should be created. This is discussed in more detail below.

It was found that the high accuracy of accounting information was itself not the most critical quality requirement for ex ante accounting information. While reasonable accuracy was expected (in accordance with the uncertainties associated with the accounting objects), key managerial quality requirements were more closely associated with believability and contextual factors, such as the completeness of information. Representational considerations mainly worked as tools to facilitate knowledge integration when creating the accounting objects and trust when presenting the findings.

It was generally noted that requirement for accuracy was affected by the value it added and the cost of obtaining the accuracy. In a new and uncertain decision-making situation it was recognized that in addition to the previous, the requirement for accuracy was closely tied with the significance of the accounting object (or part of it) from a decision-swaying perspective. Greater accuracy can be seen as being required if either the accounting object (or decision-affecting factor modeled in it) is significant from a decision-swaying perspective. Similarly, greater accuracy can be seen being required if the existing information is not accurate enough to distinguish between decision alternatives, but there

could potentially be decision-swaying differences found. As previously described, a ballpark accuracy can therefore also be sufficient from a decision-making standpoint. In practice, a "ballpark analysis" could display as calculating the best and worst cost scenarios for different decision alternatives and using that information for decision making. Similarly, such analyses can be used to limit the number of significant factors or decision alternatives analyzed. If a worst-case scenario of a factor is not bad enough to affect the decision, it should not be studied further. In any case, the requirement for accuracy is tied to the information user's ability to make a decision based on the information. This requires that the accountant understands the associated managerial uncertainties and the decision-making situation faced.

This need to establish trust via believability, completeness, reputation, and representation can be seen as a requirement for the accounting information to be utilized in decision making. This similarly affects the way accounting information is considered in relation to other sources of information. Here establishing trust was particularly found to require that the contextual and operational understanding of the creators of the information was sufficient and that the accounting objects included all the relevant factors of the modeled phenomenon. Completeness and believability were therefore found to be the most important quality attributes. There were also indications that the reputation of the source of accounting information would itself create trust in the accounting objects, lessening the need to focus on management's perception of believability and completeness. This can be considered intuitive, as an experienced and distinguished accountant's analyses are trusted more by default. Oppositely, this also displays how an inexperienced accountant should focus on establishing trust. As described by the CFO, the accounting objects need to be "sold" to the management.

Representational quality attributes can be considered supporting the establishment of other quality attributes. As seen in the sample case, it might not always be enough for the intrinsic and contextual qualities of accounting information to be good and suitable for the problem at hand. Instead, the way the quality of the accounting information is communicated can also be as important, thus also highlighting the role of the *perceived quality* of accounting information. This is where representational quality links to the other quality attributes of ex ante accounting information.

The empirical findings display that the perception of accounting objects was seen improving by displaying (i) the factors that have been considered, (ii) the assumptions underlying the accounting object, and (iii) the qualitative considerations associated with the findings of the accounting information. Displaying all the factors considered allows the users of the accounting information to assess if all relevant factors have been considered in the accounting object. Conveying the previous work put to maximizing completeness thus also improves the perception of completeness. Displaying the associated assumptions, on the other hand, improves the believability of accounting information by allowing the management to understand "where the numbers came from". Associated assumptions

should thus be available when displaying ex ante accounting information about a phenomenon with strong uncertainties. The previous doesn't mean that a list of all factors and assumptions need to be presented. Instead, the focus should be given to the most significant assumptions which contain the most uncertainties. Lastly, the qualitative considerations allow contextualizing the associated accounting information and the related assumption with other considerations, potentially improving the believability of accounting information and the associated assumptions. Qualitative considerations could also potentially support in establishing trust in the creators of accounting information, as qualitative considerations can convey the creators' understanding of the business context. In practice, this could mean accompanying the key assumptions (with high uncertainties) with the associated qualitative considerations and reasoning. Linking accounting information to other considerations of the surrounding business context can be seen as creating trust in the fact that relevant organizational objectives, limitations, and possibilities have been recognized in the accounting objects and the accompanying analysis. Understanding and recognizing the current business context is thus not only relevant in creating accounting information (Fry et al. 1995; Chapman 1997; Wouters & Wilderom 2008), but also in its further communication and justification.

The findings indicate that the further away the creator of accounting information is from the user of the information, the more should be invested into the representational factors previously listed. The reasons for this are somewhat intuitive. The further away the accountant, the more difficult (both physically and socially) it is for the user of the accounting information is to ask about the accounting objects. Similarly, a smaller distance between the accountant and the user makes it more likely that other accounting objects have previously been created and social interactions had. This could itself facilitate the trust given to accounting objects created by the accountant. This is especially relevant in an ex ante accounting situation where one-off accounting objects are used, as there is no previous validation done for the accounting objects. This again shows how the representation and communication of accounting information are contingent on the situation where accounting information is created. Requirements in an interdepartmental project group (where users of accounting information work closely with its creators) differ from a setting where accounting information is "commissioned" from a party that is far away from the decision-makers.

As already discussed, the findings of this study reaffirm the importance of understanding the business context when creating accounting information (see e.g. Chapman 1997; Wouters & Verdaasdonk 2002; Wihinen 2012). Understanding the business-related causalities (such as reasons behind historical sales or the potential reasons for the lack thereof) was recognized playing a vital role in both the creation of ex ante accounting information and establishing its believability. Such understanding can be considered critical in ex ante accounting (such as displayed in the case), as it separates a qualitatively contextualized accounting information from a more "data-analysis" oriented accounting.

In the LC project, contextual understanding allowed assessing the potential challenges and possibilities related to offering specific variable options from an operations standpoint. Accounting information was thus contextualized with qualitative considerations. This qualitative contextualization can be seen being especially important if there is a need to assess the organizational capability to influence the different underlying factors in the modeled phenomenon. Understanding the true capabilities to influence underlying factors can be seen as being greatly important in many situations. For example, seeking to objectively describe and differentiate an "optimal" and a "realistic" scenario depicted in an accounting object requires such understanding. This requires the accountant (or the interdepartmental group creating the accounting information) to understand both (i) the underlying factors that *can* be influenced, and (ii) the organizational *capability* to influence the said factors.

As the contextual information is usually available from other organizational actors, the extent of the need for knowledge integration in creating accounting objects could be seen being (at least partly) contingent on the accountant's understanding of the business context and the related real operations. In practice, less knowledge integration is required from the standpoint of creating accounting information if the management accountant is familiar with the object of analysis. This nonetheless only considers the creation of accounting information, leaving out the role of "information feedback" from the accounting object to the different non-accountants inside an organization. While a good understanding of the business context can be considered to lessen the need for knowledge integration during the creation of accounting objects, it should nonetheless not be fully abandoned. The feedback from accounting information to the operative organization can have great value adding potential. Such potential includes, for example, communicating the identified underlying financial causalities which might have previously been unknown to other parts of the organization.

In addition to the role of understanding the business context, the findings can also be seen highlighting the decision-making situation as a part of the business context to be understood. This can be seen being important in the sample case because ex ante accounting information was created to directly support in a specific decision-making situation. This somewhat differs from other accounting information (such as product costs), where predefined accounting information might be created at regular intervals, and then later recontextualized (or adjusted) to suit a specific decision-making situation. Understanding the contextual requirements and key managerial uncertainties allows creating accounting information that best answers the said uncertainties, while also utilizing organizational resources in the most efficient manner possible. This leads to the need for management accountants to understand how accounting information is going to be used. While this information might not always be available, seeking to obtain information about the decision-making situation can improve the relevance of the information while decreasing the

costs associated with creating the accounting objects. This implies that knowledge integration should thus not be limited to accountants and departmental experts, but also include accountants and the decision-making managers.

The findings of the thesis can generally be considered reaffirming the findings in previous literature (see e.g. Fry et al. 1995; Vaivio 2004; Wouters & Roijmans 2011; Laine et al. 2016) about the importance of communication, knowledge integration and iterative development in MA. The role of these can be seen being highlighted in an ex ante accounting situation, where uncertainties regarding objectives, causalities, costs, processes, and others make it more difficult to create accounting objects that well represent the phenomenon being analyzed. Additionally, the qualitative understanding gained from the listed activities can support in responding to the incompleteness of accounting information.

Efficient cooperation, knowledge integration, and information feedback are nonetheless not easy. The first phase of the LC project displayed the challenges resulting from multiple accounting objects created separately by separate people, which made it difficult to create comparable accounting information and lowered the trust given to different analyses. The second phase of the LC project then showed that a more centralized analysis, while creating a more coherent and comparable representation of the given phenomena, lacked in the communication between the accountant and the key personnel actually responsible for sales and SC development. This resulted in both impaired information exchange about changes in the inputs affecting the accounting objects, and also in sharing the findings back to the people actually developing operations.

Both of the previous show that accounting development should be performed in a setting where both the accountants and operational managers working the real process both take a shared interest in developing the accounting objects and work closely together. Here, accountants work as the facilitators of the creation of accounting information, with operational managers providing an understanding of the operational implications of different decisions and assumptions. In such a setting, information about the real process (and any changes in it) flows naturally to the accounting object, while the understanding gained from the accounting object better flows back to the managers of the real process. This way, the knowledge about the business context (Chapman 1997), general long-term objectives (Fry et al. 1995), and accounting skills of accountants are combined with the detailed operational knowledge of the operational managers. The close participation of operational managers supports in the otherwise incomplete translation of operational concerns into accounting information (Chapman 1997; Wouters & Verdaasdonk 2002) and supports in framing accounting considerations with important operative perspectives.

This can better support the creation of representative ex ante accounting information in which qualitative insights are also taken into account, better supporting the overall understanding of the causalities underlying the modeled phenomena. Indications of this were directly observed in the workshop events with the US Operations Manager. However, it

was also observed that such a model of working is very resource-consuming, as more people have to commit time for the creation of the accounting objects and to keep themselves appraised of its development. Yet again, a balance between knowledge integration and efficient use of resources needs to be found.

Such a balance in knowledge integration and resource use could be achieved by committing the key personnel or managers into the development of the accounting objects, and, for example, keeping periodic meetings for reviewing and developing the accounting objects, with the management accountant nonetheless being responsible for the accounting object itself. Such a model would allow the efficient use of resources, as information would flow to and from the accounting objects while centralizing the physical development of the accounting object to the accountant. If multiple persons are performing analyses, a shared accounting object can then be used to establish a shared set of assumptions and to effectively communicate those assumptions to other members of the project team during the creation of the accounting objects.

The challenges and requirements for accounting information identified in empirical findings and the previous discussion should be considered when creating accounting information. For responding to the identified challenges and requirements, a simple four-step process model is presented in Figure 10. The presented process seeks to ensure the effective creation of impactful ex ante accounting information. The first two steps of the process focus on the preparation and planning for the creation of accounting information. The last two steps then guide the resource-efficient creation and development of accounting information. This is done from the perspective of information impact on managerial work. The four steps of the process are discussed in more detail below.

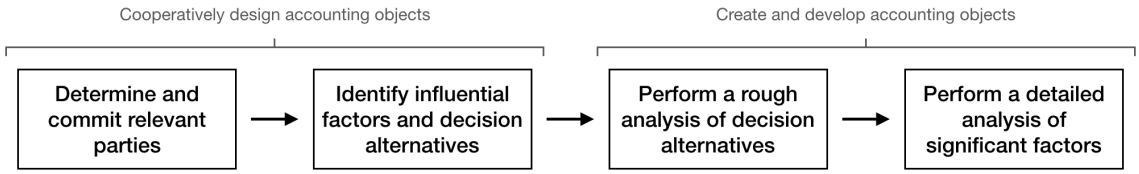

Figure 10. *The four steps for creating impactful ex ante accounting information.*

The first step responds to the recognized need to effectively commit different relevant organizational parties to the creation of accounting information. Instead of only working as sources of input for the accounting objects, different parties should be committed to creating the accounting information, and to share responsibility for its creation. This supports in bringing true operational knowledge into the creation of the accounting objects and responding to the generally incomplete translation of operational knowledge into accounting information (Chapman 1997; Wouters & Verdaasdonk 2002). Management accountants should generally work as the "owners of the spreadsheet", with the group of relevant parties cooperatively creating the information necessary for the accounting object. As previously discussed, committing different relevant parties to the creation of the

accounting object ensures that the required knowledge integration can efficiently happen when creating the accounting objects. Comprehensive knowledge integration also ensures that accounting objects represent real operations that are plausible in real life from an operations standpoint. The active search for relevant parties can also support in finding actors that have previously not realized the value-creating potential of their local knowledge (mentioned by Vaivio 2004). The commitment of different parties in the creation of accounting objects can also improve the chances that new information created in the accounting objects (such as key factors to focus development efforts on) are fed back to the representative parts of the organization. Better cooperation can also increase the acceptance of the accounting objects, supporting their further utilization (Abernethy & Bouwens 2005). This can have great value adding potential, especially when the associated parties are not the final recipients of the created accounting information, otherwise potentially missing the potentials of the accounting information created. The first step can be considered important for knowledge integration to become bidirectional, potentially allowing the building of new organizational understanding.

The second step seeks to resolve the identified challenges relating to the identification of all relevant factors (which was seen as a believability-diminishing issue), and similarly considering all the relevant decision alternatives (if ones had not been considered in advance). The objective is to design accounting objects that are complete and to also establish any potential decision alternatives which have not previously been considered. Focusing on the design of the accounting object allows the new and uncertain phenomenon to be analyzed better, as the emphasis is given to understanding and identifying the factors affecting the phenomenon as a whole. This also reduces the number of situations where previously unknown factors are identified during the analysis, and the accounting objects are appended. This key planning phase is where the benefits of interdepartmental cooperation and knowledge integration are reaped. The second step in the design phase also allows the parties involved in creating the accounting information to establish a shared set of assumptions with which the accounting objects are created. While it is likely that new assumptions are made during the creation of accounting information, establishing the way these assumptions are handled allows different parties to properly record the assumptions made, and later communicate those assumptions to the other parties involved. These other parties also include the final users of the accounting information.

The third phase starts the creation of the accounting objects and the associated data gathering. The objective of the third step is to perform a rough analysis of the decision alternatives, which allows creating ballpark analyses of the decision alternatives and the factors affecting those decision alternatives. These ballpark analyses can then be used as a first gate for the decision alternatives, providing management with the first set of rough information for potentially eliminating decision alternatives and to redirect analysis work. Similarly, rough estimates allow identifying key factors affecting the decision alternatives, which can also support management in redirecting the analysis work. These rough

analyses support the efficient use of resources, as a detailed analysis is only performed for decision alternatives that are not yet understood well enough, or to factors that can have a significant impact on the decision being made.

The fourth step is reserved for a more thorough analysis of the decision alternatives or the factors affecting the decision alternatives. In this phase, the accounting objects are developed to better reflect the underlying causalities in the decision alternatives, or the factors being analyzed. In practice, this means increasing the accuracy and detail in the accounting objects. The objective of the fourth step is to distinguish between decision alternatives, which could not have previously been done. This, as often the most resource consuming step, is thus left to last. While the boundaries between the third and fourth steps can often be blurred, the high-level objective of the two is to minimize the resources committed to obtaining information while obtaining information with the most relevance for decision-making purposes. While this might seem self-evident, the importance of actively redirecting resources to the most value-creating activities should not be understated.

The two-step process for actually creating the accounting objects closely resembles the two-step methodology mentioned by Berman and Wang (2006; originally from Daganzo 1999) when discussing logistics and distribution problems. A similar thought process is here adapted to a management accounting setting. While a similar methodology was already introduced in the contexts of logistics-related problems, the two-step model for creating accounting objects also emerged from the empirical findings of the thesis.

Discussing the process model with the CFO also raised the need to remind about the real-life nature of MA work. While the four steps in Figure 10 are presented as a sequential process, it is important to recognize that the steps are rarely truly sequential in actual work. This is the case especially with the second and third steps. New factors or decision alternatives will most likely be recognized during the creation of accounting objects, therefore affecting the created accounting objects. Similarly, identifying relevant factors and decision alternatives can be done by starting to create a rough accounting object to which the factors and decision alternatives will be gathered. The process model is nonetheless relevant in recognizing the importance of knowledge integration and planning before diving into the creation of accounting objects, while also reminding about how the detail and quality of the accounting objects should always be related to the information's decision-swaying potential. This ensures the efficient creation of impactful information.

When considering the sample case in the thesis, the findings show how both the discussion partner and number generator roles of accountants (Suomala et al. 2011) are in the center of creating ex ante accounting information for decision making. The need to understand a wide array of causalities, implications, organizational objectives, and managerial uncertainties require that accountants not only work as the "excel-gurus" but also as

holistic analyzers of the studied phenomenon. Here, knowledge integration among organizational actors plays a key role. Accounting information should be accompanied with the qualitative considerations, which allow both responding to the shortcomings of incomplete accounting information with underlying uncertainties (discussed by Chapman 1998), and to the validation of the accounting objects themselves. This encapsulates the role of management accountants as not only providers of quantitative accounting information, but more generally as holistic supporters of the decision-makers.

5.3 Limitations of the thesis

This thesis has a number of limitations strongly relating to the research strategy. The use of interventionist research strategy can itself be considered a limitation of the thesis. This is because the author had already previously worked in the case company before the start of the thesis project, which can be considered increasing the possibility for any previous biases affecting the findings obtained from an interventionist research. This can be considered affecting both research questions. Similarly, the author's previous employment in the case company and previous work experience in management accounting can be considered lowering any doubt or criticism that could be directed towards the analyses performed or findings stated, thus lowering the credibility of weak or strong market testing.

This thesis is also limited by the extraordinary growth and strong profitability of the case company, which can limit the extent to which any finding (especially concerning the use of ex ante accounting information) can be generalized to other companies. Both of the previous can be seen strongly reducing the risk associated with a "wrong decision" in any phase of the LC project, which could have affected the way managers used ex ante accounting information. As an example, any sub-optimal financial performance caused by lesser than forecasted sales volumes would nonetheless be most likely rectified in a few years because of the overall strong sales growth in the case company.

The findings of the study are also based on an organization that's relatively inexperienced, with less established SC and decision-making processes. The decision-makers were also close to the creators of both qualitative and quantitative information due to the size of the organization. This may have supported previous knowledge integration in the organization and the general knowledge of both real processes and accounting information, affecting the results of the thesis. The findings may thus not apply to more established industrial organizations, where establishing new operations and foreign investment are more common. Similarly, the findings may not apply to organizations where there is a more significant organizational division between different departments or the creators of accounting information and the decision-making managers.

The size of the organization can also potentially amplify the shortcomings of an interventionist research focusing only on a single organization. The size and organizational age

of the case company's sales and SC teams may have increased the possibility of groupthink. This could potentially have increased the similarity of interviewee opinions. This is especially in the first research question, as the LC project was generally discussed a lot in the case company.

Lastly, the findings of this thesis might potentially be limited to the described type of decision-making situation. It is reasonable to assume that other kinds of decision-making situations require ex ante accounting and the associated holistic analyses of the phenomenon to have different properties. Accounting information will likely have a different role in a "routine" investment decision regarding a new pulp plant, with the quality requirements reflecting the different role. Similarly, if the case company would open another LC in a new location, the associated uncertainties would likely be lower (or at least different), and the role of accounting information be similarly different. This can limit the generalizability of the findings.

5.4 Conclusion and suggestions for future research

This thesis analyzed the kind of an offering the case company should implement in its new US LC, and by extension, how the case company's configurable products should be distributed. It was found that the case company should focus on maximizing the sales of its product families as a whole, focusing on the number of products sold instead of how the products were configured. As such, feature options growing overall sales should be offered, with offering other feature options being limited by both financial considerations and operational capabilities. In general, the focus should be directed to developing the overall LC process from a service level and cost-efficiency standpoint, with the profitability of single feature options being of less importance. It is nonetheless difficult to draw generalizations about the way LC offering should be determined, as the decision and the risks related to each decision can be considered being contingent on various factors relating to the company, the product, and the market. This thesis does, however, display how different aspects regarding the offering decision were considered in the case company's situation, and which aspects were found to be most important. These findings can be used as guidelines for directing analysis in other similar situations.

The sample case and analysis were primarily used as a case for analyzing, how the case company management utilized ex ante accounting information, and what kind of quality requirements were set for that accounting information. In addition to the sample case, the case company management was also interviewed about an earlier phase of the LC project. This allowed creating a comprehensive understanding of the management's views about ex ante accounting information and how those views might have differed in different ex ante accounting situations (i.e. the first and second phase of the LC project).

It was found that ex ante accounting worked primarily as a tool for understanding the new and unknown phenomenon, to identify and prioritize factors affecting the associated decision-making, and to provide the management with general financial boundaries inside which focus could move more towards qualitative decision-making factors. The role of accounting information as a directing or informing activity depended on the situation accounting information was used in, and the role financial considerations had in those situations vis-à-vis other considerations. Accounting information was also used as a boundary object for creating and communicating information between actors associated with the LC project. The role of accounting information also displayed in the associated quality requirements. The fact that accounting information was used to learn and understand a complex phenomenon with multiple decision alternatives required a significant focus to be given to the completeness and believability of information. These factors were highlighted because of managerial uncertainties regarding the phenomenon being studied and the need to establish trust in the accounting objects. Accuracy was generally found to be contingent on the available information, the cost of acquiring new information, and if an increased accuracy had any decision-swaying significance. As such, even back-of-the-envelope type of ballpark analyses can be suitable for responding to managerial uncertainties. Representational quality was found to work as an attribute contributing to establishing trust in the accounting objects, and the ease of understanding of the information presented. Lastly, a simplified four-step process model was presented for supporting management accountants in creating valuable ex ante accounting information in a resource-efficient manner in similar situations. The presented model simultaneously responds to the identified challenges related to the creation of ex ante accounting information and its further utilization in organizations.

The limitations of this thesis also work as a basis for suggesting topics for future research. First, the role and quality requirements for ex ante accounting information should be studied with a larger sample of both organizations and decision-making situations. A larger study can be used to either confirm or disprove the findings of this thesis. In addition to repeating a similar study on a larger scale, it would also be essential to study, if the current findings apply in larger and more established organizations. Future research could also study the optimal amount of cooperation between different parties in the creation of accounting objects, as more cooperation allows better knowledge integration but requires more resources, and vice versa. Concerning the distribution of mass customizable products, future research could seek more extensively identify general guidelines for distribution models for mass configurable products. Potential research directions also include steering feature option demand with tools such as limited offering, and its potential effects on both profitability and perceived customer service.

REFERENCES

Abernethy, M.A. & Bouwens, J. (2005). Determinants of accounting innovation implementation, Abacus, Vol. 41(3), pp. 217-240.

Alford, D., Sackett, P. & Nelder, G. (2000). Mass customisation—an automotive perspective, International Journal of Production Economics, Vol. 65(1), pp. 99-110.

Anderson, S.W. (1995). A framework for assessing cost management system changes: the case of activity based costing implementation at General Motors, 1986-1993, Joumal of Management Accounting Research, Vol. 7(1), pp. 1-51.

Baker, P. (2008). The design and operation of distribution centres within agile supply chains, International Journal of Production Economics, Vol. 111(1), pp. 27-41.

Berman, O. & Wang, Q. (2006). Inbound logistic planning: minimizing transportation and inventory cost, Transportation science, Vol. 40(3), pp. 287-299.

Blackburn, J.D. & Millen, R.A. (1982). The impact of a rolling schedule in a multi-level MRP system, Journal of Operations Management, Vol. 2(2), pp. 125-135.

Briers, M. & Chua, W.F. (2001). The role of actor-networks and boundary objects in management accounting change: a field study of an implementation of activity-based costing, Accounting, organizations and society, Vol. 26(3), pp. 237-269.

Burchell, S., Clubb, C., Hopwood, A., Hughes, J. & Nahapiet, J. (1980). The roles of accounting in organizations and society, Accounting, organizations and society, Vol. 5(1), pp. 5-27.

Chapman, C.S. (1998). Accountants in organisational networks, Accounting, organizations and society, Vol. 23(8), pp. 737-766.

Chapman, C.S. (1997). Reflections on a contingent view of accounting, Accounting, organizations and society, Vol. 22(2), pp. 189-205.

Chen, C., Wang, B. & Lee, W. (2003). Multiobjective optimization for a multienterprise supply chain network, Industrial & Engineering Chemistry Research, Vol. 42(9), pp. 1879-1889.

Chenhall, R.H. & Euske, K.J. (2007). The role of management control systems in planned organizational change: An analysis of two organizations, Accounting, Organizations and Society, Vol. 32(7-8), pp. 601-637.

Cooper, R. (1988). The Rise of Activity-Based Costing-Part Two: When do I need Activity-Based Cost system? Journal of Cost Management, Vol. 2(3), pp. 41-48.

Da Silveira, G., Borenstein, D. & Fogliatto, F.S. (2001). Mass customization: Literature review and research directions, International Journal of Production Economics, Vol. 72(1), pp. 1-13.

Daganzo, C.F. (1999). Logistics systems analysis, 3rd ed. Springer, Heidelberg, Germany.

de Souza, F.B. & Pires, S.R. (2010). Theory of constraints contributions to outbound logistics, Management Research Review, Vol. 33(7), pp. 683-700.

D'Adderio, L. (2001). Crafting the virtual prototype: how firms integrate knowledge and capabilities across organisational boundaries, Research Policy, Vol. 30(9), pp. 1409-1424.

Eisenhardt, K.M. & Martin, J.A. (2000). Dynamic capabilities: what are they? Strategic Management Journal, Vol. 21(10-11), pp. 1105-1121.

Emsley, D. (2005). Restructuring the management accounting function: A note on the effect of role involvement on innovativeness, Management Accounting Research, Vol. 16(2), pp. 157-177.

Fisher, M.L. (1997). What is the right supply chain for your product? Harvard business review, Vol. 75 pp. 105-117.

Fry, T.D., Steele, D.C. & Saladin, B.A. (1995). The role of management accounting in the development of a manufacturing strategy, International Journal of Operations & Production Management, Vol. 15(12), pp. 21-31.

Galbraith, J. (1973). Designing complex organizations, Addison-Wesley, Readings, MA.

Guillén, G., Mele, F.D., Bagajewicz, M.J., Espuña, A. & Puigjaner, L. (2005). Multiobjective supply chain design under uncertainty, Chemical Engineering Science, Vol. 60(6), pp. 1535-1553.

Gunasekaran, A., Patel, C. & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment, International journal of operations & production Management, Vol. 21(1/2), pp. 71-87.

Gupta, A. & Maranas, C.D. (2003). Managing demand uncertainty in supply chain planning, Computers and Chemical Engineering, Vol. 27(8-9), pp. 1219-1227.

Hall, M. (2010). Accounting information and managerial work, Accounting, Organizations and Society, Vol. 35(3), pp. 301-315.

Jordan, S. & Messner, M. (2012). Enabling control and the problem of incomplete performance indicators, Accounting, Organizations and Society, Vol. 37(8), pp. 544-564.

Jönsson, S. & Lukka, K. (2007). There and back again: doing interventionist research in management accounting, Handbooks of management accounting research, Vol. 1 pp. 373-397.

Jørgensen, B. & Messner, M. (2010). Accounting and strategising: A case study from new product development, Accounting, Organizations and Society, Vol. 35(2), pp. 184-204.

Kaplan, R.S. (1984). The evolution of management accounting, in: Anonymous (ed.), Readings in accounting for management control, Springer, pp. 586-621.

Korhonen, T., Laine, T. & Suomala, P. (2013). Understanding performance measurement dynamism: A case study, Journal of Management and Governance, Vol. 17(1), pp. 35-58.

Laine, T., Korhonen, T., Suomala, P. & Rantamaa, A. (2016). Boundary subjects and boundary objects in accounting fact construction and communication, Qualitative Research in Accounting & Management, Vol. 13(3), pp. 303-329.

Lambert, D.M., Stock, J.R. & Ellram, L.M. (1998). Fundamentals of logistics management, McGraw-Hill/Irwin.

Landau, M. & Stout Jr, R. (1979). To manage is not to control: Or the folly of type II errors, Public administration review, pp. 148-156.

Lee, H.L. & Billington, C. (1992). Managing supply chain inventory: pitfalls and opportunities, Sloan management review, Vol. 33(3), pp. 65-73.

Levy, D.M. (1997). Lean Production in an International Supply Chain, Sloan management review, Vol. 38(2), pp. 94-102.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S. & Rao, S.S. (2006). The impact of supply chain management practices on competitive advantage and organizational performance, Omega, Vol. 34(2), pp. 107-124.

Lindholm, A., Laine, T.J. & Suomala, P. (2017). The potential of management accounting and control in global operations: Profitability-driven service business development, Journal of Service Theory and Practice, Vol. 27(2), pp. 496-514.

Malina, M.A., Nørreklit, H.S. & Selto, F.H. (2007). Relations among measures, climate of control, and performance measurement models, Contemporary Accounting Research, Vol. 24(3), pp. 935-982.

Malina, M.A. & Selto, F.H. (2001). Communicating and controlling strategy: an empirical study of the effectiveness of the balanced scorecard, Journal of management accounting research, Vol. 13(1), pp. 47-90.

Malmi, T. & Granlund, M. (2009). In search of management accounting theory, European Accounting Review, Vol. 18(3), pp. 597-620.

March, J.G. (1987). Ambiguity and accounting: The elusive link between information and decision making, Accounting, organizations and society, Vol. 12(2), pp. 153-168.

McGowan, A.S. & Klammer, T.P. (1997). Satisfaction with activity-based cost management implementation, Journal of Management Accounting Research, Vol. 9 pp. 217.

McKinnon, S.M. & Bruns Jr, W.J. (1992). The information mosaic: How managers get the information they really need, Harvard Business School Press.

Nixon, B. (1998). Research and development performance measurement: a case study, Management accounting research, Vol. 9(3), pp. 329-355.

Otley, D. (1999). Performance management: a framework for management control systems research, Management accounting research, Vol. 10(4), pp. 363-382.

Paul, A., Tan, Y. & Vakharia, A.J. (2015). Inventory Planning for a Modular Product Family, Production and Operations Management, Vol. 24(7), pp. 1033-1053.

Petkov, S.B. & Maranas, C.D. (1997). Multiperiod Planning and Scheduling of Multiproduct Batch Plants under Demand Uncertainty, Industrial and Engineering Chemistry Research, Vol. 36(11), pp. 4864-4881.

Preston, A. (1986). Interactions and arrangements in the process of informing, Accounting, Organizations and Society, Vol. 11(6), pp. 521-540.

Ramdas, K. (2003). Managing product variety: An integrative review and research directions, Production and Operations Management, Vol. 12(1), pp. 79-101.

Rowe, C., Birnberg, J.G. & Shields, M.D. (2008). Effects of organizational process change on responsibility accounting and managers' revelations of private knowledge, Accounting, Organizations and Society, Vol. 33(2-3), pp. 164-198.

Salvador, F. & Forza, C. (2004). Configuring products to address the customization-responsiveness squeeze: A survey of management issues and opportunities, International Journal of Production Economics, Vol. 91(3), pp. 273-291.

Saunders, M., Lewis, P. & Thornhill, A. (2009). Research methods for business students, Pearson education.

Simchi-Levi, D., Kaminsky, P. & Simchi-Levi, E. (2008). Designing and managing the supply chain: concepts, strategies and case studies, McGraw-Hill Education,

Simons, R. (1995). Levers of Control, Harvard Business School Press, Boston.

Sprinkle, G.B. (2003). Perspectives on experimental research in managerial accounting, Accounting, Organizations and Society, Vol. 28(2-3), pp. 287-318.

Stevenson, W.J. (2011). Operations management, 11th ed. McGraw-Hill/Irwin,

Strong, D., Lee, Y.W. & Wang, R.Y. (1997). Data quality in context, Communications of the ACM, Vol. 40(5), pp. 103-111.

Suomala, P. & Lyly-Yrjänäinen, J. (2012). Management accounting research in practice: Lessons learned from an interventionist approach, Routledge.

Suomala, P., Manninen, O. & Lyly-Yrjänäinen, J. (2011). Laskentatoimi johtamisen tukena, Helsinki: Edita, Vol. 202 pp. 2018-2020.

Svensson, G. (2002). A conceptual framework of vulnerability in firms' inbound and outbound logistics flows, International Journal of Physical Distribution & Logistics Management, Vol. 32(2), pp. 110-134.

Tan, B. & Karabati, S. (2004). Can the desired service level be achieved when the demand and lost sales are unobserved? IIE Transactions (Institute of Industrial Engineers), Vol. 36(4), pp. 345-358.

Tsiakis, P., Shah, N. & Pantelides, C.C. (2001). Design of multi-echelon supply chain networks under demand uncertainty, Industrial & Engineering Chemistry Research, Vol. 40(16), pp. 3585-3604.

Vaivio, J. (2004). Mobilizing local knowledge with 'provocative'non-financial measures, European Accounting Review, Vol. 13(1), pp. 39-71.

Wan, X., Evers, P.T. & Dresner, M.E. (2012). Too much of a good thing: The impact of product variety on operations and sales performance, Journal of Operations Management, Vol. 30(4), pp. 316-324.

Wan, X. & Sanders, N.R. (2017). The negative impact of product variety: Forecast bias, inventory levels, and the role of vertical integration, International Journal of Production Economics, Vol. 186 pp. 123-131.

Wang, R.Y. & Strong, D.M. (1996). Beyond accuracy: What data quality means to data consumers, Journal of Management Information Systems, Vol. 12(4), pp. 5-33.

Watson, K. & Polito, T. (2003). Comparison of DRP and TOC financial performance within a multi-product, multi-echelon physical distribution environment, International Journal of Production Research, Vol. 41(4), pp. 741-765.

Wihinen, K. (2012). Exploring Cost System Design Principles: The Analysis of Costing System Sophistication in a Pricing Context, Tampere University of Technology.

Wouters, M. & Roijmans, D. (2011). Using prototypes to induce experimentation and knowledge integration in the development of enabling accounting information, Contemporary Accounting Research, Vol. 28(2), pp. 708-736.

Wouters, M. & Van der Veeken, H. (2002). Using accounting information systems by operations managers in a project company, Management Accounting Research, Vol. 13(3), pp. 345-370.

Wouters, M. & Verdaasdonk, P. (2002). Supporting management decisions with ex ante accounting information, European Management Journal, Vol. 20(1), pp. 82-94.

Wouters, M. & Wilderom, C. (2008). Developing performance-measurement systems as enabling formalization: A longitudinal field study of a logistics department, Accounting, Organizations and Society, Vol. 33(4-5), pp. 488-516.

Zipkin, P.H. (2000). Foundations of inventory management.

APPENDIX A: INTERVIEW QUESTIONS REGARDING THE LOGISTICS CENTER OFFERING

General questions for all interviewees:

1. What are your responsibilities in the company and how long have you worked in your current position?
2. What factors/things do you think are most important to assess, when deciding the future product option offering of the US logistics center?
3. What factors/things (affecting the offering decision) do you see becoming relevant later, e.g. after 1-2 years?

Questions for the members of the sales team:

4. What product attributes (such as exterior color or other configurable aspects) do you think are most important for customers, and how do those attributes affect the purchasing decision?
5. What service attributes (such as the delivery time or other intangible aspects of the offering) do you think are most important for customers, and how do those affect the purchasing decision?
6. Which attributes do you see being most critical for having the case company selected over other vendors of similar products? (When a customer is comparing and selecting between different vendors.)
7. What kind of end user segments have you recognized and how do those segments differ from each other? (For example, based on eagerness to configure the booth instead of getting the default white booth, on price sensitivity or on lead time preferences.)
8. How do you see "day 1" and "day 2" projects differing from each other?[2]
9. How do you see the dealers affecting the different product variants and other specifics present in the end customer demand? For example, as the "gatekeepers" in the downstream value chain, do you see the dealers pushing customers into specific ordering patterns (such as ordering only default product variants, etc.)?

Questions for the supply chain personnel:

4. How do different feature options affect the supply chain and its different costs?
5. How do different order-to-delivery times affect the supply chain and its costs?
6. Which cost factors do you see being the most important to recognize during decision making?

[2] "Day 1" projects refer to sales which are made to customer's newly built sites. "Day 2" projects refer to sales that are made to customer sites which have been in use before the purchase of the case company's products.

7. How do different logistics center offering (incl. different order-to-delivery times) affect the European factory?
8. How would a decision to source some options locally from the US affect the supply chain? How would US sourcing affect costs?

Questions for all (time allowing):

9. Do you think someone specific should also be interviewed regarding this subject?

APPENDIX B: INTERVIEW QUESTIONS REGARDING THE USE OF EX ANTE ACCOUNTING INFORMATION

Warm-up and background information about the phase:

1. What was the key question/challenge being decided?
2. Who were the parties involved in the decision?

Roles and uses of accounting objects:

3. What accounting objects / analyses were used in the analysis and decision making?
4. What were those accounting analyses used for? (I.e. what questions or uncertainties did they answer? How were they used?)

Quality requirements for accounting objects:

5. How would you describe the different qualitative requirements/importance set for the accounting analyses/information? (e.g. believability, accuracy, objectivity, reputation, relevancy, timeliness….)
6. Should the quality of the accounting information have been better than what was being used, or would lower quality information have also been sufficient?

Other sources of information used in decision-making:

7. What other sources of information or separate considerations affected the decision being made?
8. How did the accounting information relate to the other sources of information, and what were the roles of the different pieces on information in making the decision?