Aalto-yliopisto
Kauppakorkeakoulu

Quality Management Framework for Cooperation with Suppliers

A case study for an IT & Security Company

MSc program in Information and Service Management

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Maria Rosenvall

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Kauppakorkeakoulu

AALTO UNIVERSITY SCHOOL OF BUSINESS
Department of Information and Service Economy
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Maria Rosenvall

ABSTRACT

Objectives of the Study

The objective of this study is to research what are the factors that enhance the quality of the product and the process of the cooperation with suppliers. The goal of the thesis is to propose a quality management framework for cooperation with suppliers for the case company's quality department. The case company is working in the IT and security sector, so there is a high demand for reliable products and fulfillment of strict international and national regulations.

Academic background and methodology

Global competition has increased and companies are concentrating more on their core business area only. This has led to the increase of global outsourcing. Quality plays an important role for companies, both for the product and for the customer satisfaction point of view. However, with the era of outsourcing, earlier used quality assurance tasks are not sufficient.

A branch called supply chain quality management (SCQM) has developed with different management-driven strategies to improve the overall quality performance of an organization through the effective management of quality on supply side. Previous relevant SCQM studies for this thesis have researched mainly how different cooperation attributes affect to the product's conformance quality and customer satisfaction.

Findings and conclusions

The created Quality Management Framework for cooperation with suppliers is one tool for the case company to do effective subcontracting, to minimize the risks of poor quality and to manage the SCQM better. The created Framework consists of two layers. The first layer divides the suppliers into four categories based on the type of outputs they are offering to the company (manufacturing vs. design) and based on the complexity and/or newness of the product. The second layer defines more in detail the main themes and methods to work in each category. For the theoretical contribution, this model provides a new specific quality framework for integrated IT systems.

Keywords

Supply chain quality management, cooperation, quality, supplier, SCQM model, Quality Management Framework

AALTO-YLIOPISTON KAUPPAKORKEAKOULU
Tieto- ja palvelutalouden laitos
Pro Gradu-tutkielma
Maria Rosenvall

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ABSTRAKTI

Tutkimuksen tavoitteet

Tutkimuksen tavoitteena on tutkia, mitkä tekijät parantavat tuotteen laatua ja yhteistyöprosessia alihankkijoiden kanssa. Tämän tutkielman päämääränä on ehdottaa kohdeyrityksen laatuosastolle laadunhallintamalli yhteistyöhön alihankkijoiden kanssa. Yritys toimii tietoliikennetekniikan ja turvallisuuden alalla, joten yrityksen on täytettävä tarkat kansainväliset ja kansalliset määräykset sekä tuotteiden on oltava luotettavia.

Kirjallisuuskatsaus ja metodologia

Kansainvälinen kilpailu on lisääntynyt ja yritykset keskittyvät yhä enemmän vain ydinosaamisalueisiinsa. Tämä on lisännyt osaltaan globaalin alihankinnan käyttöä. Yrityksille on tärkeää sekä tuotelaatu että asiakastyytyväisyys. Kuitenkin alihankinnan aikakaudella aiemmin käytetyt laadunvarmennustehtävät eivät ole riittäviä.

Toimitusketjun laadunhallinta-ala on kehittynyt erilaisista johtamislähtökohtaisista strategioista. Sen tarkoituksena on parantaa organisaation kokonaislaatusuoritusta tehokkaan toimitusketjun laadunhallinnan kautta. Aiemmat tähän tutkielmaan relevantit toimitusketjun laadunhallintatutkimukset ovat tutkineet enimmäkseen, miten erilaiset yhteistyöpiirteet vaikuttavat tuotteen laatuun and asiakastyytyväisyyteen.

Tulokset ja päätelmät

Luotu laadunhallintamalli yhteistyöhön alihankkijoiden kanssa tarjoaa työkalun kohdeyritykselle toimia tehokkaasti alihankinnassa, minimoida huonon laadun riskit ja hallita toimitusketjun laadunhallintaa paremmin. Luotu malli koostuu kahdesta tasosta. Ensimmäinen taso jakaa alihankkijat neljään kategoriaan sen mukaan, mitä he tuottavat yritykselle (tuotanto vai suunnittelu) sekä tuotteen vaatimustason ja/tai uutuuden mukaan. Toinen taso kuvaa tarkemmin pääteeman ja metodit, miten jokaisessa kategoriassa tulee toimia. Tämä malli luo kirjallisuuteen uuden spesifisen integroitujen IT-järjestelmien laadunhallintamallin.

Avainsanat

Toimitusketjun laadunhallinta, yhteistyö, laatu, alihankkija, toimitusketjun laadunhallinnan malli, laadunhallinta kehys

ACKNOWLEDGEMENTS

This thesis writing process took longer than I anticipated in the beginning. Big changes in my personal life have happened along the thesis writing from giving birth to my son Arttu, learning to act as a mom and being promoted at work. Therefore, I am proud to say that this thesis is now ready, and I am going to graduate with the Master's degree from Aalto University School of Business. I am also glad that the research topic about the supplier quality management and cooperation that I choose about 1,5 years ago feels even more relevant at this point for the case company.

I want to thank my supervisors professor Ari Vepsäläinen and professor Katariina Kemppainen for valuable comments and guidance along the thesis writing process. Thank You mom and dad for the encouragements during the studies and for the support throughout the thesis writing. Thank You sister and brother for being interested about the progress of my thesis writing and challenging about the topics. Thank you the case company interviewees for willingly accepting my request of being interviewed and for openly giving valuable comments.

Thank You my husband Jussi for all the support throughout the studies and thesis writing. You have had to make some prioritizing of your own activities because of this. I appreciate it very much.

Now, when this project is at it's end, let the new priorities and projects begin!

Maria Rosenvall

31.01.2016

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1. INTRODUCTION

"No corporation needs to be convinced that in today's scale-driven, technology-intensive global economy, partnerships are the supply chain's lifeblood… Businesses are increasingly relying on their suppliers to reduce costs, improve quality, and develop new processes and products faster than their rivals' vendors can." (Liker J. and Choi T., 2004)

The target of the study is to research factors that enhance the quality of the product and the process in the cooperation between a customer and a supplier. Based on the findings, a quality management framework for cooperation with suppliers is created for the case company's quality department. The case company's field of business is IT and security. The assumption for the study is that the model depends greatly on the type of relationship and the importance of the cooperation. In the next chapter, the background and motivation are presented for the study. In addition, the research problem, the objectives for the study and the methodology are presented. Finally, the content of the study is shortly summarized.

1.1. Background and motivation

According to Evans and Lindsay (2008), American Society of Quality published six key forces in 2005 that will influence the future of the quality: globalization, innovation, outsourcing, consumer sophistication, value creation and changes in quality.

Globalization demands new kinds of collaboration as organizations will be shaped by the adaptably of the Internet, different legacy infrastructures and shifting business politics. *Innovation* and design quality will have even more importance with the faster rates of changes and shorter life cycles. *Outsourcing* increases, as the work can be done independently of the place and time. At the same time, this will increase the global supplier networks. *Consumers* have *high expectations* on the products and their quality including seamless delivery, ever-shorter life cycles and fresh features. Quality is necessary but no longer sufficient. (Evans and Lindsay, 2008)

Determining *value of* any *product*, the stakeholder's viewpoint must be clearly clarified. Perfect quality won't be enough, as values include also sustainability and elimination of waste. Quality will have to create value in everything that is done. *Quality* must also *change* from process model way of thinking to a systems approach. Quality will move business strategies and actions through people. (Evans and Lindsay, 2008)

Ten years after the publication of this list, it is easy to say, that the forecast has come true. Karjalainen (2009) states that with the increase of global competition also the global outsourcing has increased. At the same time companies are focusing only on their core business areas and selecting own specialization strategies. This has led to the point where firms are buying more and more from outside instead of producing it internally.

However, the main target of the companies remains. Deliver on Time, on Cost, on Quality. As companies are using suppliers worldwide, the risks of poor quality by suppliers have increased. Aravindan and Maiti (2012) note in their study that in order to tackle this risk, organizations are forced to allocate resources for managing quality in the supply chain. A new branch called supply chain quality management (SCQM) has developed with different management-driven efforts to improve the overall quality performance of an organization through the effective management of quality on supply side.

However, companies are limited with money and resources for quality, so they need to concentrate on essentials. Cooperation with suppliers is an important factor in order to assure quality. As D. Lambert and M. Knemeyer (2004) state: "If your latest so-called supply chain partnership failed to live up to expectations, as so many do, it's probably because you never stated your expectations in the first place… Partnerships are costly to implement - They require extra communication, coordination, and risk sharing."

Also Von Weissenberg (2013) lists reasons why a company should know their suppliers well and what are the possible risks in the cooperation. Companies should evaluate what happens to the company's brand in case of deviations (that are possible actually caused by a supplier). Other relevant question is how the end customers see the impact of surprises, e.g. breaks in the production because of material shortages coming from a supplier. All of this is part of risk

management – and at the same time evaluation of selecting between best price and possible risks in the quality.

On the other hand, cooperation with suppliers is not only risk taking and risk sharing. Before anything, it is creating additional value to the supply chain and benefiting from collaborative relationships. As Wagner et al. (2009) state, companies do not build strong relationships with the suppliers and customers for their own sake. Rather, they take on exchange designs that offer the best performance prospects. Therefore, the support role of supply chain quality management is important for both risk managing and value creating.

1.2. Research problem and objectives of the study

The studies about cooperation with suppliers have been multiplied in the recent decades. However, most of the researches focus on the case studies and therefore generic models, especially with the importance of quality aspect, are not that common. One reason for the popularity of the studies is that the use of suppliers is increasing all the time and resources for cooperation and for assuring the quality are limited.

The case company of this thesis is working in the IT and security sector. The IT sector, i.e. electronic business is quite short-termed, which means that the company and its suppliers must adapt to changes quickly and be flexible. The Finnish part of the company has around 300 employees and works with several global suppliers. In general, the company has well designed and applied quality systems. However, the supplier quality management of the company has many different methods in the “tool box” but no generic framework to decide which tools to be used with which suppliers. At the same time, the resources for quality management and supplier quality management are limited, so effective, flexible and commonly agreed working methods with different kinds of suppliers are vital to ensure the end quality of the products and to answer to the challenging field of short-termed electronic business.

The objective of the study is to find out the most important topics and methods that affect positively to the quality in the supply chain cooperation. The goal of the thesis is to propose a quality management framework for cooperation with different kinds of suppliers for the case company in the IT and security sector. The scope of this study is limited to the contract phase. In other words, to a phase when a supplier has already been selected, but the project can be either development or in maintenance phase (manufacturing phase).

The research questions of this thesis are stated as:

1) How to categorize the suppliers based on the quality needs on the customer side?

2) What kind of cooperation and other quality related tasks are the suppliers needing (and not needing) from customers in order to fulfill the requirements?

3) How to ensure as efficiently as possible that the quality the suppliers produce is what wanted?

1.3. Methodology

This research is a qualitative study. The target of this thesis is to combine the findings from the literature review and solutions for the case company so that a quality management framework for cooperation with suppliers is constructed and proposed for the case company. Therefore, a scientific research method selected to be utilized in this thesis is action design research (ADR).

Action design research method is aimed for IT ensembles, in other words for bundles of hardware and software. Secondly, the ADR combines the theory development to a practical problem in a specific organization setting. According to the developers of the ADR method, ”ADR results in a method that focuses on the building, intervention, and evaluation of an artifact that reflects not only the theoretical precursors and intent of the researchers but also the influence of users and ongoing use in context” (Sein et al., 2011).

The ADR method contains four stages, including of certain principles. The first stage is called problem formulation, and it comprises of two principles; practice-inspired research and theory-ingrained artifact (Sein et al., 2011). This thesis identifies, articulates and scopes the problem in this first chapter, especially in the ”Research Problem and Objectives of the Study” subchapter. The practice-inspired research problem is taken from the case company from the field of IT and security. The informed theories for the thesis are studied from the field of outsourcing and supply chain quality management.

The second stage of ADR builds on top of stage one. The stage 2 includes building of the IT artifact, intervention in the organization, and evaluation (Sein et al., 2011). In this thesis, first, a literature review is made to study some general topics of quality and subcontracting. After that, the thesis concentrates on supply chain quality management (SCQM) to research general models and guidelines based on previous studies in the field. The target of SCQM review is to find out whether some theoretical framework can be exploited from the current literature, and if some patterns are seen from article to article to be reused in this framework generation.

Secondly, a case study is performed. The case company’s current way of working is described in the thesis. Next, challenges in the current way of working are analyzed by interviewing some of the main internal stakeholders involved in the supplier management and supplier collaboration. In addition, direct observation method is used to find out possible improvement possibilities in the current way of working.

The third stage of ADR is called reflection and learning. According to Sein et al. (2011), the main point of this stage is that the continuous reflection on the problem framing, the theories chosen, and emerging IT artifact to ensure that the different contributions are identified. In addition, adjustments for the research process are reflecting the found results and increasing understanding of the topic. In this thesis, the learnings and summaries of different topics are done along the thesis, especially in the last subchapters of the case study and SCQM models form the literature chapters.

The last and fourth stage of ADR is formulization of learning. The objective of this stage is to formulize the learning and to generalize the outcomes (Sein et al., 2011). In this thesis, the fifth

chapter, Results, builds up the Quality Framework for the case company by utilizing the findings from the case study and literature review.

1.4. Content of the thesis

In this chapter, the content of the study is justified and presented the goals of the study. In chapter 2, I will introduce the theory grounded for the study. First, I will concentrate on the definition and key points on quality (chapter 2.1) and subcontracting (chapter 2.2.). After this I will combine the two first topics in the theory sections and go deeper into the field of supply chain quality management (chapter 2.3.).

The third chapter describes the case company. A short description of the company's field of business and basics of the company is described and the company's current way of working with suppliers is presented. Next, selected main stakeholders of the company working closely with the suppliers are interviewed to find out the current good practices and main challenges. Finally, the targeted framework is modeled based on the interviews and the analysis of the methods. In chapter 4, some reference studies and models from the literature are presented. I also analyze the relevance and usage of the main results and proposals from each of the articles regarding this thesis.

The Results chapter (Ch 5) presents the Quality Management Framework for supplier cooperation for the case company. The chapter reasons the proposed Framework and explains each of the category in detail. Finally, a traceability from the summary findings of previous chapters are done to prove that the framework is aligned with the findings.

In the end, Conclusions chapter summarizes the proposed model and analyses the content of the thesis regarding the contribution and limitations of this study. In addition, some proposals for future studies are listed. The main content of the study is presented in Figure 1.

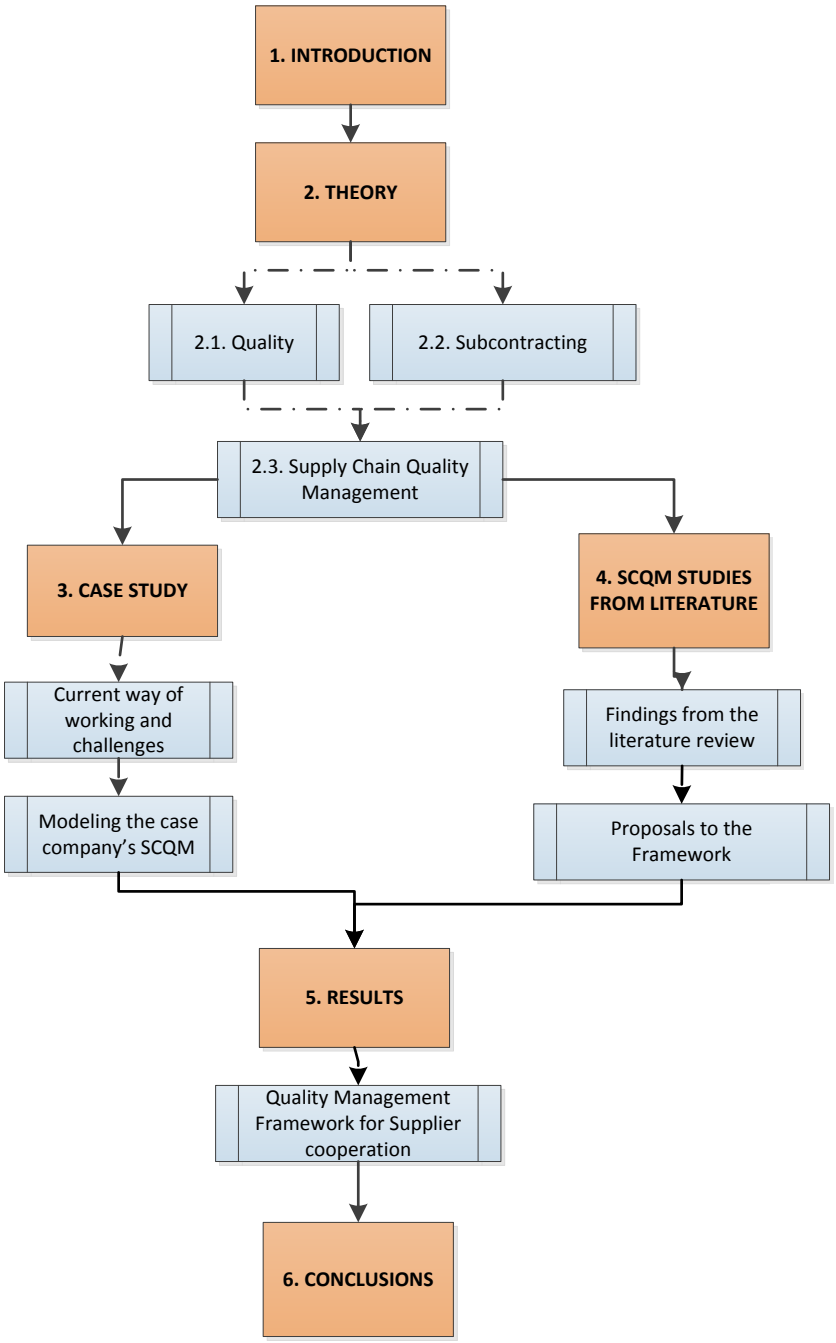

Figure 1. Content of the thesis

2. THEORETICAL BACKGROUND OF QUALITY AND SUBCONTRACTING

This chapter is divided into three separate sections. The first section studies the theory of quality and explains why quality is an important factor for the businesses. The second section comprises of a literature review of subcontracting and outsourcing. The section highlights why companies are using outsourcing and describes different subcontracting strategies depending on the type of outsourcing activities and goals. The third section discusses the supply chain quality management and its practices. The third section combines the theory of the first two sections and studies factors affecting to the supplier and supply chain quality management.

2.1. Quality

2.1.1. Introduction and definition

Quality as a concept is abstract, and there are multiple definitions for a good quality depending on the perspective. Garvin (1984) identified five approaches to define quality. Customer-driven quality perspective defines quality as meeting or exceeding customer expectations. Judgmental perspective sees quality as excellence and superiority, which leaves the analyses of quality to individuals. In the product-based perspective, quality is judged by the quantity of some product attribute, which then usually leads to assumption that the higher the price, the higher the quality. In user-based perspective, quality is defined by the wants of the customer. This view emphasizes the quality side of how well product performs in its intended function. In value-based perspective, the quality is judged by the satisfaction or the usefulness compared to the price of the product. When quality is defined by the conformance to specifications, the view is so called manufacturing-based perspective. (Evans and Lindsay, 2008)

As the purpose of this study is to find out what are the enhancing factors of quality that affect to the cooperation between buyer and supplier, *the definition of quality* used in this thesis is the *conformance to specifications and meeting or exceeding customer expectations*.

According to Evans and Lindsay (2008), organizations that want to achieve quality in its operations, there are three levels of quality to understand. In the highest level, organizational level, a company needs to focus on meeting the external customer's expectations. On the second level focuses on organizational processes, what processes are needed for different functions to perform their job as wanted and to provide necessary inputs and outputs to other functions. The third level of quality is the job level. Each employee needs to understand what is required from him in terms of accuracy, completeness, innovation, timeliness and cost.

Organizations use quality systems in order to guarantee, control and monitor their processes. *Quality system* is defined by Lecklin (1997) as *procedures that an organization applies to ensure the quality of the products*. Another definition of a quality system is *a structure that helps to systematically an organization to work according to management will*.

In the following subsections the importance of quality and costs of quality are highlighted, and a short history of important quality practices are reviewed.

2.1.2. Importance of quality and cost of quality

As seen in the above sub-chapter, the differences in the definition of quality lead to different interpretations and focus areas. However, as Zugarramurdi et al. (1995) state, the basis of quality and different quality systems is to minimize the unnecessary costs: "To do the right things, right first time, every time". The cost of quality (COQ) and the model to analyze quality costs proposed by Feigenbauern in 1974 is still used a lot as a justification for different quality initiatives globally.

In Feigenbauern model, called as a PAF-model, the production costs related to quality are divided into three categories: prevention costs, appraisal costs and failure costs. The last category is further divided into internal failure and external failure costs. Prevention costs are costs that occur before the correction of failures when actions are taken to investigate, prevent and reduce defects. As an example, quality planning costs, improvement initiatives and development of quality and information systems are part of prevention costs. Appraisal costs are costs that occur when achieved quality is assessed and recorded. Reviews, audits, tests, inspections and other

quality control mechanism are examples of appraisal costs. Failure costs are defined as costs coming from failures to achieve the wanted quality. When a failure is produced but still corrected inside a company, these are categorized as internal failure costs. As examples, scrap and rework costs and corrective actions costs are categorized as internal failure costs. If the failures are noticed the first time at the customer premises, these are labeled as external quality costs, such as customer complaints and returns and product recall and warranty costs. (Zugarramurdi et al., 1995)

The key principle is that the later the failures are noticed, the more quality costs it brings to the company. The Feigenbauer's PAF-model is shown in Figure 2.

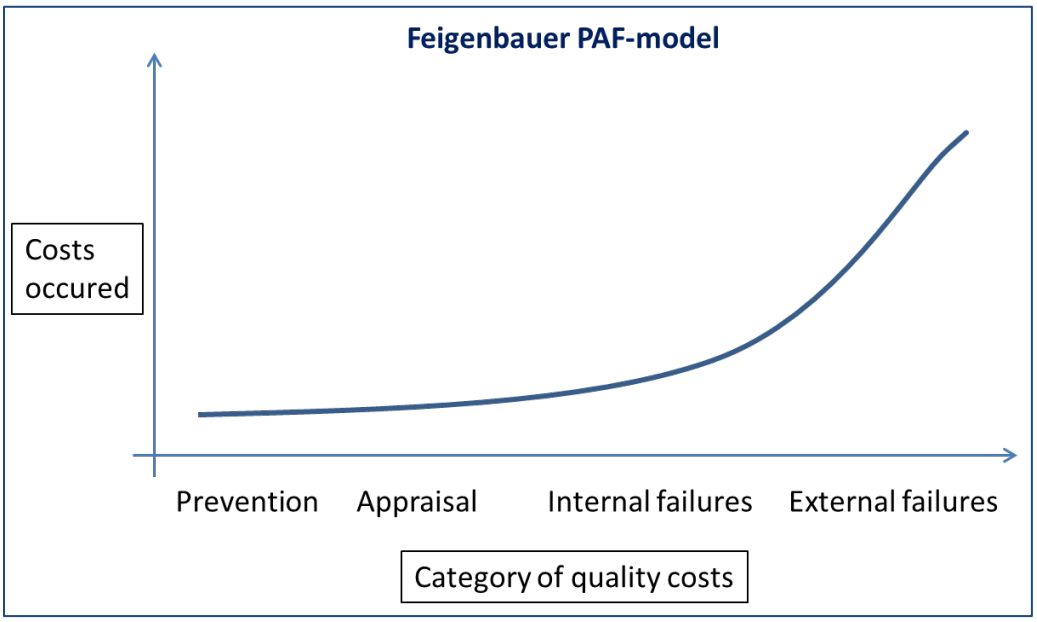

Figure 2. Feigenbauer PAF-model

In principle, the more focus is given to prevention phase, the less failures should occur in the later more expensive phases. As explained by the Quality America Inc. (2013), Juran developed the PAF-model further to analyze the total costs of quality and to find out the optimal structure and quality level to aspire. When perfect quality would be a target, the prevention and appraisal costs would rise to the sky. On the other side, if no prevention and appraisal quality costs are

allowed, the probability to high internal and external costs is very high. That's why the optimal quality level is to minimize the total quality costs. This is outlined in Figure 3 below.

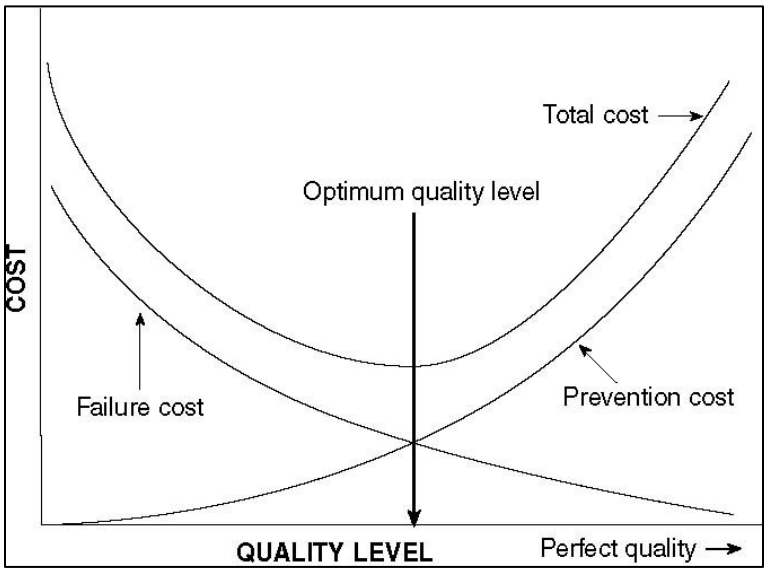

Figure 3. Optimum quality level (Jurans Quality Control Handbook, 1988)

As discussed, in order to achieve wanted quality of the products, it requires efforts from the whole organization to the individual levels. Howes et al. (2005) studied in their article "Who is supporting whom? Quality team effectiveness and perceived organizational support" how effective quality teams are correlated to support from various parties and to guide managers in the development of more effective quality improvement teams. In their research, 136 members from 25 quality improvement teams in the public sector organizations in the southwest United States participated to the survey about quality team effectiveness and perceived organizational support. As a result, it was stated by Howe et al. (2005) that "Quality improvement teams can be effective if individual members perceive that they have adequate support. This support can come from the organization and/or the team and target to the team and/or the individual." As a summary, it was noted in the research that quality teams have an important role in the organizations and can bring effective results to the company, when there is adequate support.

2.1.3. Development of the focus factors in quality over history

Quality has always played an important role in the trade between buyers and sellers. According to Lecklin (1997), already during the barter economy, the people assessed the value of the product, and the quality of the product was checked on the spot. Later handicraft professions took care of the quality control by having the master - journeymen – apprentice system. In the beginning of 18th century with the evolution of manufacturing and mass production, a new profession of quality inspectors was born to check the quality of the phase products, to report quality deviations and to come up with improvement proposals (Lecklin, 1997).

Since that time, the emphasis of the quality practices has varied and developed. In this chapter, I briefly review the history of some of the major focus factors in quality. It is noticeable, that the old quality principles are still in use as premises in today's quality management practices and initiatives as well as bringing insights to supplier quality management practices.

Dr. W. Edwards Deming understood the importance of statistical process control (SPC). Already since 1920s, he taught quality control classes to engineers and factory workers. After the Second World War, he helped Japanese industries to improve their quality and later the principles were used in the U.S and all over the world (Evans et al., 2008). The main point of SPC according to Deming is that "quality and productivity increase as variability decreases and, because all things vary, statistical methods of quality control must be used to measure and gain understanding of the causes of the variation" (Oakland, 2008).

Statistical process control provides many different methods and tools to quality control. To mathematical methods and terminologies of SPC belong as an example as control charts, medians and means (Oakland, 2008). Plan-Do-Check-Act (PDCA) cycle, Pareto analysis, Ishikawa's fishbone diagram are examples of process improvement tools (Oakland, 2008). Six sigma method was introduced by Motorola in the end of 1980s to enhance value for the customers and eliminate waste by approaching plus or minus six-sigma capability to have a defect rate of no more than a few parts per million (Oakland, 2008).

Total Quality Management (TQM) is an integrated approach, including both principles and practices, whose goal is to improve the quality of an organization's products and services through continuously meeting and exceeding customer's needs in most competitive ways (Talib et al. 2010). The idea of TQM was established in 1980s, mostly in response to the intense Japanese competition in the U.S. markets (Schroeder et al., 2005). Companies had to make big changes in order to manage the competition and high quality products coming from Japan.

First general standards and quality models were created in the end of 1980s and were developed further especially during 1990s. International Organization for Standardization (ISO) created ISO 9000 Quality Management series in 1987, and the currently used version of ISO 9001 is from 2008 (International Organization for Standardization). A new revision of ISO 9001 is finalized by the end of 2015 and taken into use in 2016. The purpose of the standard is to address various aspects of quality management and provide guidance and tools for organizations to ensure that the products meet customer's requirements and the quality is all the time improved (International Organization for Standardization). ISO 9001 is the standard that can be certified by organizations and can be nowadays considered as a mandatory requirement in many fields of business.

Malcolm Baldrige quality award was created in the United States in the end of 1980s with the goal to enhance the competitiveness of U.S. businesses. The purpose of the award is to identify and recognize role-model businesses, to establish criteria for evaluating improvement efforts and to share best practices (National Institute of Standards and Technology).

A couple of years later, in the beginning of 1990s European Foundation For Quality Management (EFQM) created similar kind of award as Baldrige to reward quality awards for European companies (Lecklin, 1997). The biggest difference in the award is that the evaluation criteria of EFQM is less detailed in order the companies to emphasize their application according to their special characteristics (Lecklin, 1997).

Schroeder et al. (2005) reviewed all the contributions made for quality in the academic journals "Production & Operations Management" in order to assess the progression of the field of quality. Their article "Evolution of Quality: First Fifty Issues of Production and Operations Management"

reviewed all the first 50 issues from 1992 to 2003. The highest numbers of quality articles were published in 1995 and in 2001. TQM was a major topic in 1990s in related to the hard Japanese competition in US markets (Schroeder et al. 2005). Also from 1990s onwards, technical tools such as SPC and PDCA cycle were interesting topics to study the impact of conformance quality on manufacturer's and user's replacement costs and the value of inspections (Schroeder et al. 2005). Standards and quality models such as Baldrige, ISO 9000 and ISO 14000 (Environmental management) are studied throughout the quality articles. The articles analyze for example the differences and relationships of ISO 9000 standard and Baldrige quality award, and their competitive advantages to the companies using those (Schroeder et al. 2005). Also human issues, such as appropriate allocation of quality teams affecting positively to the performance and service quality topics are studied in small extent in the Production and Operations Management journals (Schroeder et al. 2005).

According to Schroeder (2005), the most interest in quality topics throughout the years has been regarding quality and performance. The articles have analyzed how the quality practices affect to the quality performance. However, the articles are mostly based on empirical and case study research methods. A quite evident shortage in the quality field by Schroeder et al. (2005) was found in the lack of theory development in the quality management.

After Schroeder's article in 2005 the supply chain quality management has arisen. When looking at the number of articles written for various journals, the notifications and the importance of supply chain management and quality management can be noticed. In 2010s the topic has been continued to define more detailed methods and tools for supply chain quality management.

Currently, the most effort in the field of quality seems to be put to topics related lean methodology and agile practices. Other important topics that are visible are related to flexibility and competitive pricing. As the global competition is very intense and the companies are struggling in a difficult economic situation, it is quite apparent that the companies are looking for lean and flexible ways also in the field of quality.

2.2. Subcontracting

2.2.1. Definition

Subcontracting is defined in this thesis as *a business practice and process in which a company hires individuals or companies to perform part of the operations to complete a project or a product*. In this thesis, subcontracting includes supply management, partner management and outsourcing management. Subcontracting is a model of cooperation and relationship between different partners. According to Brito et al. (2013) cooperation can be defined as a joint activity between partners to accomplish mutually compatible goals that would otherwise be unfeasible or costly.

2.2.2. Benefits and risks of subcontracting

In a wider perspective, subcontracting can be both supplier and partnering management. In both cases, the target of the subcontracting is to understand the strategic importance of the partners and develop win-win relationships in order to benefit from it and create trust through honesty and openness (Evans and Lindsay, 2008).

Effective subcontracting provides many benefits to the company. Costs can be reduced, as the company can concentrate on its core areas to invest in (Quality Leadership, 2014). Usually the effective subcontracting brings faster time to market and increases access to better technologies, as the right experts are involved in the process (Quality Leadership, 2014). When the subcontracting is part of the normal business processes, supplier risk is reduced as the supplier is a known partner and both stakeholders have agreed on the common processes and know what the other one is pursuing (Quality Leadership, 2014). All of the above-mentioned reasons also benefit the company with improved quality.

On the other hand, subcontracting brings risks to the company as well. According to Metters (2006), the company is not gaining knowledge of the specific part of technology or part of the process but is losing it to other company. Inside the company, there are losses of career paths for employees (Metters, 2006). In organizational identification side, customers may not be that loyal and feel empathy towards the certain company anymore as well as the employees are not

identifying themselves to a certain firm to feel to proudness of the achievements of the company (Metters, 2006).

When a company makes subcontracting decisions, it must assess the appropriate contractual model to be agreed on with the chosen partner. According to Metters (2006), before the contracts, a company should evaluate the partner's different capabilities, e.g. its solvency, possibilities to expand the business and its competitiveness, for example to hire new skillful employees in the area. As part of the company's autonomy and competence area is given to another company, the supplier will have an effect on the future pricing of the product (Metters, 2006). At the same time, the information privacy topics must be agreed on and it must be acknowledged that part of the competitive advantage of the company is handed over to another stakeholder (Metters, 2006).

Figure 4 summarizes the possibilities and risks in making subcontracting decisions in terms of SWOT-analysis.

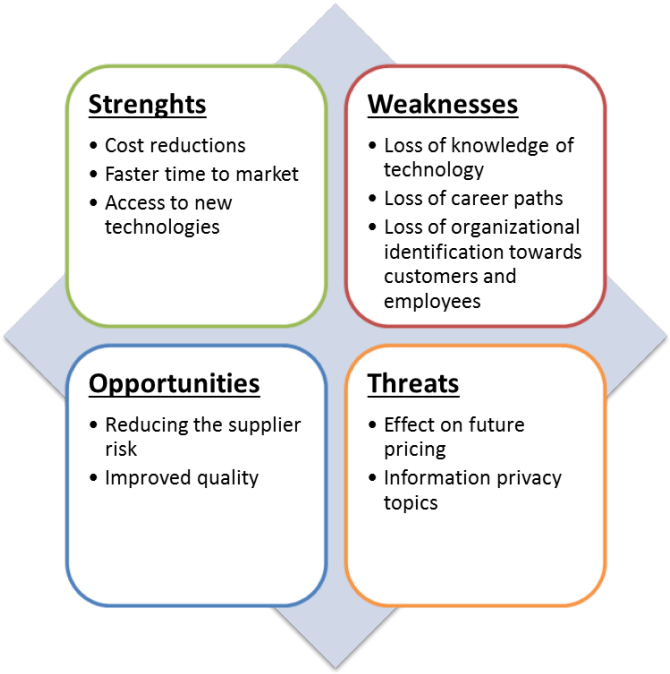

Figure 4. Summary of subcontracting decision as a SWOT analysis

2.2.3. Level of cooperation and supply strategy

Subcontracting and procurement decisions and need for various agreements depend widely of the level of cooperation. One of the most famous models on assessing the management level of purchasing is Kraljic Model. According to Krajlic (1983), the company's supply strategy depends on two variables; the strategic importance of purchasing items in terms of profit risk and the complexity of the supply market (supply risk).

Based on these two factors, company's management can evaluate the suitable supply strategy for the case and at the same time minimize the risks. Krajlic (1983) has created a four-step approach to make the analysis. In the first phase, the classification is made by evaluating the profit impact of the supply item. In the second phase the bargaining power in terms of the supplier and company's own strengths are analyzed to make the market analysis. After that, in phase three, the company makes the strategic positioning matrix by analyzing the power of the supplier and the power of the purchaser to understand the position it stands and what kind of approach the company can take. In the last phase, the action plans are made in order to secure its long-term supply and for exploiting short-term opportunities.

The Krajlic matrix is divided into four areas as shown in Figure 5. When both the strategic importance and complexity of the supply market are low, items are labeled as noncritical items and the strategy can follow purchasing management process. In purchasing management, the buy decisions can be made at lower levels of the organization and the main target is the functional efficiency, to monitor and to optimize the order volumes and inventories (Krajlic, 1983).

When the complexity of the supply market is still low but the importance of purchasing is high, the strategy should follow materials management process. In this case the items are named as leverage items and the target is to concentrate on vendor selection and on targeted pricing strategies and negotiations (Krajlic, 1983). The decision body in the company is in medium level, e.g. chief buyers (Krajlic, 1983).

Sourcing management strategy should be used when the complexity of the supply market is high, but the importance of the purchase is low. The items are identified as bottleneck items and the

focus should be to ensure the needed volume of the items (Krajlic, 1983). Vendor controlling, by securing the inventories and by having back-up plans can do this (Krajlic, 1983). The supplier selection decisions should be made at higher levels, such as by department heads (Krajlic, 1983).

The fourth category of the Krajlic matrix is supply management in which both the complexity of the supply market and the importance of the purchase are high. The items are called strategic items and the main target is to ensure the long-term availability of the items (Krajlic, 1983). The strategic decisions in this category should be made by top management. In order to ensure the strategic items the follow and control must be made carefully. For this process e.g. development of long-term supply relationships, accurate demand planning and contingency planning are important factors (Krajlic, 1983).

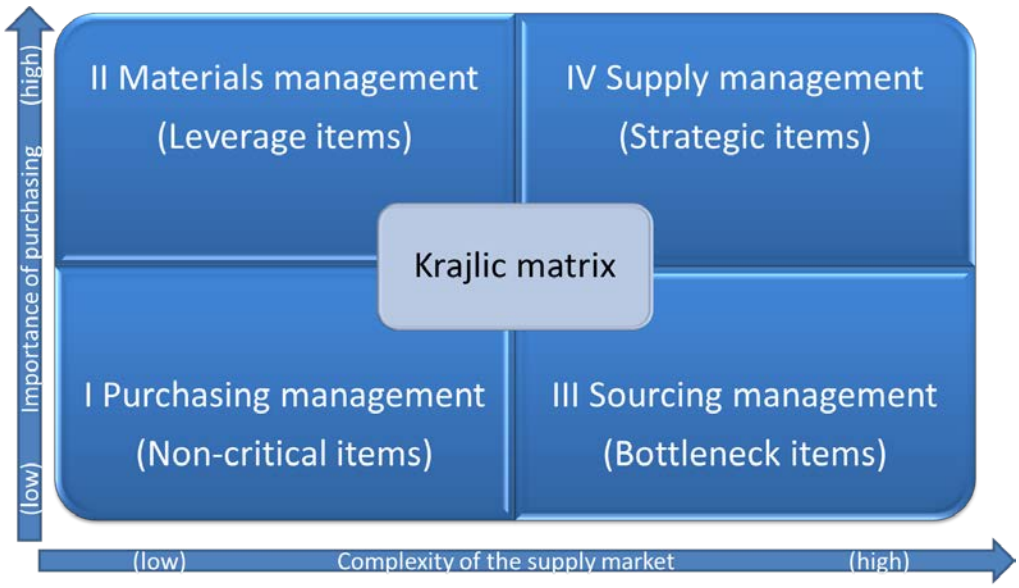

Figure 5. Simplified model of Krajlic matrix

More advanced versions and methods similar to Krajlic matrix have been developed and used in the recent years to highlight the importance of purchasing and its strategy. A.T. Kerney has developed a method called The Purchasing Chessboard®. The goal of the method is to assign strategies and methods for cutting costs and increasing the value of specific spend (Schuh et. al., 2012). With successful utilization of the model, costs are reduced and value with suppliers is increased (Schuh et. al., 2012).

The Purchasing Chessboard® consructed by Schuh et. al., (2012) consists of three structuring levels. The y-axis represents the supply power (from low to high) and the x-axis stands for the demand power (from low to high). The first level includes four strategies depending the on amount of supply and demand power (Schuh et. al., 2012). The second level with 16 levers is derived from the first strategic level to specify the approaches that are used in the discussions between various departments (Schuh et. al., 2012). The bottom level consists of 64 methods to provide a tool for operational use in procurement (Schuh et. al., 2012). This third level forms the chessboard model as the name of the method refers. For each method a set of advices and core elements are given. Figure 6. represents the Purchasing Chessboard® model to select the suitable sourcing strategy with its three levels.

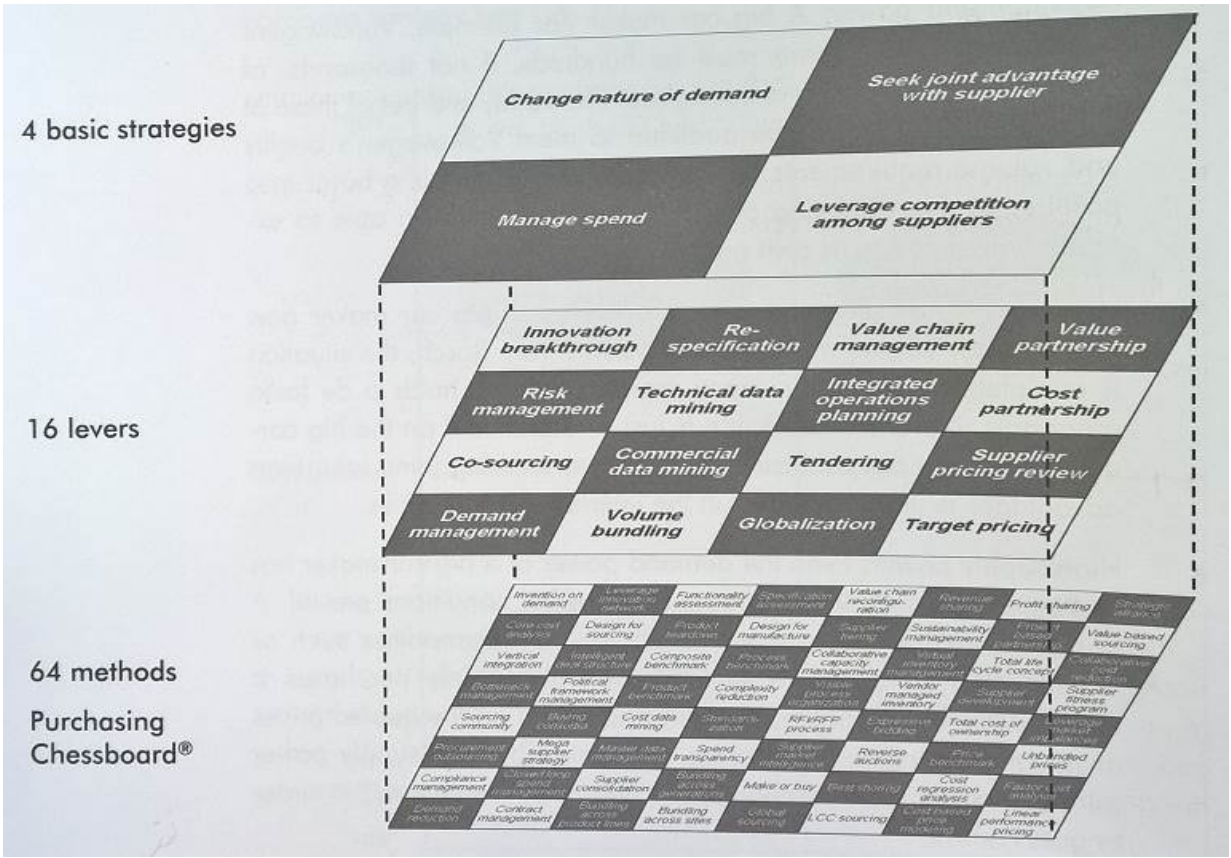

Figure 6. The Purchasing Chessboard® (Schuh et al., 2012)

2.3. Supply chain quality management

2.3.1. Introduction and definition

As reviewed in the previous sub chapter, quality management has been an important part of the companies since industrial revolution, and it plays a key competitive advantage for the organizations. Also supply chain management has been in the focus since the end of 21th century. According to Aravindan et al. (2012), companies are using suppliers worldwide and that is one reason why the risks of poor quality by suppliers have increased. In order to tackle this risk, organizations are forced to allocate resources for managing quality in the supply chain (Aravindan et al., 2012). A new branch called supply chain quality management (SCQM) has emerged with different management-driven efforts to enhance the overall quality performance of an organization through the effective management of quality on supply side (Aravindan et al., 2012).

Supply chain quality management concentrates on the integration of processes of a supply chain, both in the downstream and in the upstream (Aravindan et al., 2012). There is evidence that inter-organizational supply chain activity for quality management both integrate the processes of the supply chain partners and create a formal environment for enhancing collaboration among supply chain (Aravindan et al., 2012). The basic tools and analysis methods for quality management can also be used in SCQM. The advantage that SCQM brings is that preventive and corrective actions developed in one company can be used by others in the supply chain as and when required (Aravindan et al., 2012). Also the root cause and underlying phenomenon of quality problems can be better identified as it may be introduced in the upstream company of the supply chain and more information about the problem is available (S. Aravindan et al., 2012).

In this thesis the supply chain quality management is defined the same way as Robinson and Malhotra (2005): *"SCQM is the formal coordination and integration of business processes involving all partner organizations in the supply channel to measure, analyze and continually improve products, services, and processes in order to create value and achieve satisfaction of intermediate and final customers in the marketplace"*.

2.3.2. Themes and tools of SCQM

Robinson and Malhotra (2005) reviewed in their article “Defining the concept of supply chain quality management and its relevance to academic and industrial practice” SCM and quality management articles from several supply chain and quality related scientific journals and organized the topics into five logically categorized themes. Next, the themes based on their article are shortly presented in order to give an overview of the main topics in SCQM.

1. Communication and partnership of activities

   This theme consists of organizations working closely together and developing relationships with other members in the supply chain. The main target of communication and partnership activities is to share goals, coordinate activities and improve performance. Example topics of the theme are collaborative relationships, management of supply base activities and supplier selection criteria.

2. Process integration and management

   This theme includes the linked activities both inside and outside of a company. The goal is to have an efficient and operative supply chain by having smooth and synchronized linkages between dissimilar processes and operations of companies. Typical topics in the process integration and management are redefined process definitions extended to supply chain, tying internal work practices to customer/supplier interactions, and process measurement and control in supply chain.

3. Management and leadership

   Management and leadership theme means that management influences relationships and operations with supply chain partners. Top management needs to guide and direct both own company efforts, but also encourage participation and improve quality measurement and performance through the whole supply channel. For instance, topics such as management involvement, commitment and attitudes, and management understanding of TQM tools/systems are part of this theme.

4. Strategy

   The target of the strategy theme is to define the means and activities to realize supply chain opportunities and achieve competitive advantage. Strategy theme is divided into

three sub concepts; shared goals and strategies among channel partners, use and implementation of quality initiatives, and integrative focus and commitment.

5. Best practices

   The final theme group is named as best practices. This theme includes topics that involve the use of activities that promote quality in the supply chain. Typically, articles in this category review an implementation of the practice and its impact on company or supply chain performance, or compare practices that are researched in a literature review. Examples of main topics in best practices are JIT capability, TQM implementation, quality management standards (e.g. ISO 9001 implementation), supplier management, inspection and the role of quality department.

The target of this thesis is to create and propose a model for the case company that would take into consideration the first four items; communication, process integration, management and strategy. In order to create a functional model, best practices from similar technologies, the fifth topic, is utilized.

Supply chain quality management connects not only buyer and supplier organizations but also different functions inside a company. Different functions can have different kinds of cultures and way of working. Foster et al. (2010) researched in their article “Towards a better understanding of supply chain quality management practices” differences of quality tools and methods used by operations and supply chain managers.

According to Foster et al. (2010), in general, operation managers are focusing on internal activities and changing inputs into outputs with the help of agreed processes. Process control, process improvement and product design improvement are some of the main activities from quality point of view (Foster et al., 2010). On the other hand, supply chain management has developed from operations and marketing management integration. That is why, aggravating, the way of thinking among supply chain managers is more of thinking the upstream firms, purchasing and total cost (Foster et al., 2010).

As the field of supply chain quality management evolves, also way of thinking within stakeholders develops. Operations are all the time focusing more on customer satisfaction, and purchasing and logistics functions are gaining more a quality-minded approaches (Foster et al., 2010).

Nevertheless, some differences remain for example in the use of quality practices and tools. In Foster et al. (2010) study, a web-based survey was created in which operation managers and supply chain managers answered about the quality tools and approaches utilizing in their company. A seven-point Likert scales (strongly agree, disagree, moderately disagree, neutral, moderately agree, agree, strongly agree) was used in the survey to get ranking of the tools (Foster et al., 2010). After that researchers exploited Krustal Wallis test to analyze differences in ranks by operations and supply chain.

Table 1. and table 2. show the top 10 supply chain tools used by the study of Foster et al. (2010) about supply chain and operation managers. The results show that quality management is approached from different perspectives. Data analysis, supply chain management and customer relationship management were on the top 5 tools for both parties. Supply chain management tends to use more collaborative approaches as on the job training, complaint resolution and leadership. Operation managers, on the other hand, tend to adopt more process oriented methods such as ISO9001, project management and quality function deployment.

As an input for this thesis and for creating the model for the case company, it is important to understand this difference in the way of thinking and priorization of tools among operation managers and supply chain managers. When interviewing people, the suitable standpoint for the discussions should be used and taken into consideration. Also in proposing tools for various users, the suitability and acceptability should be analyzed.

Table 1. The most used SCQM tools by supply chain managers

Rank	SC Tool
1	On the job training
2	Data analysis
3	Supply chain management
4	Customer relationship management
5	Leadership
6	Benchmarking
7	Project management
8	Surveys
9	Complaint resolution
10	Supplier development

Table 2. The most used SCQM tools by operation managers

Rank	SC Tool
1	Data analysis
2	Customer relationship management
3	Project management
4	Supply chain management
5	CAD (Computer-aided design)
6	Design teams
7	ISO 9000
8	Surveys
9	QFD (Quality function deployment)
10	On the job training

3. CASE COMPANY FROM THE IT & SECURITY SECTOR

In this chapter, a short description of the case company is made in order to understand the field of operation. After that current way of working and methods are described. In the third subchapter, challenges of the current way of working are listed and analyzed.

3.1. Description of the company

The case company is an international company in the sector of defense and security solutions. For this thesis the Finnish part of the company, only a smaller subsection of the whole company, is covered. This Finnish subsection develops, installs and maintains professional mobile radio (PRM) platforms. The case company is one of the leaders in PMR worldwide.

There are about 300 employees in Finland in two premises in Helsinki and in Jyväskylä. The revenue of the Finnish subdivision was around 145 million euros in 2014 (Kauppalehti Yrityshaku 29.9.2015). The case company designs and develops its products but the manufacturing of the products is subcontracted. Also some of the software development is subcontracted from other companies and tested by the case company. The main subcontractors are located globally in Europe, in Asia and in the US.

Organizations, such as police and fire brigade, are using professional mobile radio (PMR) platforms. That’s why the PMR solutions must be reliable and always available and include suitable encryption functionalities. The products must also fulfill strict international and national regulations. For these reasons, quality plays a crucial role from the design phase to manufacturing and maintenance phases.

In general, the case company is certified against ISO9001 (quality management) and ISO14001 (environmental management) standards. The company has its own quality policies and processes in place, which are improved continuously. The company requires also its subcontractors to

maintain ISO certificates and to fulfill needed regulations relevant in the field of IT communication and security.

The parent company has published as one of the main quality policy principles to integrate suppliers as an extension of the quality strategy. Suppliers are an important part of the total quality towards customers also in the Finnish subsidiary. However, the Finnish subsidiary and its quality team is only a small part of the whole company and have to tailor its way of working accordingly.

The field of IT and electronic business has its own special characteristics of short-term planning that affects the case company. Customers are expecting to get the products they have ordered in a few weeks' time interval. However, because of the nature of the need of reliable electronic components, the lead-time for some of these may be several months. Therefore, the case company must do the forecasting of the future deliveries continuously. In addition, the working methods and possibility to the change of plans must be flexible with the case company and its suppliers.

3.2. Current way of working and methods

The case company has several people in different roles that are working with suppliers on a daily basis. The main job descriptions and task responsibilities are well described and are well known in the organization. However, as usual, there are individual differences in the way of working for the same role, and that is why there are different ways of working towards different suppliers.

In general, sourcing manager is the main contact point towards suppliers. His responsibility is to maintain the customer-supplier relationship. Sourcing manager negotiates the contracts and prices with the suppliers. He is also helping to tackle problems that may occur in the cooperation.

Buyer's main task is to make purchase orders to suppliers based on the orders that the case company receives from its customers and based on the forecasts that are made. Buyer also

follows that the supplier confirms the orders and that the deliveries happen according to the agreed schedules.

NPI (New Product Introduction) manager is the main responsible during the product launch phase towards suppliers. His tasks include building up the manufacturing and delivery capability for new products, by giving inputs to suppliers based on the research and development (R&D) documentation. NPI manager works also with suppliers in the maintenance phase when products are having major changes or a manufacturing plant is changed.

R&D contact is usually a software and/or hardware engineer who is the main developer of the product. He is producing documentation of the product, e.g. specifications and drawings of the product that are delivered to suppliers. He is also a technical support in case of unclarified issues and makes the final verification of supplier's outputs.

Quality manager is responsible of the quality of the processes and products. He is following that internal stakeholders and suppliers are working according to agreed processes. He is also monitoring the product quality, for example by checking the yield reports of the products. Quality manager is responsible for conducting audits.

Management of the case company is responsible about the overall performance and about the strategic decisions. Management follow-up the status in high perspective and solve issues in case of escalations. Table 3. summarizes the main responsibility areas of various stakeholders.

Table 3. Case company internal stakeholders towards suppliers

Internal stakeholder	Main responsibility area with suppliers
Sourcing manager	Main contact towards suppliers. Responsible of creation and updating of contracts.
Buyer	Make purchase orders to suppliers. Follow up on supplier confirmation, deliveries and performance.
NPI manager	Build up product manufacturing and delivery capability for new products.
R&D contact	Create documentation for new products and product versions. Technical support in case of product issues.
Quality manager	Follow-up on quality related topics such as yields and process monitoring. Conduct audits.
Management	Manage relationships and follow-up general performance and status. In case of escalations, solve issues.

The case company has a pool of different methods for working with suppliers and in ensuring the quality of the products and processes. In order to give an overall understanding of the way of working by case company, some of the main methods are described next.

Contractual requirements, e.g. quality certificate related requirements

Contract between customer and supplier has several requirements from country and field of business specific regulatory requirements to single project specific requirements. The quality requirements are dependent on the type of relationship and outputs the suppliers are producing, e.g. software versus hardware suppliers.

In general, the case company requires that the suppliers are maintaining a quality system that meets the requirements of main quality certificates such as ISO9001 (Quality Management Systems) and ISO14001 (Environmental Management).

Audits

The case company conducts audits for their suppliers. A companywide audit plan is made annually. Usually a yearly audit is done for the most important suppliers, and other suppliers are audited case by case based on the analysis of internal stakeholders.

Supplier evaluation and development

Supplier evaluation and development (SED) review is done for the main suppliers annually. The case company's main stakeholders per a supplier are rating supplier's performance of the year based on commercial, technical, quality, logistics and customer support activities. After the rating, the feedback is reviewed with a supplier and a development plan with development targets and corresponding measures is generated. Same template is used for all suppliers in order to compare the results from year to year and between different suppliers.

Quarterly Business Reviews

Sourcing manager is organizing quarterly business reviews (QPR) with main suppliers. Top management of both organizations is reviewing in the meetings the status of cooperation mainly from business and financial point of view. Also other important or escalated topics can be discussed during the QPR.

Monthly meeting with steering groups

A monthly meeting with a steering group is organized to follow the status on a high level. The basic agenda of the meeting is to review the order and forecast status of deliveries, discuss about ongoing project statuses, check the buffer stock status and needs for the coming months. In addition, key performance indicators are reviewed and possible improvement actions are defined. Key middle level managers from each department are participating from both sides of the companies.

Product and process controls (product manufacturers)

Case company's stakeholders, mainly NPI manager, R&D representative and quality manager, are visiting supplier premises to make process and product controls. Control visits are done especially when there is a new product launch or a major change in the old product. Controls can also be done by reviewing supplier's work instructions. This is done either on site or in the company's laboratory by comparing actual product, specifications and the work instructions.

Product and process controls (software suppliers)

Case company is reviewing and approving supplier's project plans and specifications in order to have a common understanding of the deliverables and quality levels. The case company requires suppliers to test their deliverable and deliver their test reports. The case company is also making own testing of the delivered software before an acceptance of the deliverable is given.

Scorecards

Suppliers are measuring and following Key Performance Indicators (KPIs). Monitored KPIs are agreed together and the target levels are reviewed and agreed yearly. Example KPIs are product yields, incoming and outgoing inspection findings and number of open repairs.

Claim process

Claim process is used when there is non-conformity of a delivered product. A claim towards a supplier describes which product is at issue, to whom and when it was delivered and a description of the non-conformity. It must be also stated at the claim, which corrective actions are wanted from the supplier, e.g. by sending a new compensatory product immediately. The supplier must act according to the waiver request. They have to investigate why the non-conformity happened and what are corrective actions for this product, and preventive actions that this problem does not occur in the future anymore.

Improvement projects

Improvement projects are either supplier's own improvement projects or cooperative improvement projects. Usually the target of an improvement project is to improve and enhance current product, production or processes.

Everyday communication

Stakeholders of the case company and its suppliers are of course working and communicating with each other by daily or weekly basis. Usual communicating methods are phone calls, e-mails, weekly teleconference meetings and communication through agreed tools (e.g. documentation and fault correction related topics).

3.3. Challenges in the current way of working

Interviews in the case company were organized in order to understand the challenges in the current way of working. Six interviews were held, one participant from each role of internal stakeholder as presented in this thesis. The participants were located in two sites, Helsinki and Jyväskylä. Helsinki participants were interviewed face-to-face, and Jyväskylä participants through collaborative Webex-calls.

Each participant was asked beforehand whether (s)he would be interested to participate to the survey. From the original plan one planned interviewee declined, and a new person from the same role was asked to be a participant to the study. A calendar invitation was sent about a week before the interview with the overall target of the thesis and the main questions related to the interview.

The interview questions was left purposely quite open, to find out the actual challenges with the cooperation with suppliers, and not to lead the answers to some intended direction. In general, the starting questions for the interview were:

1) What are currently good practices with our suppliers?
2) What are the main challenges / what is not working?
3) In case you have some improvement proposals that the quality of the products and/or the customer (=us) satisfaction would improve?

The details of the interviews are collected to Appendix 1. Next, a short summary of each interview is presented.

Sourcing Manager, J.K. (Helsinki)

"I find it good that the case company's processes are not that detailed, which makes it possible to be more flexible and to adapt to the different needs of different suppliers. Partly, I think, this is because the organization is smaller and therefore decision-making can be done faster.

Currently, each sourcing manager is selecting the way of working with own suppliers. As most of the sourcing managers have been with the same suppliers for a long time, same kind of way of working has existed with several suppliers. The difficulties rise when several sourcing managers are involved with the same suppliers, for example in the case of project specific sourcing manager is different from the nominated main sourcing manager for the supplier.

Also, the long-term cooperation should be considered during the contract negotiation. If only price is important, the flexibility and long-term cooperation will get difficult. In my opinion more important is to concentrate on good specifications by our side and to make quality related templated regarding different kinds of contracts."

Buyer, M.V. (Jyväskylä)

"In my opinion, the frame contracts should define the ISO quality requirements as the quality baseline for the companies. However, even though a company has the ISO9001 certificate, it doesn't assure that the processes are really in place.

To me, the best companies are flexible and lean for requests for customer. Of course, the good attitude from suppliers depends also whether we are a "big player" for their own business. For

our role as the buyer, when everything works, no additional work and methods are needed. For example, order confirmations and price changes run itself. If more work has to be done for these, then we know that something is wrong.

For the quality, I think it's not only product quality but also good communication and e.g. keeping of delivery times. Sometimes also negative start may bring positive output for the loyalty. I mean, when a claim is resolved correctly and in a good timely matter, the proactive resolving gives good sign about the supplier to us, and the loyalty is increased."

Quality Manager, A.P. (Jyväskylä)

"In my opinion, regular meetings with the main suppliers and their quality people is important. However, the meeting must contain such person from the supplier side who is entitled to make decisions and changes in their organization. Also open and honest communication is the key factor in the customer – supplier relationship.

Audits and assessments are important methods for the approval of supplier production and practices. In case of quality issues, a good practice is to gather together with all the parties (e.g. supplier, sub-supplier and customer) and discuss together the root cause of the faults and how improvements could be done. However, we as a customer should only support this process and not be involved too much in the fault management process.

As a main improvement need, I see, that we should concentrate more on describing our requirements and expectations better to the suppliers."

R&D (HW) Development Manager, J.L. (Helsinki)

"I see that we have a couple of different kind of working method with different kinds of suppliers. With our main manufacturers, the main benefits are achieved by sharing feedback to our proto rounds of new products. Also the brainstorming workshops at supplier premises have been fruitful for both parties.

With other suppliers, we write the specifications and verify later that the requirements have been implemented. It would be good to add in the future requirements also for the development phase of the supplier to understand how things, such as reviews, are really done and to emphasize the quality aspect more. Otherwise, regular meetings are held in case of problems.

As a lessons learnt from previous project, in a partner-mode working, a good introduction to our products, processes and expectation levels should do well."

Head of Quality Finland, T.K. (Helsinki)

"In my opinion, we should invest more in the supplier management. The main improvement there would be to categorize and model the way of working with different suppliers. We have both software and hardware related suppliers. In general, I would divide the suppliers to three category. In the first category belongs the product manufacturers. The second category is the subcontractors in the projects who are developing a part of the system. The third category is the subcontractors who are working as they would be part of our organization; they are working according to our company processes.

Yearly supplier audits should be planned so, that there are selections from each of these categories. In addition, new topics are coming throughout the year, so the need for audits must be evaluated case by case."

NPI, J.V. (Helsinki)

"Our own purchasing specifications and product specifications must be on spot for the suppliers that are producing their own products. A good practice is to meet the counterparty face-to-face in case we do not have the exact specification known, in order to communicate the wants and needs better.

With our current main suppliers, we have to follow up actively the ongoing topics. This is both valid for the purchasing as well as for the manufacturing. If you are not receiving automatically the information (e.g. schedule, manufacturing, proto phase), question the supplier whether

everything is going as it should. On site visits are very important in order to make sure that the communication and feedback loop is working. Especially in the case of claims and faults, the message goes better when you are able to show face-to-face the mistakes that have been done and challenge how this has happened.

The contracts and frame agreements must exist and they have to be followed. The contract should state clearly what is the scope, expected outputs and schedules. In arguing situations, we are in trouble if the contracts have not been followed and expected the supplier to follow them too."

In the next chapter, a summary of the topics in this chapter, including summary of the interviews (in the Table 5) are presented.

3.4. Modeling the case company's work for the framework

The target of this chapter is to analyze the company's current methods of working and summarize the main challenges and improvement needs regarding the topic of this thesis. The case company has a wide range of methods and tools for the supply chain quality management. However, the methods are used depending on the people involved, and no framework of the methods exists. Similarly, interviews gave a lot useful information about what is working well and what are possible improvement needs currently in the company. This chapter includes two parts; the first part analyses the case company methods, and the second analyses the possible categories of company's suppliers.

This thesis uses the earlier presented Robinson and Malhotra's (2004) SCQM themes as a starting point for frameworking the company's methods. The target of the frameworking is to review whether all SCQM themes are covered by the methods. The summary of the coverage with the methods is shown in the Table 4.

Table 4. SCQM themes and case company methods

SCQM theme	Case company methods
Communication and partnership activities	Monthly meeting with steering group Everyday communication Audits
Process integration and management	Scorecards Product and process controls (manufacturers) Product and process controls (software suppliers) Claim process Improvement projects
Management and leadership	Contractual requirements Quarterly Business Reviews
Strategy	Supplier evaluation and development

Communication and partnership activities are covered in the case company by every day communication with the suppliers' counterparties, monthly meetings with steering groups and with audits. The coverage seems reasonable as there is involvement of all the relevant stakeholders and the time span of activities are from every day communication to once a year (or on needed basis) audits.

Process integration and management theme includes quantitative the most methods. Scorecards and product & process controls methods target are to follow the suppliers' common practices and the success rate of normal way of working. Claim process is built to have an agreed recovery process in case of non-conformities. Improvement projects are done more seldom but the outcome of these is pursued to be long-term.

Management and leadership theme contains contractual requirements and quarterly business reviews. Contracts are signed in the beginning of the cooperation and updated on needed basis. Management reviews are arranged four times a year to review the overall status and to discuss the future prospects of the companies. Also this theme is from my opinion covered enough. The

management is involved and their support can be used when needed. In addition, the contracts create the baseline for the cooperation.

Supplier evaluation and development (SED) is the only method in the strategy theme. SED is done for selected partners and its target is to give feedback to the supplier about its performance and agree together next improvement needs and actions. In my opinion, strategical selections are more of a company's internal activities, and that's why not in the main scope of the supplier cooperation. Therefore, also this theme is adequately covered.

As a summary, all the themes of the SCQM are covered quite well with the current existing methods of the company. However, not all methods are practical with all the suppliers as the general goal is to "make less work and get better results". Therefore, a creation of a framework is needed to categorize and guide on the usage of different methods for different types of cooperation.

In order understand and analyze which methods are important for each stakeholder and therefore to which kind of suppliers, the main messages from interviews are collected and summarized in the Table 5.

Table 5. Summary of comments to methods from interviews

Method	Main message	Commented role
Contracts, Frame agreements	"Long-term cooperation should be considered during the contract negotiation; not to concentrate only to price"	Sourcing manager
	"The frame contracts should define the ISO quality requirements as the quality baseline for the companies."	Buyer
	"The contracts and frame agreements must be state clearly the scope, outputs and schedules to avoid arguing situations"	NPI manager

Meetings with suppliers	"Regular meetings with suppliers are important. People entitled to make decisions must be present at the meetings"	Quality manager
	"On-site visits are very important in order to make sure that the communication and feedback loop is working."	NPI manager
Audits	"Yearly audits should cover different types of suppliers"	Head of Quality Finland
	"Audits and assessments are important methods for the approval of supplier production and practices"	Quality manager
Requirements	"Development phase requirements and phase-deliverables should be included always to suppliers designing products to us"	R&D HW manager
	"We should concentrate more on describing our requirements and expectations better to the suppliers."	Quality manager & Sourcing manager & NPI manager
Processes	"When everything works well by supplier, no additional work and methods are needed; order confirmations and price changes runs itself."	Buyer
	"I find it good that the case company's processes are not that detailed, which makes it possible to be more flexible and to adapt to the different needs of different suppliers."	Sourcing manager
	"The difficulties rise when several sourcing managers are involved with the same suppliers, as each sourcing manager is selecting the way of working with suppliers."	Sourcing manager
Product and process controls	"Feedback sharing in the proto phase with suppliers is very important"	R&D HW manager
	"In case of quality issues, a good practice is to gather together with all the parties (e.g. supplier, sub-supplier and customer) and discuss together the root cause of the faults and how improvements could be	Quality manager

	done." "We have to follow up actively the ongoing topics, and question the supplier whether everything is going as it should. Especially in the case of faults, the message goes better when you are able to show face-to-face the mistakes that have been done and challenge how this has happened."	NPI manager
Improvements	"Brainstorming workshops a good practice"	R&D HW manager
Claim process	"When a claim is resolved correctly and in a good timely matter, the proactive resolving gives good sign about the supplier to us, and the loyalty is increased." "We should support in case of quality issues, but not be involved too much in the fault management process."	Buyer Quality manager

As seen from the table, different stakeholders are emphasizing the different topics and needs for the cooperation. Buyer and sourcing manager is treating the suppliers in the same kind of way, whereas quality people and R&D manager are categorizing the suppliers more and analyzing different methods deeply. This outcome will be used in the framework creation, and the dividing for the different categories can be partly explained by this.

Similarly, the categorization of the suppliers were handled differently by different interviewers depending on the role they were representing. The Head of Quality divided the type of suppliers into three categories; product manufacturers, sub-project subcontractors and to subcontractors working according to the case company processes. The R&D HW manager divided their cooperation with suppliers into two categories; manufacturers who produce products based on case company's own design and drawings, and other suppliers, who make the design based on case company's specifications. The sourcing manager was categorizing the suppliers more based on the volume of the orders. In general, buyer was regarding all the suppliers same way, and for him the difference was seen more on the flexibility of the supplier.

As a summary, there was not a common view of the categorization from the viewpoint of different stakeholders. But with combining all the views together, a categorization of suppliers can be drawn to four different types:

1) *Manufacturers of customer specific products*: These are the suppliers, who manufacture case company's products based on the given design and drawings.
2) *Manufacturers of generic products (with possibility to modifications)*: These are the suppliers, who are either manufacturing generic product (Commercial-Off-The-Shelf) to the case company, or are manufacturing products to the case company with slight modifications to their generic portfolio products
3) *Designers of customer specific products*: These are the suppliers, who make design (either software, hardware or both) based on the case company's specifications and create specific products or sub-products in a project
4) *Designers of generic products (with possibility to modifications)*: These are the suppliers, who make design (either software, hardware or both) generic products to the case company, of make slight modifications to their generic portfolio in providing (sub-)products to the case company

Each of these categories are looked deeper in the Results section when generating the Framework model for the case company.

4. SCQM MODELS FROM LITERATURE

In this chapter, three models from previous SCQM studies are chosen and presented. The models are selected based on their possible relevance towards this study. Each of the selected articles were cited a lot by other articles, which also shows the importance and validity of the study. The third selection criteria was to select different kinds of articles that review the results of the different sides of the supply chain quality management, cooperation with suppliers and outcome of cooperation to quality performance. In addition, each SCQM study presented a clear outcome of the study and the effects of the selected attributes. Based on this, a basic model of the study's outcome was drafted in this study. Next, each model is presented, and its strengths, weaknesses and the relevance regarding this thesis scope are analyzed.

4.1. The impact of supply chain relationship quality on quality performance

4.1.1. Summary of the article

Fynes et al. (2004) study in their article "The impact of supply chain relationship quality on quality performance" whether it is possible to measure the multi-dimensional nature of supply chain relationships. If the answer is positive, their second focus is to study what is the effect of supply chain relationships on quality performance.

The researchers Fynes et al. (2004) developed a framework about chosen dimensions of supply chain relationships and quality performance. After that, a data survey was performed with 200 suppliers in the electronics branch in the Republic of Ireland. The framework was tested against the outcomes of the survey. In short, the developed framework was supported by the answers from the data survey.

The researches of the article base their model to six dimensions of supply chain; trust, adaptation, communication, dependence and interdependence, commitment and cooperation. According to the earlier studies, these same dimensions are used in different models and therefore seem to be the dependent factors. According to the article, the studies about SC relationship frameworks in

Europe, especially in Scandinavia, and in North America vary a lot, mainly because of the differences in research traditions, industry structures and socio-economic factors. However, both parties share these six dimensions (Fynes et al., 2004).

Fynes et al. (2004) define the trust as the most used dimension of SC relationship in the literature. Trust can be divided to contractual trust, competence trust and goodwill trust. Adaptation is an essential factor, as both suppliers and customers need to adapt to the needs and capabilities of each other. In order to succeed, effective communication is an important dimension. Dependence and interdependence stands for a firm's need to maintain the partnership to achieve wanted goals. Commitment on the other hand measures the future orientation and willingness of a company to build relationships with certain partners. The last SC relationship, cooperation, refers to companies working together to achieve commonly shared goals.

The conceptual framework of the article is based on six hypotheses. The first hypothesis states "Supply chain relationship quality (SCRQ) is a higher order latent construct reflective of the dimensions of communication, trust, adaptation, commitment, interdependence, and cooperation" (Fynes et al., 2004). The second and third hypotheses argue that SCRQ has a positive effect on conformance quality (H2) and on design quality (H3) (Fynes et al., 2004). Hypotheses four to six relate to different quality definitions. The fourth and fifth state that design quality has a positive effect on conformance (H4) and on customer satisfaction (H5) (Fynes et al., 2004). The sixth hypothesis tests whether conformance quality has a positive effect on customer satisfaction (Fynes et al., 2004). Figure 7 shows a simplified structural equation model from the article.

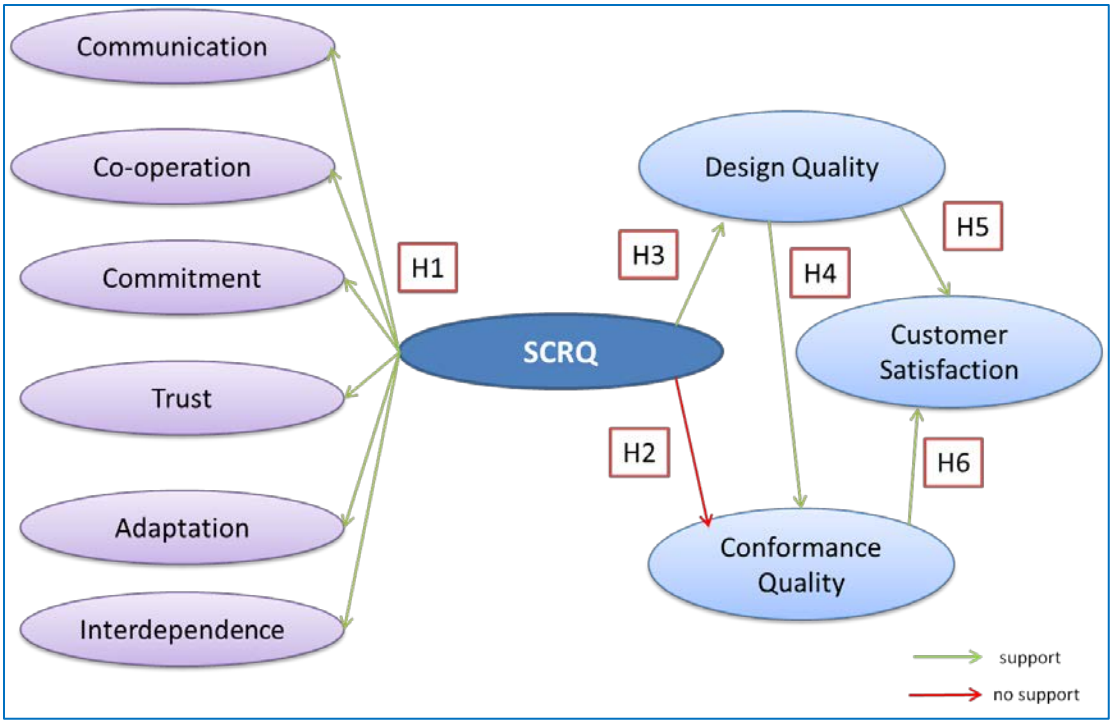

Figure 7. Simplified Fynes' et al. structural equation model operationalizing framework

To test the hypotheses, researchers Fynes et al. (2004) use a single-step analysis of both measurement and structural models by using AMOS 4. A confirmatory factor analysis (CFA) was used to check the model. The CFA showed significant and strong support for H1. The other dimensions except interdependence showed high and significant results with standardized loading over 0,6. The researchers argue that also the interdependence can be kept in the model as the factor loading of 0,531 is "reasonably high". The other hypotheses were estimated with standardized path estimate values. The results supported hypotheses H3-H6 but not H2 (SCRQ → conformance quality). The H3-H6 got high standardized path estimate values (γ>0,20) and showed significance (t>1,96).

The outcome of the Fynes et al. (2004) study is that SCRQ has a positive impact on design quality but not on conformance quality. The researchers indicate that the reason for conformance quality could be that it is anyway a basic competitive requirement, which is needed regardless of SCRQ. In summary, the article proposes that mutual trust and commitment are important SC factors for management. They also advice suppliers to be involved early in the product design

and development processes. This will improve design quality and that will affect positively to other performance measures as well. As a final statement of the discussions, the article arguments that quality performance is not only the outcome of quality practices but also by management focusing on SC relationship will improve the quality of the products.

4.1.2. Analysis of the article for this thesis

Fynes et al. (2004) tested a model made by researchers on the effect of SC relationships on quality performance in the article "The impact of supply chain relationship quality on quality performance". The model was tested with 200 suppliers by asking their perceptions on the use and relationships of the focal or "most important" customer. Regarding the study of this thesis, the results and the content of the Fynes et al. (2004) article reflect the most the strategic items of Krajlic matrix (as presented in chapter 2.2.3) and the first presented theme of SCQM, "Communication and partnership activities" (from chapter 2.3.2). Based on the results of the data, the writers of the article give also recommendations to SCQM themes "Management and leadership" and "Process integration and management".

A strong point from the article is that it is one of the first studies where the quality performance is examined from the supply chain relationships point of view, not from quality practices point of view. This gives the view point that is wanted also for this thesis and for constructing the overall model.

As a limitation of the article, as well as for constructing the model in this thesis, the questionnaires are asked only from suppliers, not from customer. The questionnaire and data is therefore predictions of the suppliers of "what their customers appreciate and what is the effect to the quality". That's why it feels quite logical, that the suppliers feel the earlier they are in the process with the customer and may affect to the design choices, the better the design quality. This was also seen from the data; the hypothesis H4 and H5 ("Design quality to affect conformance quality and customer satisfaction") got the highest standardized path estimate values (>0,5 vs. ~0,3) from other supported hypotheses. On the other hand the suppliers usually have more experience on the manufacturing the items, so they can improve the design when given a possibility.

As the hypothesis H2 of SCRQ having a positive effect on conformance quality was not supported, it can be concluded that conformance quality is a characteristic for all supplier relationships and quality blocks, in the Krajlic matrix terms from non-critical items to strategic items.

From the dimensions of SC relationships, communication and trust got the highest standardized loading values (>0,8 vs 0,53-0,75). Also the segmentation of different types of trust can be possible utilized in the creation of the model; contractual trust to belong in every relationships, competence trust to a higher level relationships, and goodwill trust to have in the most important relationships to enhance the quality of the products.

It is also very important to understand and notice the argumentation of the article of quality performance to be dependent both on quality practices but also by management focusing on SC relationships. That is also a reason why the second presented theme of SCQM "Process integration and management" is only one theme of the whole puzzle.

4.2. What type of cooperation with suppliers and customers leads to superior performance

4.2.1. Summary of the article

Brito et al. (2013) study in their article "What type of cooperation with suppliers and customers leads to superior performance" how cooperation affects to financial performance. The research evaluates four different cooperation types between supplier and customer, and analyses how these cooperation methods affect to supplier and to customer profitability and growth.

The researchers Brito et al. (2013) developed a questionnaire based on the four selected cooperation types from literature and based on two dimensions of financial performance, profitability and growth. The questionnaire was iterated in two rounds; first with a semi structures qualitative interviews with six experts and then with 40 industry practitioners. After that, 124 Brazilian packaging manufacturers answered to the questionnaire by rating the

agreement of statements using a five-point Likert scale. The cooperation part was asked to be evaluated by averaging their three most relevant suppliers and customers, and in the financial part, the comparison was asked to be done against their main competitors.

Brito et al. (2013) mention that most of the studies regard cooperation as unidimensional. However, the authors argue that cooperation is more complex. That's why in this study they are using originally Heide and Miner's (1992) segmentation of cooperation into information exchange, flexibility, joint problem solving and restraint in the use of power. Information exchange is defined as "sharing both proprietary and public information, as well as unplanned, voluntary, and informal communication" (Brito et al., 2013). Flexibility specifies how much the stakeholders are willing to adjust their own behavior to accommodate the needs of others (Brito et al., 2013). Joint problem solving is assessed the search for solutions and the acceptance of shared responsibility for undefining problems (Brito et al., 2013). Lastly, the restraint in the use of power is defined as "degree to which agents refrain from taking advantage of opportunities that may negatively affect partners" (Brito et al., 2013).

This study is based on four major hypotheses that each are divided into two parts. The first hypothesis of Brito et al. (2013) states, "Flexibility in the relationship between *producer and supplier* promotes producer superior performance" (H1a). Similarly, the second major hypothesis treats the same idea from customer relationship point of view stating, "Flexibility in the relationship between *producer and customer* promotes producer superior performance" (H1b) (Brito et al., 2013).The other six hypothesis follow the same pattern. Hypotheses H2 study the information exchange's affect to superior performance between producer and supplier (H2a), and between producer and customer (H2b). Thirdly, restraint in the use of power is reviewed in the same way (H3a and H3b). The final hypotheses are studied from the shared problem solving point of view, again viewing the situation between producer and supplier (H4a) and between producer and customer (H4b) (Brito et al., 2013). The superior performance of a firm is divided in this study into two parts; to profitability and growth (Brito et al., 2013).

Brito et al. (2013) makes the data analysis in two steps. The first step is made by using confirmatory factor analysis (CFA) to establish dimensionality, validity and reliability of the

constructed cooperative behaviors. Then ordinary least squares (OLS) model is used to test the hypotheses about the dimensions of the cooperation and financial performance. The results of the study are presented in the form of tables and numbers in the article. In order to give just an overall understanding of the hypothesis and their outcomes, a simplified model is created for this thesis and presented in the Figure 8.

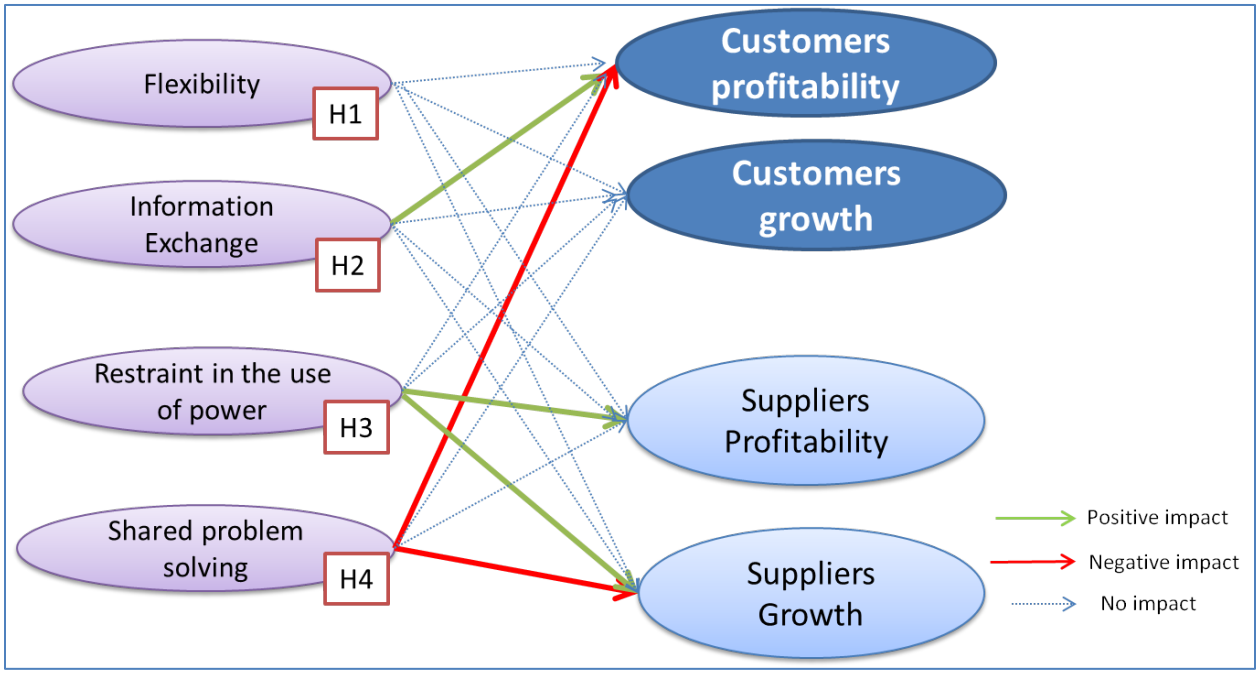

Figure 8. Brito et al. Cooperation type's effect on customer and supplier performance

Outcome of the Brito et al. (2013) study shows that different types of cooperation types and different results. Most of the hypotheses show no impact to customer or to supplier's financial performance. Flexibility has no significant effect on profitability or growth. Information exchange shows positive effect on customer's profitability, but however no impact to growth. Restraint in the use of power has a positive effect both to supplier's profitability and to growth. Finally, shared problem solving shows negative effects to financial performance. Shared problem solving has a negative effect to customer's profitability as well as to supplier's growth.

4.2.2. Analysis of the article for this thesis

Brito et al. (2013) study in their article ”What type of cooperation with suppliers and customers leads to superior performance” different cooperation types’ effect to financial performance. The article relates directly to the SCQM theme “Communication and partnership activities” even though the comparison is made against companies’ profitability and growth.

There are multiple benefits from the article and its results to this thesis. Firstly, the study covers both supplier and customer point of view, and therefore shows the differences in the outcome of a same action towards the customer and the supplier. Secondly, the article does not only measure the benefits of various SCQM related cooperation types but links them also to financial results. This is generally always the case in the private sector businesses, like in the case company. Quality related actions and improvement should show the benefit both to the product, but especially to the customer satisfaction and therefore to improved financial results of the company. Thirdly, the study is quite new (from 2013), so it can presume to represent the present day requirements and way of working well.

As a limitation of this study to this thesis, the field of business and the geographical area of the survey are not same. In the article, the survey was made for packaging manufacturers in Brazil. The case company operates more in Europe and Asia. However, I believe, that the results of the Brito et al. (2013) study could be quite the same if the survey group would have been more international. A bigger difference is the field of business. Even though some of the case company’s suppliers are from the packaging industry, it’s still a minority. The case company’s field of business is somewhat more demanding for the suppliers, as the security related products require a high level of quality and endurance. In the product development and prototyping phase the results could show bigger differences to the results of Brito et al. (2013) study, but when the case company’s products are in the maturity phase, then the standard processes could be imagines to be similar kind as in the packaging industry.

In general, this study gives good observations to this thesis. Cooperation cannot be handled as a unidimensional topic as different cooperation types gives different outcomes. Even though the main scope of this thesis is to consider customer-supplier cooperation from quality point of view,

the results should always benefit the financial performance. Lastly, same cooperation method may give different positive or negative results towards customers and suppliers. Even though the main focus point here is the case company in the role of a customer, both standpoints have to be considered.

4.3. Supply chain quality management practices and performance: An empirical study

4.3.1. Summary of the article

Zeng et al. (2012) article "Supply chain quality management practices and performance: An empirical study" proposes a multidimensional framework to study three dimensions' relationship in the supply chain quality management. The dimensions', internal quality management (QM), upstream QM and downstream QM, relationship impact is tested against each other, and against two types of quality performance; conformance quality and customer satisfaction.

According to Zeng et al. (2012), internal quality management consists of in-house quality management practices such as internal design reviews, monitoring of internal quality processes and quality related trainings in the company. Upstream QM is defined by the researches of the article as interaction for quality with suppliers on the upstream side of supply chain. Upstream QM includes for example long-term relationships with suppliers, supplier certification and suppliers involvement in quality improvements (Zeng et al., 2012). Similarly, downstream QM is the interaction for quality with customers on the downstream side of supply chain (Zeng et al., 2012). Tasks such as frequent meetings with customers, encouragement of customer feedback on quality and use of customer needs survey belongs to downstream QM (Zeng et al., 2012).

The proposed framework is validated by using structural equation model (SEM). A broad survey through an international joint research, "High Performance Manufacturing" is covering 283 plants. The data of Zeng et al. (2012) study covers three industries; electronics, machinery and automobile, and the interviews were asked from eight countries (US, Japan, Italy, Sweden, Austria, Korea, Finland and Germany).

The first part of the proposed framework consists of the segmentation of internal QM. The authors divide the internal QM into six QM practices based on an extensive literature review. The practices are top management leadership, strategic planning, quality information, process management, workforce management and product design (Zeng et al., 2012). Top management leadership is defined by the authors as an "involvement in and constant commitment of the company top management in all its functions to quality improvement". Strategic planning related tasks aim to design internal functions to match with company's mission (Zeng et al., 2012). Quality information's target is to have information available on quality performance and productivity to all people in the company (Zeng et al., 2012). Process control related tasks, preventive maintenance and housekeeping are functions in the process management (Zeng et al., 2012). The fifth internal practice, workforce management, takes the employees in account by giving quality related trainings and involving employees into quality circles and other improvement projects (Zeng et al., 2012). The last practice of internal QM in this framework, product design process, aim is to involve and cooperate all needed internal stakeholders in design reviews (Zeng et al., 2012).

The multidimensional framework of the article is based on eight hypotheses. The first hypothesis states that "Internal QM has a positive impact on upstream QM" and the second hypothesis is that "Internal QM has a positive impact on downstream QM" (Zeng et al., 2012). Similarly, next hypothesis state the positive impact on upstream QM on conformance quality (H3) and on customer satisfaction (H4) (Zeng et al., 2012). Next, the positive impact of internal QM towards conformance quality (H5) and customer satisfaction (H6) is studied (Zeng et al., 2012). Lastly, the downstream QM's positive impact on conformance quality (H7) and customer satisfaction (H8) is put as hypotheses (Zeng, et al., 2012).

As a summary, hypotheses H1-H2, H5-H6 and H8 were supported. This means that internal QM has a positive impact on all the areas studies; both to upstream and downstream QM, and to conformance quality and customer satisfaction (Zeng et al., 2012). On the contrary, upstream QM did not seem to have impact on conformance quality or on customer satisfaction (Zeng et al., 2012). In downstream QM, a positive impact on customer satisfaction was supported, but not on conformance quality (Zeng et al., 2012). Also from conformance quality point of view, only

internal QM has a positive impact, whereas upstream QM and downstream QM do not effect on the conformance quality (Zeng et al., 2012). Figure 9 shows the proposed model with its hypotheses and their results from the article.

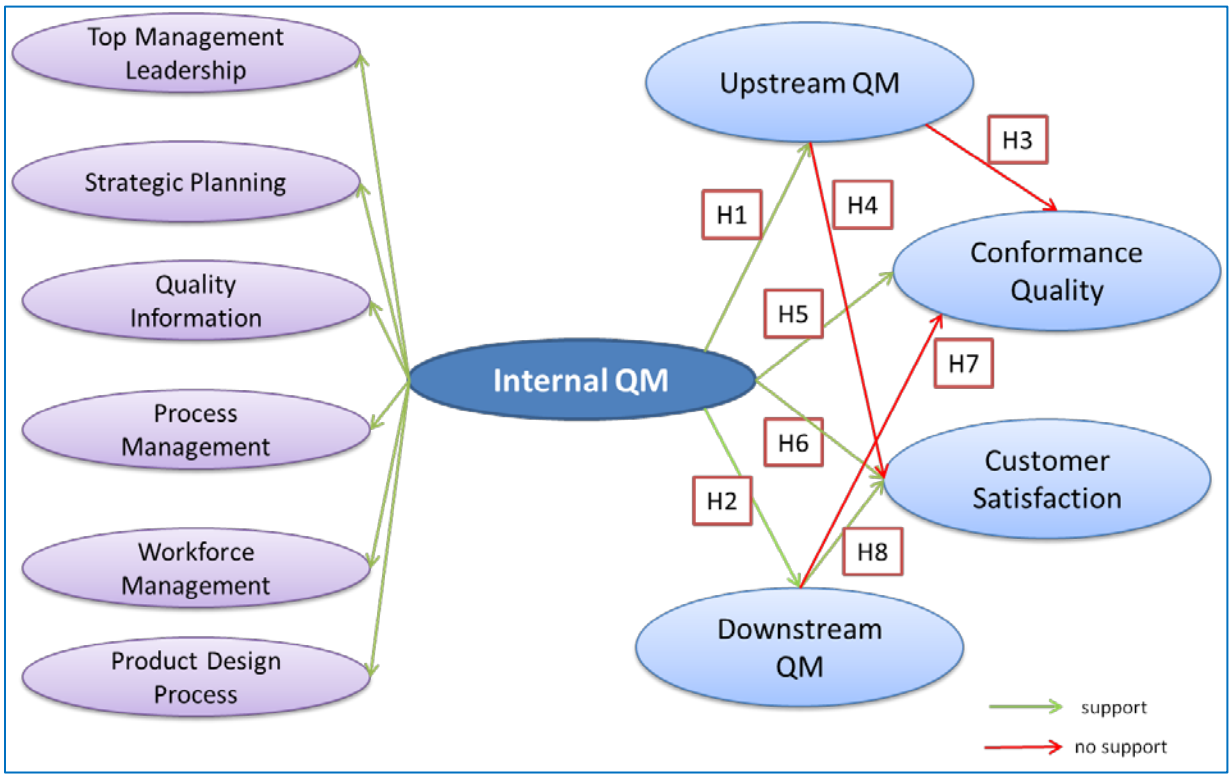

Figure 9. Zeng et al. proposed model of three dimensions relationships of SCQM

As an outcome of the Zeng et al. (2012) study, internal QM seems to be the key driver for SCQM. That's why it is vital to understand the importance of effective implementation of internal QM within individual supply chain members. The study also noticed that downstream integration with customers for quality brings benefits on the customer satisfaction.

4.3.2. Analysis of the article for this thesis

Zeng at al. (2012) study "Supply chain quality management practices and performance: An empirical study" proposed a conceptual framework to study the three dimensions – internal QM, upstream QM and downstream QM - of SCQM with the impact on conformance quality and customer satisfaction.

This article gives a very good reference to this thesis because of their equivalency. Both the sector and geographical location give a good match against this thesis as electronics was one of the three sectors under the study and in addition, Finland was part of the survey. The survey, and therefore the Zeng's et al. study covered also many other countries which gives good viewpoint for the differences for case company's different suppliers (around the world) in this thesis. The article is written only few years back in 2012, so it can be reasonably assumed that the results of the survey are still valid.

The classification of SCQM and internal quality management practices is done a little bit differently as presented earlier in this thesis, the mapping in the title level can be easily done and therefore can be said to be similar. Even though the scope of this thesis is to study only the upstream QM (by using the terminology of this article), it's good that the article brings both viewpoints in to the consideration as the survey is asked from plant managers, which in this thesis are the supplier's managers.

As a limitation of the research and its results, the results are based on the survey that asks manager's opinions about their plant. Therefore, there is no objective data based on the answers. As a limitation to this thesis, the viewpoint of this study is from the plant's point of view. For this thesis it hence means that the suppliers are asked, and the customer of the survey was then the case company of this thesis. On the other hand, the results of the article can be used exploited, as no survey for suppliers is made in this thesis.

This study gave somewhat conflicting results with the thesis assumptions about the upstream quality management from the original hypothesis for this thesis. The original assumption was that the way the case company acts towards its suppliers plays a crucial role from quality point of view. Based on this survey, there is no benefit with the long-term relationship with suppliers or of involving supplier in the product development and quality improvements for the conformance quality or to customer satisfaction. For this thesis, these observations from the article mean that the case company should concentrate on its internal quality management. In addition, the case company should require and verify that their suppliers' own internal quality management is as

functional and efficient as possible. This way also the case company's satisfaction towards suppliers remains high.

4.4. Proposals from the literature models for the framework

In this chapter, three different studies about supply chain quality management were presented. Even though the selected articles were studying the supply chain quality management from different scopes and viewpoints, similarities in the outcomes and lessons are seen.

Fynes et al. (2004) studied in their article "The impact of supply chain relationship quality (SCRQ) on quality performance" whether it is possible to measure the multi-dimensional nature of supply chain relationships and what is the effect of supply chain relationships on quality performance. As the outcome, the SCRQ showed positive effect to design quality but not to conformance quality. In addition, customer satisfaction was positively affected by design and conformance quality.

Brito et al. (2013) studied in their article "What type of cooperation with suppliers and customers leads to superior performance" how cooperation affects to financial performance. The research evaluated different cooperation types between supplier and customer, and analyzed how these cooperation methods affect to supplier and to customer profitability and growth. As a result, most of the cooperation types did not show impact on financial performance. Customers' profitability was positively impacted by information exchange and negatively impacted by shared problem solving. On the other hand, suppliers' financial performance was positively influenced by restraint in the use of power and negatively by shared problem solving.

Zeng et al. (2012) article "Supply chain quality management practices and performance: An empirical study" proposed a multidimensional framework to study three dimensions' relationship in the SCQM. The dimensions', internal quality management (QM), upstream QM and downstream QM, relationship impact was tested against each other, and against two types of quality performance; conformance quality and customer satisfaction. Internal QM affected positively against all four measurements, whereas upstream QM showed no effect neither to

conformance quality nor customer satisfaction. Downstream QM showed support to customer satisfaction.

Combining the results and the proposals of the three studies, following guidelines can be drawn:

1. Concentrate mostly on company's internal quality and its processes
   All three studies showed that internal quality management has the biggest impact on quality performance. Internal QM affected positively towards both design and conformance quality, as well as to upstream and downstream quality management.
2. Ensure that suppliers' internal processes work
   Downstream and upstream quality management, i.e. involvement with suppliers and customers do not have an influence on conformance quality. Therefore the first finding can be interpreted also so, that customers should ensure that their suppliers' internal quality management is in place and not be itself too much involved with their practices.
3. Devote to Quality management as it increases customer satisfaction
   Customer satisfaction is positively impacted by design and conformance quality. Internal QM and downstream QM also influence positively customer satisfaction. So therefore, quality management does pay off.
4. Involve suppliers already in the design phase
   Studies show that early involvement of suppliers in the product design and development processes will improve design quality that will affect positively to other performance measures as well.
5. Have clear responsibilities and assign problems to right party
   Shared problem solving has a negative impact both to supplier and to customer profitability according to the referred studies. The practical proposal here is to have clear requirements, such as contracts and other documentation, and in case of problems, an agreed claim process in place.
6. Invest to information exchange
   Information exchange and communication showed positive effects in all three studies. It benefits customer profitability and customer satisfaction. Communication was also rated

as a very important supply chain factor. Thus, common meetings and other information exchange methods are valuable.

7. Understand your power as a customer

   Restraint in the use of power impact positively to suppliers profitability and suppliers growth. In general this means that suppliers are positively impacted when customers refrain from taking advantage of opportunities that may negatively affect partners. As an example, if a customer is satisfied, it can add volumes at the supplier (and therefore reduce the use of other suppliers) and praise the supplier to other potential customers.

8. Nurture the supply chain relationships with mutual trust and commitment

   Mutual trust and commitment were seen to be the most important SC factors for management. It should be noted that quality performance is not only the outcome of quality practices but also management focusing on SC relationship will improve the quality of the products.

9. Understand and segment the relationship levels of different suppliers

   A cooperation model should be selected based on the supplier importance to the customer. Same methods are not valuable to every relationship. As an example, contractual trust belong in every supplier relationships, competence trust to a higher level relationships, and goodwill trust to have in the most important supplier-customer relationships to enhance the quality of the products.

As a summary, it can be concluded that the framework for the case company cannot be directly created from these findings. All the reviewed researches in the literature in the field of SCQM were studying and showing the effects of certain attributes to the supplier cooperation, product quality and customer satisfaction. However, when the framework model is created in this thesis, the validity is checked and evaluated against these proposals from the literature.

5. RESULTS

This chapter combines the earlier presented topics to the form of results. This chapter exploits the previous chapters' outputs and the builds up the supply chain quality management model for the case company. The first sub chapter describes the overall idea for the Quality Management Framework to the case company. The next subchapters go deeper into the model by presenting the layer 1 and layer 2 of the framework. The fourth subchapter validates that the summaries of the earlier findings of this thesis are used with the Framework.

5.1. Quality Management Framework to the case company

The main target of the Quality Management Framework to the case company is to define a high level the way of working and procedure with different kinds of suppliers. This allows the organization to be sure that the main needed quality assurance methods are used in the supplier management in an efficient way. Also for individuals in the company, the framework gives instructions what are expected from them and gives guidelines for best practices.

The definition of quality in this thesis was selected as the conformance to specifications and meeting or exceeding customer expectations. This definition is supported by the different SCQM studies and their results. However, the SCQM studies and the models presented do not give a good starting point for the framework generation in this thesis, as they were studying only how certain attributes affect to the supply chain quality management. Therefore, the reference for the framework is taken more from different models presented in the chapter of subcontracting.

The basic principle for the model of the company matrix is following the earlier presented Krajlic matrix and its principles. In addition, the Purchasing Chessboard's® layer model is utilized in this company model. The first layer of the Framework divides the suppliers in the different categories based on the type of outputs they are offering to the company, and based on the complexity and/or newness of the product. As justified before in the chapter 3.4., the categories are

1) Manufacturers of customer specific products

2) Manufacturers of generic products (with possible modifications)
3) Designers of customer specific products
4) Designers of generic products (with possible modifications)

The layer two is built by following the Purchasing Chessboard's® model that the lower levels of the framework are describing the way of working more in detail. The topics selected for this Framework are following the same themes as in Robinson and Malhotra (2004) in their article "Defining the concept of supply chain quality management and its relevance to academic and industrial practice". Therefore, the themes are strategy, management, process integration and communication activities. The preferred methods to be used for different types of suppliers are selected based on the case company's current methods and case company stakeholders' interviews.

The purpose of the model is to give guidelines to company's internal stakeholders about the cooperation with suppliers. Therefore, for each case the actual cooperation model and methods can be tailored from the proposed category, but the differences must be justified and recorded to a document.

5.2. Quality Management Framework Layer 1

In order to keep the model usable and simple for various stakeholders, layer 1 is divided into four categories. The x-axis categorizes the model by the complexity and newness of the product from low to high, and the y-axis is defined by the type of purchase ranging from manufacturing to design. Figure 10. describes the company model layer 1. Next, each category is presented with its target and examples of product types.

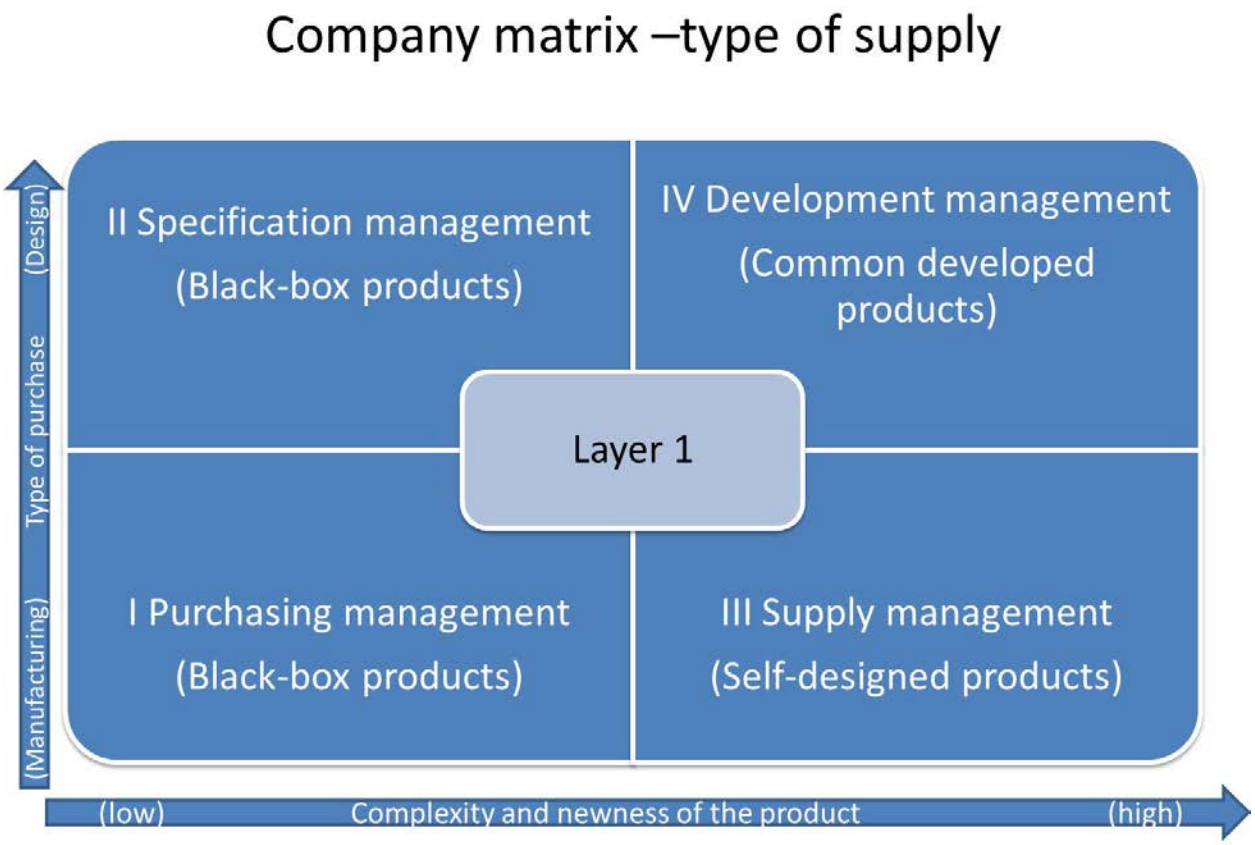

Figure 10. QM Framework Layer 1

I Purchasing management

Purchasing management strategy is used for manufacturing products which complexity and newness is low. In principle, this means products that the company is buying from other vendors directly without doing any, or only minor, additional modifications to the product. That is why these can be called as black-box products; the company is mainly interested only the outcome of the product. The target of this category is to minimize the additional work and follow-up by the company and get the ordered products with minimum effort to work with the main products.

Main categories that belong to this group are server products and basic components as sub-assembly products. The company is buying commercial-off-the-shelf (COTS) servers from HP and other vendors for example to the dispatching products. Also basic accessories such as additional cables and filter materials are part of this group.

II Specification management

Specification management strategy is used for designed products which complexity and newness is low. In other words, this means the software or hardware products that the company is buying from its subcontractors as "black box" products. In specification management type of cooperation, the company specifies the requirements for the end product and for the end documentation, but the subcontractor is responsible to use their own development and quality processes. The target of this category is to ensure that the common understanding of the output and its quality level is same but to leave the development phase as much as possible to the subcontractor. Usually this means that the case company needs to invest to specification and approval verification phases.

Main categories that belong to this group are new software products or new versions of products that are considered as "additional features or products" to the basic portfolio. Example products that are within the specification management group are network management tools, 3rd party applications and accessories.

III Supply management

Supply management strategy is used for the manufactured products which complexity and newness is high. In general, this means products that the company is specifying and designing by themselves and then delivering the specifications and drawings to manufacturers. The target of this category is to be involved in the whole life cycle of the product and therefore additional effort is needed with the chosen suppliers.

Main categories that belong to this group are the main portfolio products such as basestations and its units. The company is using long-term suppliers for these kinds of main products. This is

needed as the knowledge and skill level to produce the products is high and requires long-standing experience. This way also the company is able to gain good feedback and improvement proposals from the manufacturers and can make improvements to the manufacturability and usability of the designed products.

IV Development management

Development management strategy is used for designed products which complexity and newness is high. In general, this means products that are considered as main portfolio products or have an effect to several features or products. The company has two kinds of subcontractors in development management category; subcontractors that are working directly according to company's development and quality processes and subcontractors, that are working according to own company processes but are delivering agreed phase deliverables throughout the design and development for case company's review and verification.

Main categories that belong to this group are the new areas of portfolio in which the company do not have good enough knowledge of its own. The newness may be usually because of new technology "conquest" or because of a new development platform. The target of this category is to be closely involved in the development with the subcontractor and assure that the cooperation works smoothly. Usually the cooperation requires that both parties are sharing their knowledge and teaching the other party unknown topics.

5.3. Quality Management Framework Layer 2

Layer 2 uses as a starting point the Purchasing Chessboard® and the four SCQM themes by Robinson and Malhotra (2004). The purpose of the second layer is to give more detailed guidelines of the different topics that must be covered, and to propose the main methods to work according to the guidelines. The y-axis categorizes the model by the four SCQM themes; strategy, management, process integration and communication activities. The x-axis is the same both in layer 1 and in layer 2, and describes the complexity and newness of the product. Figure

11.shows the company model layer 2. Next, each category is presented with its themes and proposals for the methods used for the themes. Here, also the fifth SCQM theme “Best practices” is added to describe one case example of the category.

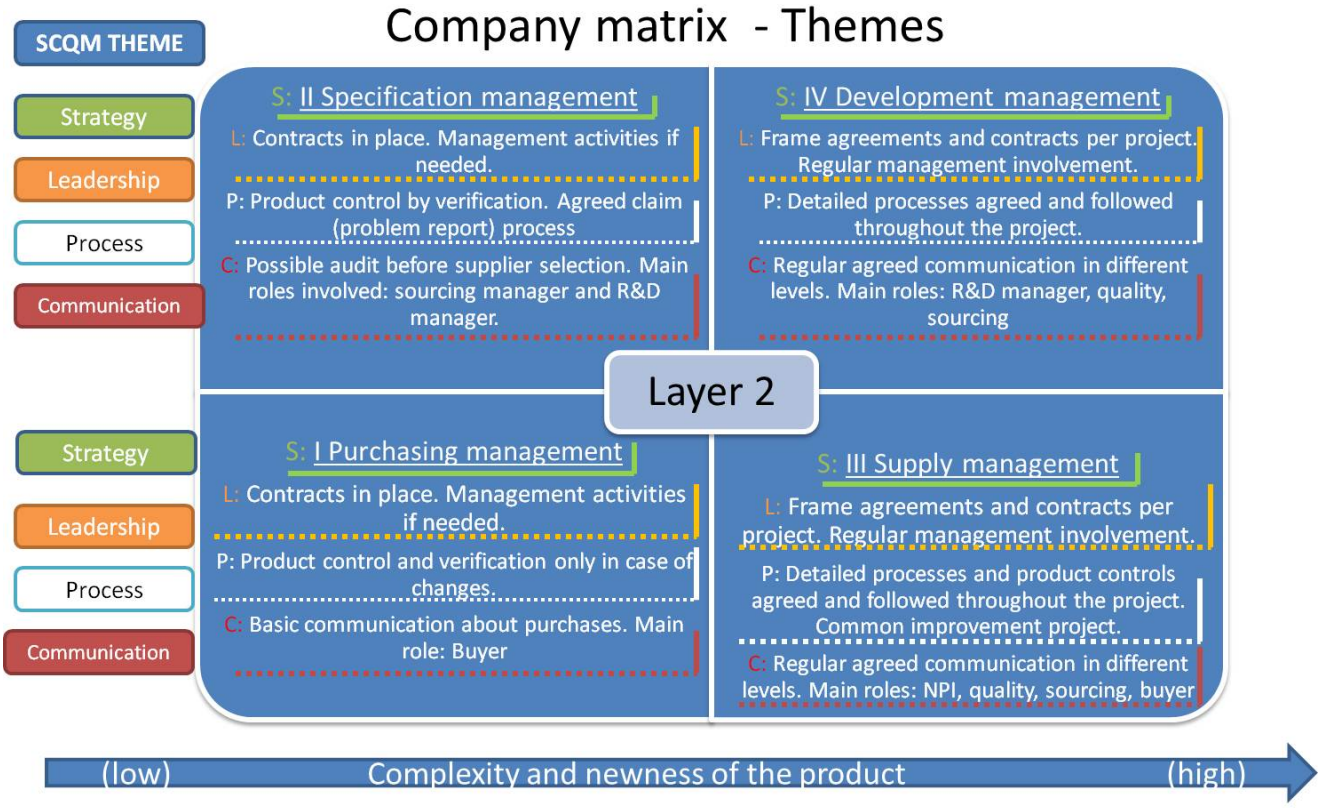

Figure 11. QM Framework layer 2

I Purchasing management

Leadership: In purchasing management category, the target of the leadership is to have contracts in place, which allows the other processes to work as smoothly and with minimal effort as necessary. When the contracts include regulatory and other mandatory requirements, management involvement is needed only if there are big problems with the supplier and the cooperation is wanted to be continued also in the future.

Process: Process control and verification activities are needed in the beginning of the cooperation to assure that the purchased products fit to the company's system environment. Otherwise, verification activities are done only in the case of changes.

Communication: Also the level of communication is kept at "only when necessary" level. That is why the main party operating with purchasing management type of companies is the buyer, who is making the purchases and following the delivery accuracy. Other roles, such as sourcing manager and R&D specialists are taken into process only when needed.

Best practice: Case company's roadmap of the servers follow the general roadmap of the commercial-off-the-self servers. The generic contracts are in place with the server manufacturer. Buyer is ordering the products based on the demands and following the delivery accuracy. When a new server variant is introduced by the server company, R&D specialists are verifying the suitability against of case company's applications and then a new variant is added to the portfolio.

II Specification management

Leadership: Like in purchasing management category, also in specification management category, the target of the leadership is to have contracts in place, which allows the other processes to work as smoothly and with minimal effort as necessary. When the contracts include regulatory and other mandatory requirements, management involvement is needed only in cases, there are big problems with the supplier and cooperation is wanted to continue.

Process: In this category, the beginning and the end of the project are the most important phases from the case company perspective. The company needs to specify in detail what is expected and wanted from the product and from the subcontractor's process. Process control activities are needed in the end of the project, before the final delivery of the designed product. Verification is assuring that the output from the subcontractor is as agreed. In order to report and follow the status of the findings efficiently with subcontractor, a claim (problem report) management process need to be agreed and placed accordingly.

Communication: In order to work efficiently with this category type of subcontractors, the selection of the supplier has to be done carefully. That's why the need for audit has to be considered. Otherwise, sourcing manager and R&D are the main roles involved in the cooperation with suppliers to make sure the contracts and requirements are fulfilled accordingly.

Best practice: The case company is using a couple different subcontractors for the network management system development. The frame agreement states the general requirements of the contract and the project specific contract defines the topics related the current project, done by the sourcing manager. In the selection phase of a new subcontractor, or in the beginning of a new project, a quality audit is held to check that the subcontractor is fulfilling all the basic requirements of the quality management, development processes and legal and security requirements. The R&D project is making the detailed specification in the beginning of the project and agreeing with the subcontractor about the way, content and period of status reporting. In the end of the project, the case company is verifying the solution in the real system in the acceptance testing and reporting the findings as agreed in the beginning of the project.

III Supply management

Leadership: The target of the supply management category is to build good and long-lasting relationship with the suppliers. Therefore, frame agreements must be agreed and signed that the product specific contracts can be placed efficiently when needed. Management should be regularly involved, for example in participating to Quarterly Business Reviews and discussing the current status and future outlook of the companies.

Process: In this category, detailed processes and product controls should be agreed with the supplier. These processes are followed regularly together with suppliers. In addition, common improvement projects are launched to enhance the efficient way of working and especially to assure the quality of the end products.

Communication: Frequent and open communication is a key to success in this category. Regular meetings and other communication methods are agreed in different levels of the cooperation. Supplier is reporting the status based on the agreed metrics in the scorecards. Audits are organized in agreed intervals to check that agreed processes and practices are followed. Main roles involved are NPI, quality, sourcing and buyer.

Best practice: The case company is having a long-lasting cooperation with one of the main manufacturers. There is frequent communication between different parties and different levels; the contracts are updated when needed. The top management is having common meetings every quarter. The middle management is having monthly meetings to follow the status of the deliveries, quality, new products and other agreed topics such as buffer levels. Quality audit is organized every other year to check that the agreed practices are in place and followed. New product development projects are having weekly meetings with the supplier to share and check the status, and to share ideas for tricky parts. The supplier is making specific reports and scorecards of the status to the different boards.

IV Development management

Leadership: The target of development management category is to build good relationship with the suppliers and allow possibility for a smooth long-lasting cooperation. Therefore, frame agreements must be agreed and signed so that the project specific contracts can be placed efficiently when needed. Management should be regularly involved, for example in participating to Quarterly Business Reviews and discussing the current status and future outlook of the companies.

Process: Detailed processes in a project should be agreed with the supplier. These processes are followed regularly together with suppliers to assure that the end product is what is wanted; on time on quality and on cost.

Communication: Communication and knowledge exchange is the key success factor in this category. That is why regular and agreed communication methods in different levels should be agreed. Main roles involved are R&D, quality and sourcing.

Best practice: The case company is using a specific subcontractor for a new kind of technology development. The sourcing manager has agreed the Frame agreement and project specific contracts are signed when new projects are starting. The management is having steering group meetings every quarter to review the status of different projects and to agree on milestones of payments and other general topics. Review of project and process milestones are held in agreed intervals. The development project is having weekly core team meetings to check the status in terms of progress, schedules, quality and open issues. The developers are communicating daily to exchange information, for updating of specifications and reporting about the progress of the tests.

5.4. Justification from proposed SCQM Framework to literature and case study findings

The proposed Supplier Quality Management Framework for the case company in the security and IT sector is composed of two layers. The first layer describes generally the categorization of suppliers into four branches, and the second layer describes more in detail how the main supply chain quality management themes and fulfilled in practice.

The case company did not have previously any model to define the categories for subcontractors and how the evaluate the applicable methods per subcontractor. Therefore, also the comments from the interviewees varied quite much depending on their background and the position the respondent has at the case company. That is why a direct utilization of the comments to the Framework's different parts is not feasible. However, the justification how the Framework is built and how it can be utilized against the important aspects that the people came up in the interviews can be shown. The purpose of the justification is done to prove that the Framework answers to the needs of the case company.

Table 6. justifies how the different messages from the interviews are implemented in the Framework. The table is built the same way as the summary table in the case company interviews to show the clear traceability. The table consists of the quality practice method and related messages from the interviews, and then justifies how the implementation of the framework is done against the messages.

Table 6 Traceability from interview comments to Framework

Method	**Message from the interview**	**Implementation in Framework**
Contracts, Frame agreements	"Long-term cooperation considered in the contract negotiation" "The frame contracts to define the ISO quality requirements." "The contracts and frame agreements must be state clearly the scope, outputs and schedules to avoid arguing situations"	√ The importance of contracts highlighted in the Framework layer 2 in the Leadership area
Meetings with suppliers	"Regular meetings with suppliers. People entitled to make decisions present at the meetings" "On-site visits are very important in order to make sure that the communication and feedback loop is working."	√ Framework Layer 2 Communication area defines the communication methods with different kinds of suppliers
Audits	"Yearly audits to cover different types of suppliers" "Audits and assessments for the approval of supplier production and practices"	√ Suppliers divided into four categories and Layer 2 Communication theme describes the evaluation of an audit need
Requirements	"Development phase requirements and phase-deliverables to be included to suppliers	√ The contract phase and the importance of

	requirements” “Concentration on describing the requirements and expectations to the suppliers.”	specifications emphasized and the different resources
Processes	“When everything works well by supplier, no additional work and methods are needed; order confirmations and price changes runs itself.” “Good that the company’s processes are not that detailed. Possibility to be more flexible and to adapt to the different needs of suppliers.” “The difficulties rise when several sourcing managers are involved with the same suppliers, as each sourcing manager is selecting the way of working with suppliers.”	√ Especially for the category I Purchasing Management, only the basic work by the case company is recommended √ The Framework sets the generic model and gives guidelines how to use them, but in each case the tailoring can be done
Product and process controls	“Feedback sharing in the proto phase with suppliers is very important” “In case of quality issues, a good practice is to gather together with all the parties (e.g. supplier, sub-supplier and customer) and discuss together the root cause of the faults and how improvements could be done.” “Active follow-up of the ongoing topics is important, and question the supplier whether everything is going as it should. Especially in the case of faults, the message goes better when you are able to show face-to-face the mistakes that have been done and challenge how this has happened.”	√ In the Layer 2 category III Supply Management, process and communication areas state the importance for feedback sharing, common control meetings and for follow-up meetings.
Improvements	“Brainstorming workshops a good practice”	√ Categories II Supply Management and IV Development Management highlights the importance

		of close cooperation and common improvement loops
Claim process	"When a claim is resolved correctly and in a good timely matter, the proactive resolving gives good sign about the supplier to us, and the loyalty is increased." "We should support in case of quality issues, but not be involved too much in the fault management process."	√ Claim management highlighted for each category by the Layer 2 Process area

The same applies also for the findings from the literature review. The findings cannot be used as such in the framework, but a justification shows that the findings are taken into account in the proposed Framework. Table 7. shows the justification of the literature review findings to the implementation in the Framework. As in the case company table, also the findings from the literature review are kept the same in order to show the full traceability.

Table 7. Traceability from literature reviews to the Framework

Finding from the literature review	**Implementation in the SQM Framework**
1. Concentrate the most on company's internal quality and its processes	√ Supplier Quality Management Framework created for the case company that explains how the case company should work internally
2. Ensure that suppliers' internal processes work	√ Processes described in the Layer 2 such as audits and process assessment does this. No common processes proposed in the framework to hinder this.
3. Devote to Quality management as it increases customer satisfaction	√ Framework enables quality managers and other stakeholder's to concentrate on the vital tasks with different stakeholders with the main

	target to increase case company's customer satisfaction
4. Involve suppliers already in the design phase	√ Early involvement enhanced in the categories III (supply management) and IV (development management)
5. Have clear responsibilities and assign problems to right party	√ The importance of the contract phase and the claim process highlighted by the Framework
6. Invest to information exchange	√ Communication is one of the main themes. The methods and targets of the communication is described separately for each category
7. Understand your power as a customer	√ Framework gives guidelines how to work in a smart way with suppliers
8. Nurture the supply chain relationships with mutual trust and commitment	√ Communication and Management are one of the main themes. The methods and targets of the communication are described separately for each category. Also other themes target the relationship trust to grow.
9. Understand and segment the relationship levels of different suppliers	√ The Framework categories the supplier into four different types

6. CONCLUSIONS

6.1. Quality Management Framework for cooperation with suppliers

The target of this study was to research what are the factors that enhance the quality of the product and the process in the cooperation between a customer and a supplier. Based on the findings, a quality management framework for cooperation with suppliers was created for the case company's quality department.

The case company of this thesis is working in the IT and security sector. Different authorities use the case company's products and therefore the products must be very reliable and fulfill strict international and national regulations. For these reasons, quality plays a crucial role from the design phase to manufacturing and maintenance phases. The IT sector, i.e. electronic business is quite short-termed, which means that the company and its suppliers must adapt to changes quickly and be flexible, and therefore ensure beforehand that e.g. critical long lead-time components are available in the stock when needed.

The case company has well designed and applied quality systems. However, the supplier quality management of the company had many different methods in the "tool box" but no generic framework to decide which tools to be used with which suppliers. At the same time, the resources for quality management and supplier quality management are limited, so effective, flexible and commonly agreed working methods with different kinds of suppliers are vital to ensure the end quality of the products and to answer to the challenging field of short-termed electronic business.

In general, effective subcontracting provides many benefits to the company. Costs can be reduced, as the company can concentrate on its core areas to invest in. Usually the effective subcontracting brings faster time to market and increases access to better technologies, as the right experts are involved in the process (Quality Leadership, 2014). According to Aravindan and Maiti (2012), global use of suppliers may increase the risk for poor quality. In order to tackle this risk, organizations are forced to allocate resources for managing quality in the supply chain. As Aravindan et al. (2012) states, a new branch called supply chain quality management (SCQM)

has emerged with different management-driven efforts to enhance the overall quality performance of an organization through the effective management of quality on supply side.

The created Quality Management Framework for cooperation with suppliers is one tool for the case company to do effective subcontracting, to minimize the risks of poor quality and to manage the SCQM better. The created Framework consists of two layers; the first layer to divide the suppliers into different categories and the second layer to define what are the main methods to work with in each category. The same model was presented in the Results chapter in two different figures, one per layer. The combined Framework's two layer model is presented in the Figure 12.

The basic principle for the model of the company matrix is following the earlier presented Krajlic matrix and its principles. In addition, the Purchasing Chessboard's® layer model is utilized in this Framework. The first layer of the Framework divides the suppliers to different categories based on the type of outputs they are offering to the company (manufacturing vs. design) and based on the complexity and/or newness of the product.

Hence, the first category called Purchasing Management is generally for manufacturers of generic products with possible modifications. The second category, Specification Management, is giving guidelines to working with subcontractors who are designing generic products with possible specific modifications for the case company. Supply Management is the third category for subcontractors who are manufacturing the case company specific products. The fourth category, Development Management, is targeted for subcontractors who are designing and implementing case company's specific products.

The layer two of the framework is created to describe the way of working more in detail. The topics selected for this Framework are following the same themes as in Robinson and Malhotra (2004) about supply chain quality management; strategy, management, process integration and communication activities. The preferred methods to be used for different types of suppliers are selected based on the case company's current methods and case company stakeholders' interviews.

The purpose of the model is to give guidelines to the company's internal stakeholders about the cooperation with suppliers. Therefore, for each case, the actual cooperation model and methods can be tailored from the proposed category, but the differences must be justified.

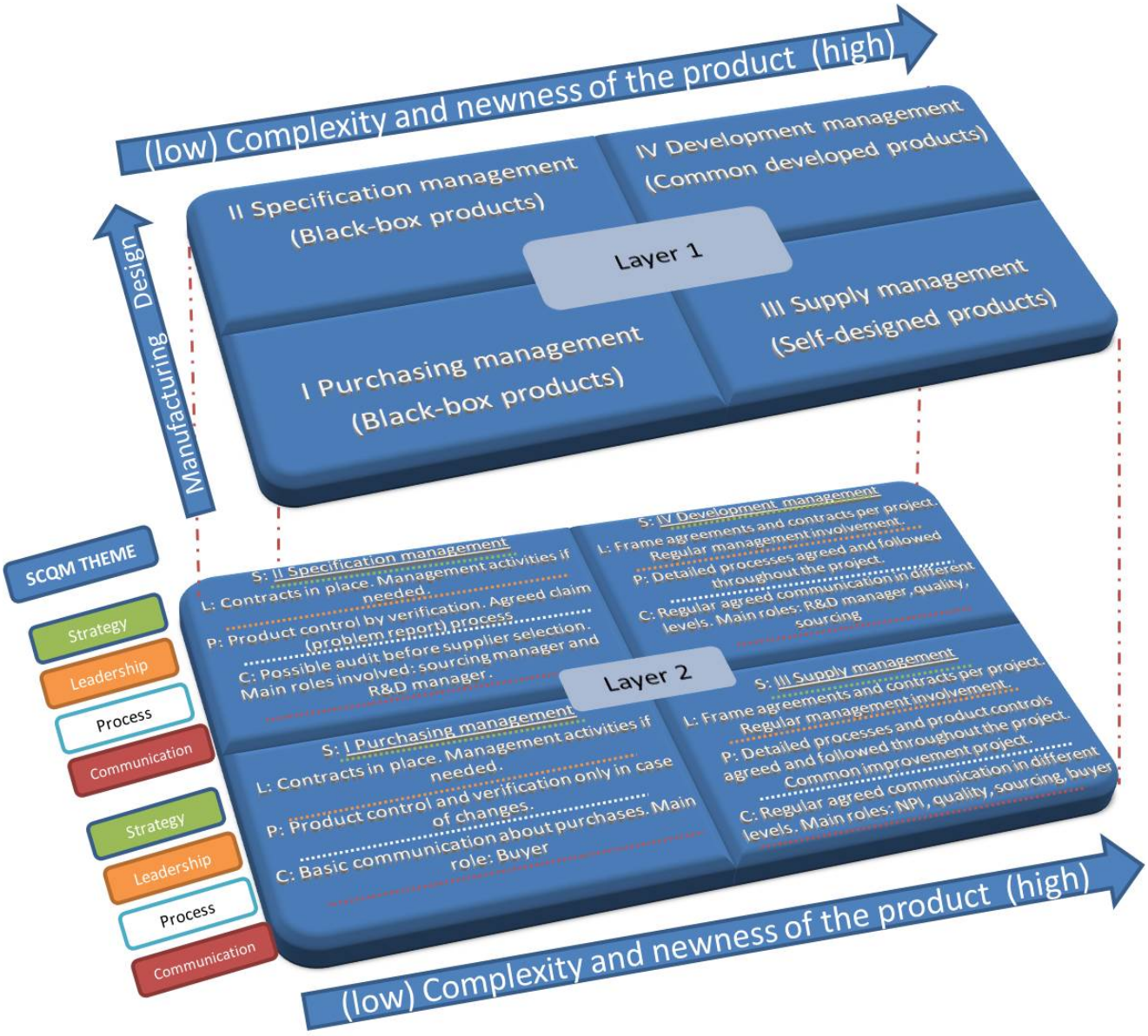

Figure 12. Quality Management Framework for cooperation with suppliers

6.2. Analysis of the research

This study was based on three research questions. Firstly, the purpose of the research was to find out how to categorize the suppliers based on the quality needs on the customer side. Secondly, to investigate what kind of cooperation and other quality related tasks are the suppliers needing from the customers in order to fulfill the requirements. Thirdly, to study how to ensure as efficiently as possible that the quality the suppliers produce is what is wanted. As a form of results, a quality management framework for cooperation with suppliers was created for the case company's quality department.

The first research question was answered by dividing the subcontractors into four different categories, as presented in the layer 1 of the Framework. The categorization was done by combining the current literature model and answers received from the case company interviews.

The second research question about the way and need of customer cooperation towards suppliers gave very different results that I had thought beforehand. Especially the literature review showed clearly, that the involvement of customer does not have an influence on the conformance quality. Therefore, the main topic of the customer is to ensure that the supplier's internal quality management is in place.

However, the third research question about ensuring efficiently that the subcontractors are producing the quality as wanted, is answered by the layer 2 of the Framework. This layer provides details of the management for the case company, and therefore is not in contradiction to the findings of the second research question.

6.2.1. Theoretical contribution of the study

As a presumption when starting to study this topic, I thought that there are multiple different quality management models and frameworks for cooperation with suppliers available in the literature. Thus, the target of this thesis would be to select the best practices from various models that fit best to the case company. However, most of the previous relevant supply chain quality management studies had concentrated on selected parameters of the SCQM and studied their

effect in the supplier cooperation and quality management. Therefore, those studies could not be evaluated as such for this Framework. However, there are multiple different models for subcontracting and categorization of purchasing itself.

Therefore, this Framework provides a new simple model of supply chain quality management and cooperation with suppliers. This framework is done specifically to the IT sector, in which the combination of software and hardware products leads to the area of integrated systems. As the domain of integrated systems has become more and more common, this Framework provides a new and specific supply chain quality model for cooperation with suppliers in the IT integrated business.

6.2.2. Practical contribution of the study

The main target of the Quality Management Framework is that the case company has a defined, basic guideline model for the way of working and cooperation with different kinds of suppliers. This allows the organization to be sure that the main needed quality assurance methods are used in the supplier management in an efficient way. Also for individuals in the company, the framework gives guidelines what are expected from them and gives guidelines for the best practices. In general, the target of the framework is to guide to be more effective with less work and same time to get better results.

Again, even though the framework is generated for the case company, similar technologies are able to utilize the model with modest tailoring.

6.3. Limitations and proposals for future studies

This study, as every other, has it shortcomings. For the case company part, only one person per a role was interviewed. In general, same kind of direction of answers was received but, of course, more confidence to the outcome would come by having more interviews. In addition, the interviews emphasized more about the manufacturing side, as the selected people had more

responsibility in that area. In order to enhance the survey even better, new roles could be introduced from the software design parties.

As the interviewer works in the same company with the interviewees, it may affect to the way interviewees were answering to the question. However, I feel that the professional and objective level of interviews were kept. The interviews were done only in the case company. If the study wants to be enlarged, the suppliers from the different categories should be interviewed to ensure the approval for findings from their side as well.

For the literature review part, some of the well-known subcontracting models were selected to be presented in this thesis, and thus used as a starting point for the framework generation. The literature has many different models available, and also the outcome could be a bit different by using different models as a starting point. Many articles regarding the SCQM and the effect of cooperation with suppliers were reviewed for this study, but only a couple of earlier studies were selected to be introduced and analyzed in detail in this thesis.

For the future studies, the current framework should be re-evaluated after some period of time. The new findings from the usage could re-iterate the framework, especially to have more details for the level 2, or even create a level 3 for detailed method level. In addition, it would be good to study whether this framework generated for the case company could be enlarged to cover the IT and security sector as such.

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APPENDICES

Appendix 1: Case Company Interviews

Sourcing Manager (J.K.), Helsinki, 19.10.2015

Interview comments translated from Finnish to English:

"Each supplier is different. The way they are working is strongly affected by their structure; whether it's legal headed or not. The negotiations are more challenging where legal department is in the big role. With sales people the negotiations are easier. Also cultural differences are visible in the contract negotiations; with companies from US it's more challenging than with Finnish or European companies.

For the process point of view, process descriptions of contract phase and some templates updates would be needed.

What is good, is the smaller organization and therefore, not all processes are defined in detailed. This leaves more options to adapt and to be flexible. Also the decision-making is faster when all the decision makers are in the same building, or at least in the same country.

Negotiation styles should be noticed: to think about the long-term cooperation. The both parties should be flexible and think how both parties benefit from each other. If only price is important, long term cooperation very difficult.

Working with suppliers: with bigger suppliers there are regular meetings e.g. for care topics and for manufacturing place change status follow-up. With main software suppliers there are steering group meetings based on the ongoing projects.

Each sourcing manager is "selecting" the way to work with suppliers. There is an existing way of working with suppliers that have been in the cooperation for long time. The difficulties come when several sourcing managers are involved with the supplier, e.g. in case of main SM vs. project specific SM. Everything works the best when one person has the overall view and detail information available as topics can be done differently, e.g. bringing new topics to contracts either by amendments or just by updating price lists.

Wishes for the quality managers: Get involved in the topics, question and challenge internal and external work. Be involved with major milestones with project managers to analyze the status and maturity of the quality.

What is also important is to concentrate on good specifications. The content must be reviewed very carefully in the beginning. Sometimes own problems are tried to turn to supplier problems. Also in case of customer claims, the analysis must be done carefully before claiming the problems from suppliers."

M.V., Buyer, teleconference Jyväskylä/Helsinki, 20.10.2015

"There are global differences in the culture of quality. Usually the sales guys are giving the sales speech of quality and how it is at place. This works with European, but with Asia (I mean China), the price comes first and quality comes later. This brings us issues. Samples sent by the manufacturer are ok in the first time, but later e.g. the material can be changes. That's why everything has to be validated with detailed verification tests and process implementations in order to keep the quality level high.

ISO requirements should be the baseline for companies, but that does not assure that the quality is in place. However, usually it means that there are some processes, e.g. for claim process such as registration and follow-up. The ISO9001 sets the minimum requirements and basic baseline, and actual requirements and quality must be built on top of that.

Best companies have characteristics of flexibility, control of processes (e.g. document flow flawless, traceability, processes in place), listen to the customer, they have good attitude. They are easy to talk to and they find solutions. They have dedicated personnel, lean methods for all requests ("They just do it") and they are innovativeness. This feels that our company inputs count (we are the big player). The most important features are the flexibility, that they listen to the customer and that they control their processes.

I see challenges with wig organizations with "black box", as we not always receive answers from them and they are not flexible in changes. In one supplier the problem is that, management level has made decisions that the production are not able to keep. This brings irritation to us and therefore extra work and hassle are needed from our side.

In best cases, when everything works, then no additional work & methods are needed. Updates happens itself (e.g. in price changes runs itself). If more work has to be done, then we know that something is wrong.

Quality to me is not only about product, also communication and keeping of delivery times etc. Price should not be the only factor but also quality. If the relationship is ok, there should be no reason to change the subcontractor.

The total view counts: Hidden costs for quality (I mean costs that come to the organization that are difficult to count) and aggravation level. These take time and effort from other tasks and possible improvements and innovations are not done.

Sometimes negative topics can bring positive view in total: Loyalty may increase when a claim is solved is resolved correctly in a timely matter. This is the case of proactive resolvers."

Quality Manager, A.P. (Jyväskylä)

Interview comments translated from Finnish to English:

"Regular meetings with supplier quality people is a good practice. However, the meeting must contain such person who is able to make decisions and changes. The person can either be in the position of having the responsibility for decisions or have such a relationships to the management and production that he can affect to the decisions and improvements. Sometimes, especially with Asians, we have had meetings where the parties agree the actions but are not able to take that responsibility of actions.

Open and honest communication is the key factor in the customer – supplier relationship. We are expecting, that our suppliers are responding fast to our requests, but we must assure that we act as well as we expect others to act.

Audits and assessments are important for the approval of supplier production and practices. In case of quality issues, a good practice is to gather together with all the parties (e.g. supplier, subsupplier and customer) and discuss together the root cause of the faults and how improvements could be done. Also this discussion can be done together with suppliers that are providing same parts that problems and lessons are shared openly. However, we as a customers should only support this process and not be involved too much in the fault management process. We must guide the discussions and justify the acceptable level for deviations (e.g. scrathes on the surface). In my opinion, usually people want to do their best, but they need to know what they are expected to do.

Also the monthly meetings with suppliers are in the idea level good, but the current atmosphere with a certain supplier makes the discussions more difficult.

Improvement needs that we have:

We must be better at describing our requirements and expectations. In some cases, we are thinking only from the cost perspective as long as we are able to deliver products, and e.g. we don't demand reports even though they are requested in the original contracts.

We have to describe better also the quality level that we accept. For example, for scratch cases it is not enough to state pass or fail, but to state why they are ok or not ok.

We are all the time making small improvements to some products in the production to improve them. This way the change management process is very challenging to do. We should rather make more seldom big changes at once.

Also the internal communication and openness should be improved. There are cases where the core team knows the status and have made the decisions but other people are not informed about it. That's why I have created now monthly internal meetings with mechanical and HW teams. "

J.L., R&D HW Development Manager, Helsinki, 29.10.2015

Interview comments translated from Finnish to English:

"I would like to think this from the actual way of working with current suppliers and subcontractors.

This is how we work with our main manufacturing suppliers: we are delivering them drawings and other specifications that they can manufacture. We have the common meetings with NPI to discuss about open issues, especially during the project development phase. As the meetings were started quite late in the product development phase for this project, it is not that beneficial for us, I think we are there more to support NPI. What is important and value adding are the product controls on site, receiving feedback from the manufacturers for the proto phase and our own product controls in our premises. Also the brainstorming workshop at manufacturer premises gave very valuable information and good ideas for the product development phase.

With the subcontractors that are making modifications to their products to fit our systems, in the beginning of the project we make a requirement specification. In the case of issues, we have regular meetings to solve the topics as quickly as possible. The subcontractor is showing the fulfilment of our requirements by traceability to each requirement. Otherwise, the subcontractors are working independently.

In order to emphasize the importance of quality, I think we should be closer involved. We should check that the process is going as we want, now we have stated only methodology for certain topics, e.g. for reliability and criticalities. Usually if we don't hear anything from the field, it means that so far so good. Also for their own changes in the products to improve the quality, we should follow the changes better.

The third group of different type of supplier is the subcontractor who is designing a new product for us, and we will be later in charge of the subcontracting the manufacturing. In these cases we are making very detailed specifications for the subcontractor and the subcontractor is designing the product independently, as a black box product, for us. After that, we are verifying the product in our environment. In the recent case we found out afterwards, that the subcontractor did not review their phase products well even though it was planned so. In the beginning, we received weekly progress reports from them but in some phase, they ended (and I felt that I did not need the detailed reporting). As a lessons learnt from this project, we should introduce our subcontractor partners better to our working practices that they understand what is the expected quality and our process level way of working that we expect them to follow too."

T.K., Head of Quality Finland, Helsinki, 5.11.2015

Interview comments translated from Finnish to English:

"An improvement would be needed for the overall supplier quality management. We have different kinds of suppliers in the software and hardware branch. In my opinion, I would categorize the suppliers to product manufacturers, project specific subcontractors (that are designing a part of the system) and to subcontractors that are working according to our company quality processes.

All of these different types of suppliers should be followed and audited in regular time intervals to check that everything is in control.

The other part that has to be agreed more in detail is the management of supplier audits and their budgeting. The product development projects should not be the payer of the audits, unless a single project wants to make a specific audit. Audit needs are coming throughout the year, so there must be margin in the planning and executing of audits."

J.V., NPI Manager, Helsinki, 8.12.2015

Interview comments translated from Finnish to English:

"For the suppliers that are producing their own products, what needs to be improved from my opinion from our side is that the purchasing specifications and product specifications must be on spot. We must be sure what we really want before the product is produced. If the starting point and the information have some mistakes, it makes huge extra work for NPI in the future.

A good practice for the case of not necessary having the exact specification known is to meet the counterparty face to face in order to communicate the wants and needs better. This is always easier than writing the topics in an e-mail. Also by meeting the person, the communication environment is launched which helps the cooperation throughout the project.

With our current main suppliers, we have to actively follow the ongoing topics. This is both valid for the purchasing as well as for the manufacturing. If you are not receiving automatically the information, (e.g. schedule, manufacturing, proto phase) question the supplier whether everything is going as it should. Especially with manufacturing the follow up must be done continuously, also in the feedback phase.

I think the communication towards the suppliers is vital; if I don't communicate, we cannot expect that the supplier would have readiness for our products. On site visits and discussions are very important to make sure that the communication and feedback loop is working. Especially in the case of claims and faults, the message goes must better when you are able to show the mistakes that have been done face to face and challenge how this happened.

I feel that some difficulties are because of this era. Some people are not that proud anymore of their work and how they contribute to the quality of the products. Also it is too easy to communicate with e-mails or text messages and not to meet face to face.

The contracts and frame agreements should exists and they should be followed. The contract should state clearly what is the scope, expected outputs and schedules. In arguing situations, we are in trouble if the contracts have not been followed and expected the supplier to follow them too.

For the business continuation point of view, we should have several suppliers for same products to secure the deliveries and have second options.

This electronics business is own kind of business compared to e.g. to car or building industry: the forecasts are short-termed and we do not necessary know what we are producing (what the customers are wanting) in six months."