LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

School of Business and Management

Master's Programme in Supply Management

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THE INFLUENCE OF A SUPPLIER DEVELOPMENT PROGRAM ON SUPPLY CHAIN PERFORMANCE: A MIXED METHODS CASE STUDY IN FINNISH FOREST INDUSTRY

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ABSTRACT

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The link between supplier development activities and supply chain performance is a relevant concern for those who aim to use such activities as a trigger of performance improvements. In practice, the link is always not clear or transparent, in addition to which the topic has not been extensively studied in literature either. The better the connection and its mechanisms are known in beforehand, the more likely it is that supplier development activities are carried out successfully.

The aim of this thesis was to examine the effectivity of a supplier development program on supply chain performance by conducting a mixed method case study. The chosen methodology provided a versatile view on the phenomenon and allowed the thorough examination of the case. Moreover, the methodology was selected as a means of improving the validity of results concerning the actualized influence. In examination of supply chain performance, separate constructs approach was applied and the definition of it relied on three fundamental perspectives of it. The aspects were resource, output and flexibility, out of which resource and output were considered as relevant perspectives in measuring the quantitative effects of the development program.

The results support the idea that supplier development program can be a source of performance improvements in cases where the conducted development activities and supply chain performance have a direct connection. Indirect influence on supply chain performance through changes in supplier performance was found not to have taken place. For those companies wishing to objectively evaluate the realized effectivity of supplier development program, it was seen useful to consider measurement of performance already while planning the program to be able to better follow the influence and take better corrective actions already during the process.

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Toimittajien kehittämisen ja toimitusketjun suorituskyvyn välisen yhteyden olemassaolo on edellytys suorituskyvyn parantumista tavoittelevien toimittajankehitysohjelmien onnistumiselle. Käytännössä yhteys ei kuitenkaan ole aina selvä tai läpinäkyvä, minkä lisäksi aihetta ei myöskään ole runsaasti tutkittu. Mitä paremmin yhteys ja siinä vaikuttavat mekanismit tunnetaan, sen todennäköisempää on, että kehitystoiminta on tuloksellista ja kannattavaa.

Tässä monimenetelmätutkimuksessa tutkittiin toimittajankehitysohjelman vaikutusta toimitusketjun suorituskykyyn. Tutkimusmenetelmät mahdollistivat monipuolisen näkökulman tutkittuun aiheeseen sekä tarjosivat keinon tutkia valittua tapausta perusteellisesti, minkä lisäksi ne tukivat lopputulosten validiteettia. Toimitusketjun suorituskyky käsitettiin useasta erillisestä käsitteestä koostuvana kokonaisuutena ja näiden käsitteiden määrittely pohjautui kolmeen toimitusketjun suorituskyvyn perusnäkökulmaan, jotka olivat resurssi, tuotos ja joustavuus. Tutkimuksen määrällisessä vaiheessa keskityttiin suorituskyvyn resurssi- ja tuotosnäkökulmiin.

Tulokset tukivat ajatusta siitä, että toimittajankehitysohjelma voi olla toimitusketjun suorituskyvyn parantumisen lähde niissä tapauksissa, joissa toteutetut kehitystoiminnot ja toimitusketjun suorituskykymittarit ovat suorassa yhteydessä toisiinsa. Epäsuoraa vaikutusta toimitusketjun suorituskykyyn toimittajan suorituskyvyn parantumisen kautta ei todettu tapahtuneen. Tutkimuksessa havaittiin, että yrityksille voi olla hyödyllistä huomioida suorituskyvyn mittausnäkökulma jo kehitysohjelman suunnitteluvaiheessa, jotta ohjelman vaikuttavuutta voidaan seurata, arvioida ja hallita paremmin jo kehitysohjelman toteutusaikana.

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These five years have been a rewarding journey. The world of business has been both intriguing and at times challenging, while being an excellent platform for the development of thinking. Moreover, the gained understanding of economic mechanisms is a great asset, which's value is not limited to office hours.

In the context of this work, I warmly thank each of my supervisors, both official ones and those of you who remain anonymous. Without you challenging me in the right phases of the work, the results within and outside of the written work would not have reached the point they did. Also, the everyday support I've received at home has been an important factor enabling the completion of this work in the given schedule. It's been surprising how well engineering and business mindsets fit together.

Finally, I thank my family and friends for the support you've provided throughout the years. Without you, this road would have been much rockier to travel.

Lappeenranta 28.6.2018

Jenni Kahri

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1. Background

Supplier development programs aim at changing supplier behaviour for the advantage of the supply network. A program can include versatile activities and initiatives and it is often driven by a purchasing company in order to conduct improvements in supply chain processes. What is common to suppliers being developed through programs is that they are considered important by the purchasing company, which is why changing the supplier is less attractive for the buyer than influencing their performance through development efforts, due to which the program is introduced. However, the realized value from supplier development programs has not been thoroughly researched, in addition to which many results obtained regarding supplier development programs' effects have not been explicit.

The ability of a supply chain to perform defines the boundaries for operational activities in a company and as a concern reaches also tactical and strategic decision-making levels. Moreover, the performance of supply chain has a significant role in company's ability to satisfy its customers' needs. As a concept, supply chain performance is nevertheless vague, and in several contexts defined in a generic way. Despite the great amount of studies conducted in the field, the connection of supply chain performance and supplier development activities has not been extensively studied.

While the two topics are important and relevant in a general level, the forest industry is one of the key influencers in global supply networks, as wood has a significant role in them. Billions of everyday products and their packaging solutions over the world are connected to wood, which can be used for diverse purposes. As a renewable resource, wood as a raw material is a sustainable solution and will therefore maintain its role also in future supply networks.

Since wood has a great role in several supply chains, the efficiency in the sourcing process of the raw material has implications on the supply networks of millions of products. This sourcing process is the environment of the case examined in this study. Moreover, as wood has a connection to several supply chains, even slight process improvements in this part of the supply chain can have a remarkable overall impact on a network level. Despite the importance of the raw material for many supply networks, supply chain performance has not been extensively studied in the context of wood supply, which is a gap that this study will contribute to.

1.1 Prior literature

Marketing management has not traditionally acknowledged the significance of supply chain management as a key element in gaining advantage in the marketplace (Christopher 2000). Nowadays the importance of efficient and effective supply chain management is better understood and the need of research in the area of supply chain has increased while more complex delivery networks have been enabled by globalization. New challenges have emerged, which have required deep understanding of the field to solve them and effective collaboration in a global context simply requires supply chain management skills. Supply chain management is a key activity in controlling these supply networks. In managing a supply chain, it is also necessary to evaluate the chain's performance in order to manage the network efficiently. Simply put, "You can't manage right what you can't measure well" (Cruz-Cázares et al. 2013, 1239**)**. Hence, the concept of supply chain performance and especially the measurement of it are important topics to be examined.

To provide the reader with an idea of the literature in the field, it was examined how much research has been published in the relevant areas and how these areas have developed over the last eight years. This was conducted by exploring ScienceDirect, Emerald Insight and Taylor & Francis Online databases, which are online libraries with plenty of academic business literature and visualizing the results. All databases were searched with terms "supply chain", "supply chain management" and "supply chain performance", year being limited to one year at a time. The search was conducted from year 2010 on and always with only one of the three search terms mentioned. Moreover, in each search only those articles were considered which's title included the exact search term, which provided more accurate results. Nevertheless, it is to be noted that the possibility of slight overlapping of articles between these groups is not excluded. The total number of relevant articles in these two databases is therefore only approximate.

Based on these databases it can be discovered that the trend in the number of supply chain articles has been arising. Figure 1 shows that the field of supply chain management (SCM) has been an interesting topic that has had a relatively stable proportion in supply chain literature over the years compared to supply chain performance, which then seems to have slightly gained more appreciation since 2014. The increasing number of articles indicates that the areas still have importance.

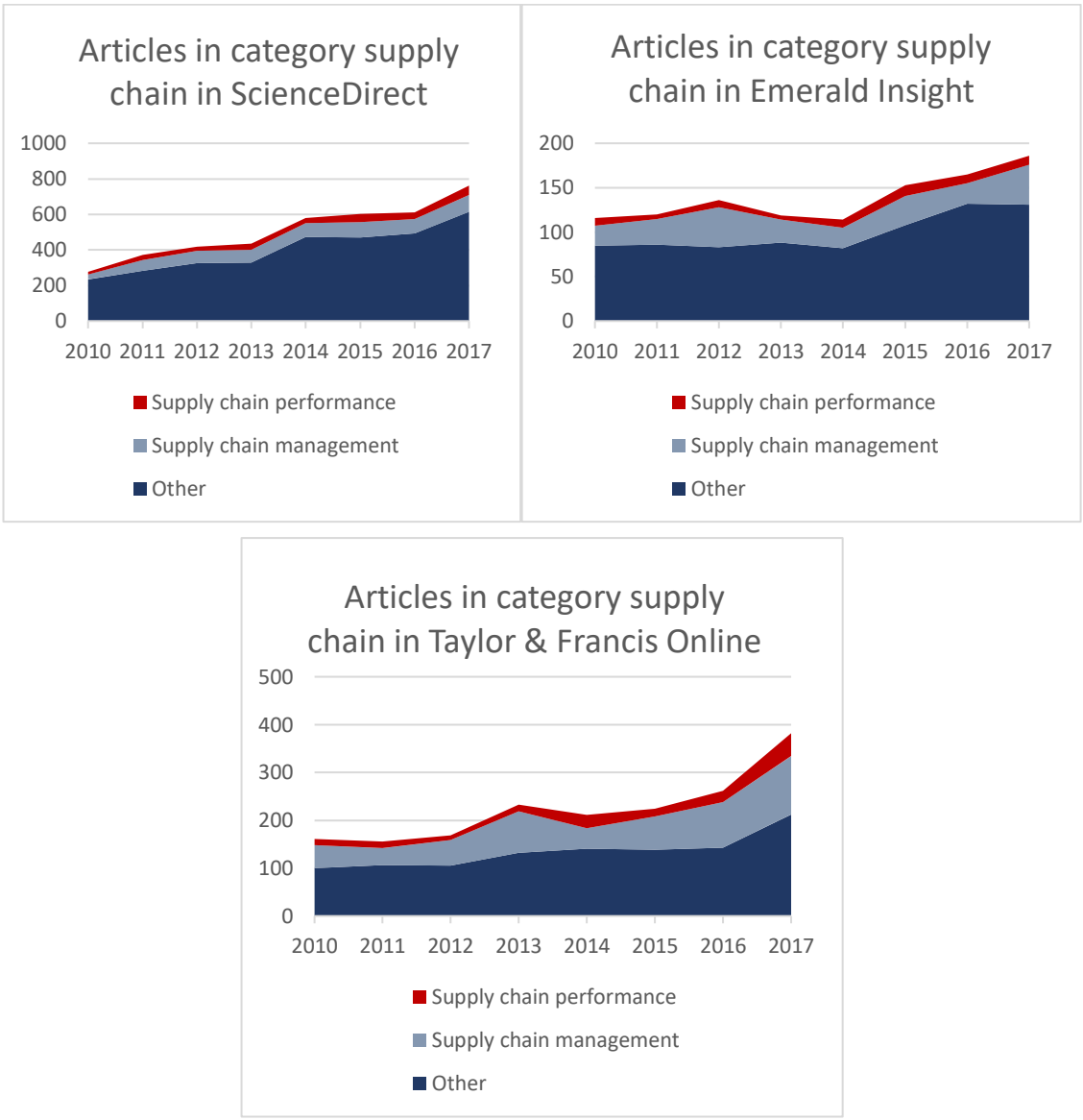

Figure 1. SCM and SCP articles in category "supply chain" in different databases

With SCM becoming increasingly important in global competitive marketplace, performance has become a key research area both in academia and industry. (Ip et al. 2011) Supply chain performance (SCP) influences firm performance (Tan et al. 1998) and is an important topic in evaluating a company's ability to meet customer expectations. Logically, SCP is not a new concept in research either, which can be seen in figure 1. Within the area especially measurement has been a researched topic.

Measurement literature regarding supply chain performance is versatile. SCP has been researched by evaluating the number and type of performance measures (Beamon 1999, Chalyvidis et al. 2013), characteristics of good performance measurement systems (Akyuz

& Erkan 2010) and approaches to measurement (Dolci et al. 2017). Moreover, measurement of SCP has been researched by evaluating appropriate frameworks for measurement and the effects of widely used measurement approaches, such as balanced scorecard and SCOR (Gunasekaran et al. 2001; Aykuz & Erkan 2010; Alomar & Pasek 2014).

The large amount of literature concerned with measurement of performance might be related to its value in practice. The objective of SCP measurement is to provide information to support decision-making in organization (Ip et al. 2011), which enables the decision-makers to better understand the state and potential development targets of the network. According to Elrod et al. (2013) there are several ways to measure and define supply chain metrics. Moreover, the measures are frequently industry specific. Common to all supply chain measures is, however, that using them eases implementing new strategies in the supply chain. (Elrod et al. 2013) Logically, the information collected with these measures is analyzed and used widely by top management (Pekkola & Rantanen 2014).

In literature considering supply chain performance as a phenomenon, there have recently been several studies related to the factors that influence it. For example the role of power in supply chain performance has been examined lately (Odongo et al. 2017). Also the role of trust (Capaldo & Giannoccaro 2015) and the role of supply chain collaboration (Huseyin & Ozkan 2015) have been examined in the context, each of these topics being connected to supplier relationships. However, in addition to these factors it is also important to study how the suppliers are influenced in these relationships and how this connects to performance. Despite the relatively numerous amount research considering supplier development programs and their benefits, the influence of a supplier development program on SCP has not been extensively studied. Studying this aspect thoroughly is important, for the programs often have a direct motive of improving supply chain performance, and if this is not conducted, it is difficult to accurately influence the performance through the programs.

Motives for conducting supplier development programs are versatile, as SDPs can have a positive impact in various dimensions (e.g. Kumar & Routroy 2017). In practice, for example image contribution has been stated to be an important motive for SDPs (Hales & Arumugam 2012). In each motive there is always one or more goals connected. However, not many studies have reported to quantify and evaluate the degree of supplier development program's success (Routroy & Pradhan 2014), which is relevant for evaluating the effectivity of the conducted program and then developing these programs further.

Performance as a topic has been important in forest industry as well. During the 21st century the economic downturn and continuing technological change in communications have caused pressure on the forest industry, and partly due to this the efficiency of operations has been paid attention. For example, the efficiency in resource utilization has been a very important topic for the forest industry in China and the need for reliable and cost competitive wood flow has also recently been acknowledged in Canada (Cheng et al. 2010; Lehoux et al. 2016). Moreover, during the 21st century research has examined the reasons and impacts of productivity changes in US in the area of forest products (Lee et al. 2011; Hussain et al. 2016). In Finland, efficiency has also been a concern. There currently is a practical development program and an R&D program taking place that precisely aims at improving the efficiency of timber flow by 2020, in which it is stated that if the cost efficiency in timber supply chain is improved by 30%, a potential saving of 350 billion euros can be achieved (Metsäteollisuus & Metsäteho 2012), which connects to the topic of this study on a practical level.

Literature showing the significance of supply chain performance on the field globally, this study contributes to the research by shedding light on the influence of supplier development program on the performance and hence approaching the topic from supply management perspective. As the influence of supplier development program to SCP has not been studied before as a mixed-method case study, this study contributes to literature also by examining the topic with a new methodological approach, which enables the formation of a holistic understanding of the case at hand.

1.2 Research questions

The aim of the study is to investigate a supplier development program's effect on supply chain performance, which is conducted by answering to three research questions. The questions are

1. How has the supplier development program impacted supply chain performance?

This main research question is being answered by examining the following sub-questions:

1.1 What connects the supplier development program and supply chain performance?
1.2 What evidence of realized impact is there and how consistent is it?

The sub questions 1.1-1.2 are both considered in the qualitative part of the research process by using interview as a data collection method. The interview also provides relevant

material for data collection in the quantitative stage, in which e.g. performance measures examined are defined in the qualitative section.

The quantitative part of the research is built on findings regarding the question 1.1 but is especially concerned with the latter sub-question. The focus in the section is on the KPIs and on the development of them within the frame of the supplier development program. The influence in indicators is examined by using ANOVA, Kruskal-Wallis or t-test on the relevant performance KPIs. This stage relies on two types of data: supplier classification and performance data. Supplier classification data is collected within the interviews and performance data from the ERP systems of the company. Null hypotheses within the ANOVA, Kruskal-Wallis and t-tests are that there is no difference between the performances of suppliers, who match the goals of the development program, and the suppliers, who do not match the program. The tests are conducted for data produced in the beginning of the development project and for data produced in the latter part of the project, which enables the interpretation of the results on time scale as well.

1.3 Key concepts

In this study, there are a few main concepts that are important for the reader to consider. Moreover, in the empirical context somewhat narrower definitions were used in the interviews. These definitions are nevertheless introduced in the relevant context.

supply chain	following the definition of Carter et al. (2015), supply chain is a network that consists of nodes and links
supply chain management, SCM	focusing on the material and organization aspect in the definition of LeMay et al. (2017), with SCM is meant “the design and coordination of a network through which organizations get, use, transport and dispose material goods”
performance	Following Laitinen (1998): company’s ability to produce results on the set dimensions in relation to the set goals

supplier performance	the extent to which supplier contributes to buyer's supply chain performance
supplier development program	intentional activities of the buyer which are aimed at changing supplier behaviour and ways of collaboration within a certain period of time

1.4 Conceptual and theoretical frameworks

Conceptual framework of the study is built on topics related to supply chain management and more specifically, to performance measurement. The framework provides an overview of the position of the examined topic in the field. The framework is presented in figure 2, in which the relations of the topics are also visually described.

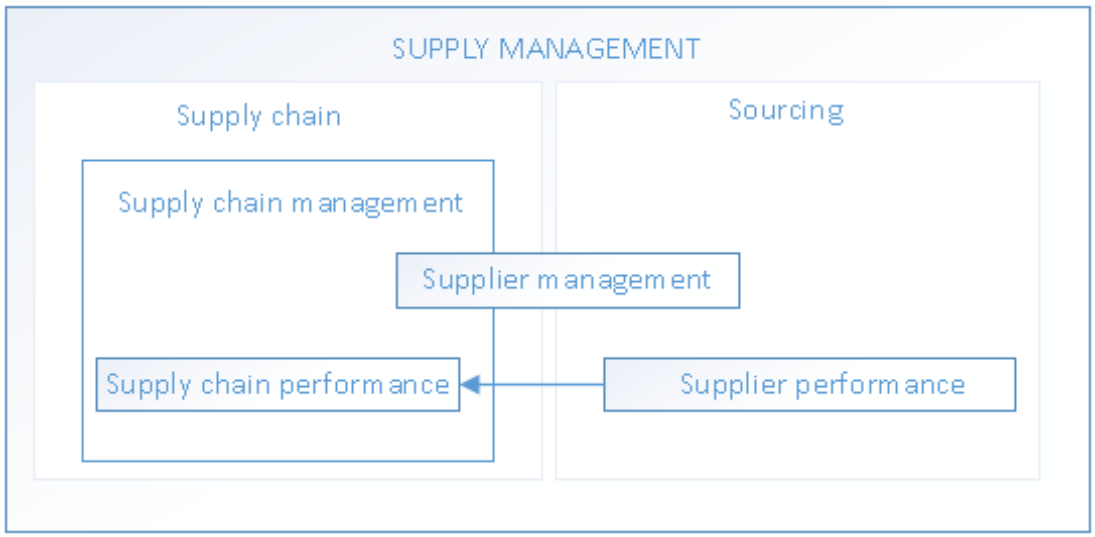

Figure 2. Conceptual framework of the study

Theoretical framework of the study begins from relevant theories considering supply management, as they can be found in the background of the motives of supplier development programs, which can then be seen in the influence itself. In figure 3 the theoretical framework for the study is introduced.

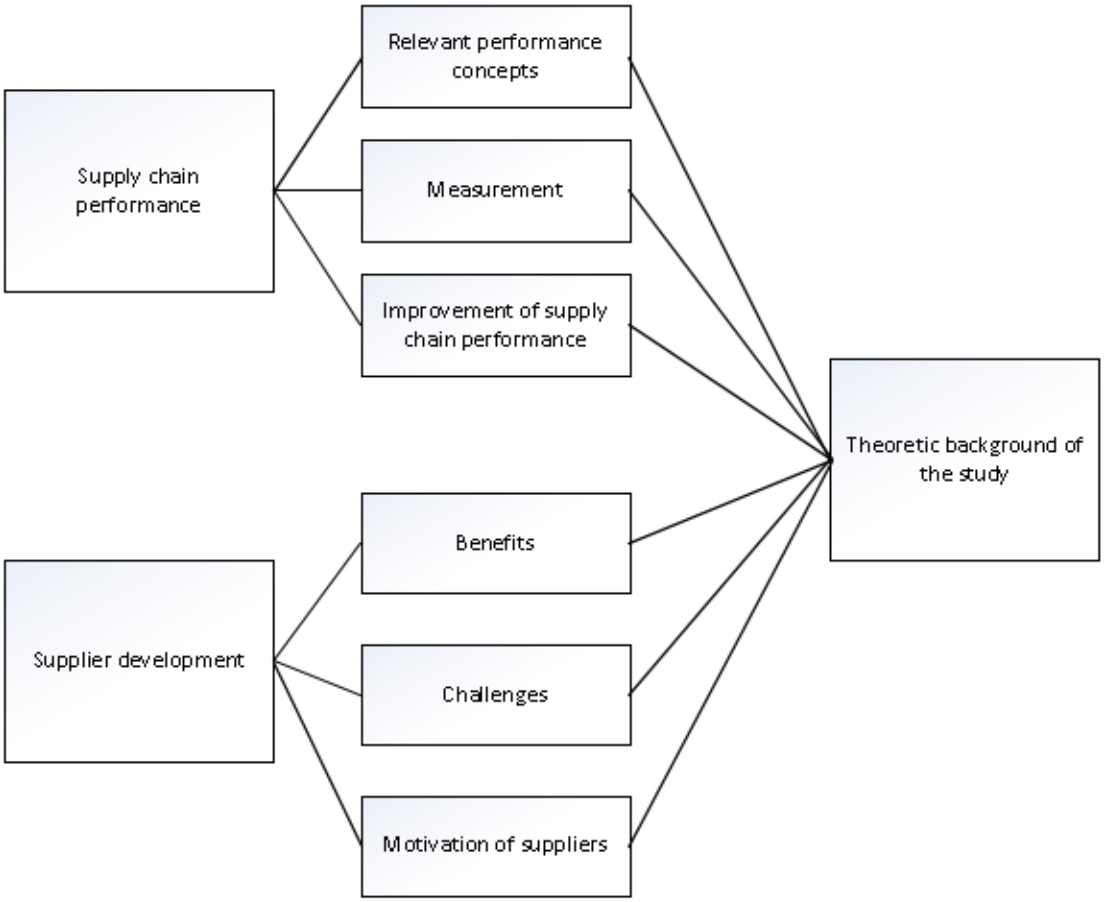

Figure 3. Theoretical framework of the study

1.5 Delimitations

In the study, it was assumed that the examined part of the supply chain process is the weakest in the chain, i.e. that improvement in this part of the process will improve the performance of the chain in total. This assumption is also made based on the idea that performance gained in the studied part of the process is not derived from the other ends of the process. In other words, partial optimization is not expected to have implications anywhere on this supply chain process.

The case has taken place in Finland, which means that the local culture is present in the interaction with the suppliers and which can have had such an impact on the result, which is not present on a corresponding study in a remarkably different context. This limitation is

connected to the qualitative part of the study, where cultural characteristics may have influenced the data.

Moreover, a relevant delimitation in the study was that only the intended influence is being focused on. Possible side effects regarding the supplier development program were not separately examined, though they were not completely left out of the research scope either due to the data collection method in the qualitative stage. This study also relies on the assumption that if significant side effects emerged, they were mentioned by the interviewees in the last interview question in the qualitative part of the study.

2. Research design

Based on the fuzziness of the idea of SCP and the versatile activities conducted within supplier development programs, it is not reasonable to rely only on quantitative or qualitative methods in this study in collecting of data. In this case, quantitative data does not reflect the reality comprehensively, as they cannot measure the experiences regarding the program. Neither could purely qualitative data enable the measurement of influence in an objective, reliable and exact way, also because of the timespan of changes that sets obstacles for collection of good qualitative data several years afterwards. Due to these characteristics of the phenomenon, a mixed method approach is chosen to be applied.

Mixed methods is a suitable research strategy in situations where researcher wants to gain a more holistic view on the examined phenomenon. A mixed-method study can be defined as a study that involves the collection and/or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially and are combined at one or more stages in the research process (Hurmerinta-Peltomäki & Nummela 2006). The strategy has been applied especially in social and behavioral sciences and are a newer approach to research than quantitative and qualitative approaches separately.

Mixed method case studies have been conducted in business literature, although publishing mixed methods research the area has been found more challenging than publishing research conducted using traditional methods (Hurmerinta & Nummela 2015a). They have also been used in examining precisely supply chain performance (Haavisto 2014), which supports the selection of this research strategy on this study.

Mixed method studies can be analyzed based on three dimensions: type of data collection and analysis, research process and purpose for using mixed methods. There has also been introduced a classification tool for mixed method studies, which combines the data collection and data analysis methods (appendix 3). Using the tool, it has been found out that in most mixed method studies considering international business, the research design AD has been the most popular one used, i.e. the most popular design has been to analyze qualitative data qualitatively and quantitative data quantitatively. Moreover, it has been found that the value-added of mixed methods has been in the increased validity of the results. (Hurmerinta-Peltomäki & Nummela 2006) In addition to this, according to Hurmerinta & Nummela (2015b), the level of integration in mixed methods can roughly be

defined in three groups: independent, combined and integrated, which are described in appendix 4. In this study, combined method is applied.

Within mixed methods study there are several strategies that can be applied. Three general strategies in mixed method studies are sequential, concurrent and transformative strategies. In sequential procedures, the researcher aims to elaborate on or expand the findings of one method with another method, which can mean beginning a study with qualitative method for exploratory purposes and then continuing by using quantitative methods to a large sample in order to produce generalizable results. Concurrent procedures take place when researcher examines both types of data simultaneously and then integrates information in the interpretation of the overall results. Transformative strategies take place when the researcher uses theoretical lens as an overarching viewpoint in a design containing the both types of data, qualitative and quantitative. (Creswell 2003) This study will follow sequential exploratory design, which according to Tashakkori & Teddlie (2003) is characterized by the collection and analysis of qualitative data that is followed by the collection and analysis of quantitative data. They also point out that priority in this type of research is usually given to qualitative data.

Case studies are more commonly used in business research. Quality of case studies in purchasing and supply management have been studied in several papers. For example, Dubois & Araujo (2007) studied case research in purchasing and supply management and based on their findings defined five rules according to which one can conduct good quality case research. Especially Seuring (2008) contributed the area by examining research on supply chain performance management and sustainable supply chain management, finding a major issue to be that often the studies do not even provide the basic information about the research process, which affects the appreciation of the methodology and influences the reliability of the research. Documentation of the research process is also important in conducting mixed methods research, which emphasizes the importance of research process documentation in this particular study.

Based on the three dimensions that can be used to analyze a mixed methods study (type of data collection and analysis, research process and purpose for using mixed methods), this study can be characterized with the following notations. First, this research followed the AD design, in which the qualitative data is analyzed qualitatively and quantitative data quantitatively and which has been the most popular design in mixed methods research. Secondly, the research process has followed a sequential exploratory design, in which is first collected and analyzed qualitative data, that is then followed by the collection and analysis of quantitative data, which in the end are integrated as results of the study. Thirdly,

mixed methods were used to be able to examine the connection of the two multifaceted concepts, supply chain performance and supplier development program, with a greater level of validity than purely qualitative or purely quantitative methods would allow.

The structure of the research process followed sequential exploratory approach and it is presented in figure 4. The beginning of the process is described on the left side and the end of the process on the right side of the figure. In the structure of the research process is also considered the integration of the analysis, which finally answers the main research question.

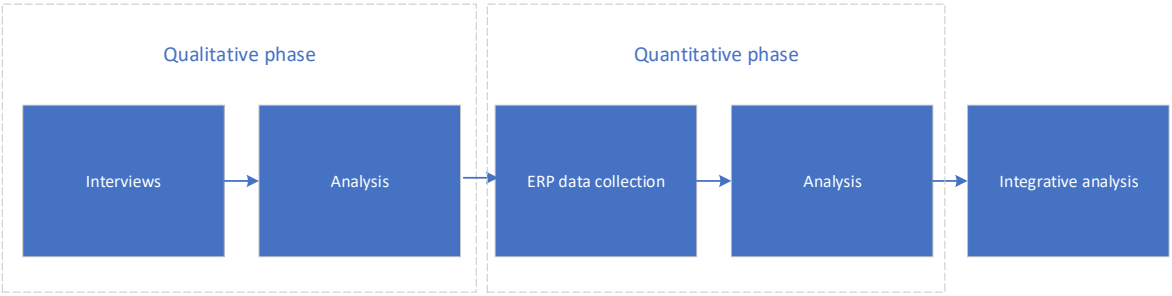

Figure 4. Phases of the research process

2.1 Validity

Whereas increased validity regarding the results of a mixed methods study is used as a reason for applying the strategy (Hurmerinta-Peltomäki & Nummela 2006), validity itself is an important aspect in the application of the strategy. There are several threats that concern validity, which need to be considered during the research process.

Validity means the extent to which a certain statement, interpretation or result express the object which it is supposed to express. In addition to this there are two sub concepts for validity, which are internal validity and external validity. Internal validity stands for the internal logicality and consistency of the interpretation, whereas external validity is concerned with the generalizability of the interpretation. (Koskinen et al. 2005)

Validity in mixed-methods research can be strengthened by showing the consistency among the research purposes, the questions and methods used (Tashakkori & Teddlie 2003). As in all methods, also in mixed methods there are some threats to validity and reliability, some of which are especially important to consider. According to Ihantola & Kihn (2011), in mixed methods accounting research the significant threats include internal

(contextual) validity, external validity (generalizability and transferability) and (procedural) reliability, last of which is discussed in the next chapter.

In this study, validity is considered as follows. First, the consistency between each research phase is considered throughout the process and the study is structured based on this. This is presented in more detail in chapter 2.3. Secondly, the key concepts of the study are transparently defined. Thirdly, the logic behind the crucial research stages is thoroughly described and visualized. Lastly, the major factors influencing the generalizability of the results have been presented in limitations.

2.2 Reliability

Internal reliability deals with the consistency of collecting, analyzing and interpreting the data, while external reliability considers the replication of the study (Mohammad 2013), i.e. if it the study can be reproduced by an independent researcher. In this study both will be considered by documenting the research process and by basing the analysis on documented material. Moreover, on company level this aspect will be considered by interviewing different people from the case organization to form a firm view on what SCP means for the company, so that the results are valid in that context.

According to Mohammad (2013), prior research suggests that reliability in a mixed method study can be enhanced through three techniques: the investigator's position, triangulation and audit trail. The investigator's position means in practice that the investigator needs to explain explicitly the different processes and phases of the inquiry and elaborate on every view of the study, while describing in detail the rationale of the study, design of the study and the subjects (Mohammad 2013). Triangulation, then, means the combination of different methods, researchers, data sources or theories in a study, which includes multiple aspects into the study, and is a way of enhancing the reliability. (Saaranen-Kauppinen & Puusniekka 2006) Audit trail as a procedure can be fulfilled by describing profoundly how data collection and analysis have been performed, the way how different themes are derived and how the results have been formed. (Mohammed 2013)

Investigator's position, triangulation and audit trail are profoundly considered in chapter 5.1.2, where they are considered in the context of this study. Moreover, the reliability of the study is also enhanced by chapter 5.1, where the background of the study is thoroughly described.

3 Supply chain performance

From the perspective of supply chain management, it is critical to measure the versatile aspects of supply chain operations (Elrod et al. 2013) Measuring the aspects results in information regarding resources and their utilization, enabling the evaluation of performance at supply chain level. As the competition takes place between supply chains (Christopher 2000, Mohanty et al. 2014), this evaluation is one of the key matters in business nowadays.

Evaluation of supply chain performance is, however, challenging. The wide concept of supply chain and the fuzzy concept of performance do not naturally provide explicit boundaries for measurement, making SCP a difficult topic to approach. Hence previous literature regarding the concepts, their measurement and performance improvement provides indispensable theoretical basis for this study.

In the next chapters are first discussed the definitions of performance, supply chain performance and logistics performance to establish an understanding of the phenomenon on a theoretical level. This is followed by chapter focusing on measurement and approaches taken on supply chain performance, after which the key frameworks regarding the evaluation of SCP are discussed. Last chapters of this section deal with improving supply chain processes and business analytics in the context of supply chain performance, which connect to both, the estimation of performance and to developing of suppliers.

3.1 Definitions

The business literature does not discuss the definitions of performance, performance measurement, performance measurement systems or management of performance extensively (Pekkola & Ukko 2016), in supply chain context either (Maestrini et al. 2017). Moreover, performance is often treated very abstractly or generally in theory sections of research papers, while empirical work is grounded in one or more specific outcome variables, which are reasoned on an ad hoc basis. This practice is very dangerous for the field, as it creates significant difficulties in interpreting the results of a published study. (Miller et al. 2013)

In light of these remarks, it is increasingly important to collect the research considering definition of performance in order to create a sound basis for the empirical part of this study. Should the study lack this, the risk of ambiguous results would be difficult to avoid.

3.1.1 Performance in business

Company performance is one of the most prominent concepts in organizational research. In spite of its importance and the many developmental critiques that have appeared over the years, performance is still a challenging concept to apply in a scientifically rigorous way. (Miller et al. 2013)

There are several definitions of performance on an abstract level. Laitinen (1998) describes performance as company's ability to produce results on the set dimensions in relation to the set goals. Pekkola & Ukko (2016) agree this by admitting performance to be concerned with achieving organization's goals, but also describe performance as a complex idea with versatile meanings.

As making of profit is often stated to be the ultimate goal in business, it is logical that firm performance has also been examined with heavy focus on financial aspects (see e.g. Sarkees 2011, Arraíz et al. 2013, Chaudhuri et al. 2016). Financial perspective on performance is inevitably important, but interpreting only financial measures does not give a profound view on the way the performance has been created. For a full picture of firm performance, also other types of descriptive measures need to be considered. This can mean the inclusion of qualitative measures as well.

Firm performance as a construct can be treated in three ways: as a latent multidimensional construct, as a domain of separate constructs and as an aggregate construct. These three approaches are, importantly, prominent in general research on the treatment of constructs. (Miller et al. 2013) The approach taken is in many studies not clearly stated, though the selection of approach is relevant for the interpreter of the results.

Latent construct is a construct that can only be measured indirectly (Statistics Finland 2011) and it exists at a more abstract level than its dimensions. Such a construct is represented by dimensions that capture the relevant conceptual space. Treating firm performance as a latent multidimensional construct is expected to appear as focus on abstract, general

conceptualization of firm performance in theory developments and in empirical work as assessing performance as the shared variance of dimensions based on factor analyses, reliability analyses and other similar tools. (Miller et al. 2013)

In separate construct approach, performance does not exist as a meaningful general construct but is a set of loosely related, distinct and separate constructs. Finding the empirical overlap between different aspects of firm performance to be very small, many researchers have encouraged those aspects to be considered as conceptually distinct. It is expected that in the theory development of a study, which applies this approach, the researchers focus their arguments on specific aspects of performance and in the empirical work assess distinct variables and use them in separate analyses. (Miller et al. 2013)

An aggregate construct of firm performance rests on the belief that performance is a complex concept with multiple components that must be conceptually reconciled and aggregated. From this aspect, performance is a holistic concept that is built from disparate dimensions which can provide an encompassing view when aggregated. In a study where this approach is used, it is expected that in theory development researchers focus their arguments on performance that has been explicitly conceptualized as a mathematical combination of various dimensions. In empirical work it is expected that in such study performance is being assessed using the mathematical combination of dimensions. (Miller et al. 2013)

3.1.2 Performance in supply chain

In industrial practice, performance has been estimated regarding each process instead of focusing on the whole supply chain (Clivillé & Berrah 2011). Focusing on the supply chain perspective could, however, provide a better understanding on the state of the whole process and how the subprocesses influence the formation of customer experience that takes place in the end of the supply chain.

Supply chain performance has had several definitions in the literature and several dimensions out of which it has been suggested to result from. For example, supply chain performance has been defined to comprise of product life cycle time, productivity, efficiency and revenue (Luu 2016). This definition, however, lacks the view of the customer, which is

ultimately at least as important as the perspective of the producing company. SCP has also been defined through operational measures such as operating costs, inventory costs and flexibility (Gunasekaran et al. 2001) and by using financial measures, for example profitability and return on assets (Paddeu 2016**,** Gunasekaran et al. 2001).

Fuzzier definitions can perhaps describe the nature of the concept better than precisely described characteristics. According to the definition of Dolci et al. (2017), supply chain performance results out of multiple combined actions. They state that enterprises seek to achieve predetermined goals by optimizing the available resources, which is connected to performance being understood through terms such as success, effectiveness, utility maximization and productivity improvements. Based on their perception, performance measurement should include internal and external approaches, first approach having operational focus and latter approach having financial focus. This is in line with previous research suggesting that financial performance is a result from operational performance (Kaynak 2003, Gunasekaran et al. 2004). Moreover, Clivillé & Berrah (2011) suggest that the performance of SC can be identified to be the combination of the operational processes' performances of the involved companies, which matches with the idea of Dolci et al. (2017) and supports the inclusion of operational aspect of supplier performance in the estimation of supply chain performance. This suggests that as a construct, supply chain performance should be evaluated with versatile dimensions.

Definition of supply chain performance can also be approached from the perspective of the measures used, which reveals certain preferences regarding the concept of SCP itself. Cadden et al. (2013) focused on buyer's supply chain metrics in evaluating supply chain performance, which included both operational and financial measures. This approach on the evaluation is reasoned in cases where the perspective of the study is that of the buyer. However, if supply chain performance is being attempted to define from supply chain perspective, the perspectives of all supply chain actors should be taken into consideration. Sustainability being one of the key aspects in business nowadays, this approach could yet be taken further by defining SCP from the perspective of all stakeholders of the SCP, including also environmental and social aspects.

The choice of actor perspective influences definition of SCP and hence the measurement of SCP. With each actor having a varying set of preferences and goals, also the measurement can differ from one setting to another. Based on the reviewed literature, the most encompassing approach to capture SCP is nevertheless achieved by using both quantitative and qualitative measures. The relation of perspectives and definition of SCP is presented in figure 5.

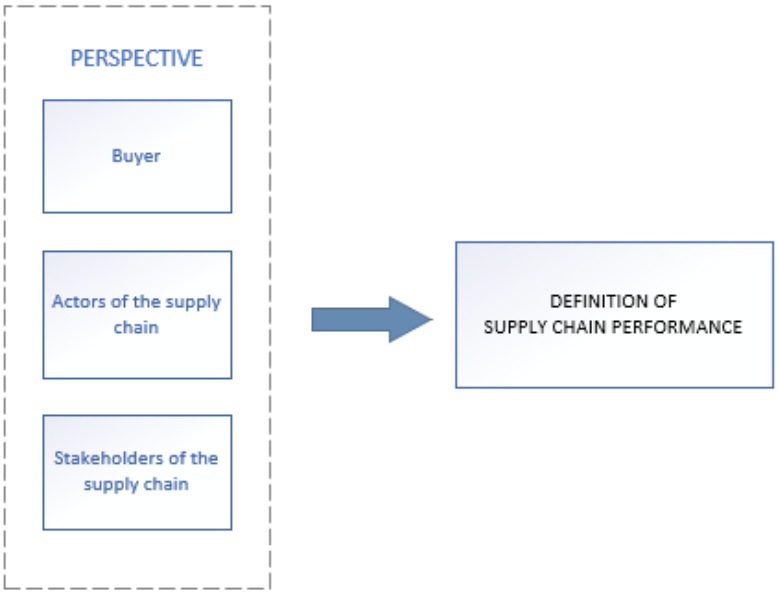

Figure 5. The relation of perspectives and the definition of supply chain performance

The definition of SCP can be approached from the perspective of aims of supply chain in general. The aims are often described in the form of 7Rs: ensuring availability of the right product, in the right quantity and the right condition, at the right place, at the right time, with the right information and at the right price (Azfar et al. 2014, Politis et al. 2014). The more precisely the goals regarding these aspects are met, the better the supply chain can be stated to have performed.

Characteristics of good and bad supply chains differ from each other. Characteristics of a good supply chain are suggested to be results-based, employee-focused, flexible, pragmatic and externally focused, in addition to which a good supply chain needs to thrive constructive criticism. Poor performing supply chains, then, can have culture characteristics such as job-focused, defensive, inflexible and internally-focused. (Cadden et al. 2013)

Logistics performance

As logistics are an inseparable part in supply chains of physical products and of this study, it is reasonable to discuss performance in the field of logistics as well. The difference between supply chain and logistics concepts is in the focus areas of the two: focus of the first is on the entity of supply chain with suppliers' and customers' aspects included, whereas focus of logistics is on flow and storage aspects in the supply chain (Paddeu 2016).

Garland et al. (1994) conducted a literature review about performance in logistics research which focused on definition and measurement of performance in logistics. Within logistics research, the definitions of performance have varied greatly between studies and organisations (Garland et al. 1994), as also has happened in general level regarding performance. Interestingly, soft measures have had a significant role in many empirical studies, though hard measures have not been excluded either. Logistics performance has also been studied in multiple levels, from e.g. activity level to firm level. (Garland et al. 1994)

Based on the review, Garland et al. (1994) argued that the concept of logistics performance is multi-dimensional and that no one measure will suffice for describing it. They suggest that it is the objective of researchers and managers to find a set of measures that collectively capture the most of those performance dimensions that are thought to be important. In current research a holistic view on logistics performance is still preferred (Dörnhöfer et al. 2016, Paddeu 2016), in addition to which the holistic approach seems to remain present in nowadays practice as well. For example, the popular Logistics Performance Index of World Bank Group includes several indicators and combines both qualitative and quantitative data in rating countries with the performance index (Arvis et al. 2016).

Performance in logistics can be evaluated by examining different aspects that define the successfulness of the activity. The aspects are almost the same as in the context of supply chain performance and often described as "7 Rights". The concerns from the logistics' perspective are delivering the right product, in the right quantity, in the right condition to the right place at the right time at the right cost to the right customer (Miler & Pac 2015, Kain & Verma 2018). Choosing performance indicators for all these areas enables the capturing of the essential in logistics performance. This aspect is included as a characteristic of logistics performance in the list of table 1, in which there are also relevant characteristics of business and supply chain performance presented.

Table 1. Overview on the characteristics of the concept of performance in business, supply chain and logistics

Business performance	Supply chain performance	Logistics performance
Different approaches to construct Concerned with organisation's goals	Multifaceted Operational and financial indicators Definition of perspective	Qualitative and quantitative indicators Holistic view is important "7 Rights"

3.1.3 Concept of supply chain performance in this study

Reflecting on the literature presented, the most important variables in defining the concept of performance are approach and perspective. With approach is meant the way under which the construct is being examined (as a latent multidimensional construct, from separate constructs approach or as an aggregate construct) and with perspective is meant the parties from whose perspective the performance is being evaluated. First of these variables influences the examination of the construct and the second influences the definition of the core elements of the performance.

The core elements in the concept of performance are goals and dimensions. Goals present the direction towards which is headed while the dimensions define the scope of the performance measurement, which then provides information on how the goals are being achieved. The goals do not need to be explicit but desirable direction of change in each dimension must be clear: otherwise, the evaluation of data in each dimension is impossible. In other words, the classification whether a dimension is a cost-type or benefit-type, needs to be also present in order to measurement of the dimensions to result in useful information.

The definition of supply chain performance in this study is defined as the extent to which buyer's business goals are achieved within multiple, separate dimensions and the concept is studied from the separate constructs approach. In other words, supply chain performance is being understood as a set of separate constructs, in this case dimensions, which can then be separately analyzed. By this definition it is also possible to measure the changes in

the performance indicators with the minimum level of manipulation of the indicators, unlike if the concept is treated as an aggregate construct.

3.2 Measurement

Neely et al. (1995, p. 80) define performance measurement as ”the process of quantifying the efficiency and effectiveness of action”. In this definition, with effectiveness is meant the extent to which customer requirements are met, whereas efficiency is considered as a measure of how economically the resources are utilised while providing certain level of customer satisfaction. In collaborative network, these actions are produced together with other actors. (Pekkola & Ukko 2016)

Supply chain performance measurement literature has evolved from financial approach to a balanced view of the supply chain inter-process activities (Agami et al. 2012), indicating the need to capture a holistic view of the process. This development of SCPM in a timeline is presented in figure 6**.** Nevertheless, the area of supply chain performance measurement is not fully studied. In the same year was published a literature review of Gopal & Thakkar (2012), in which was discovered that there still is room for research in addressing issues in SCP measurement.

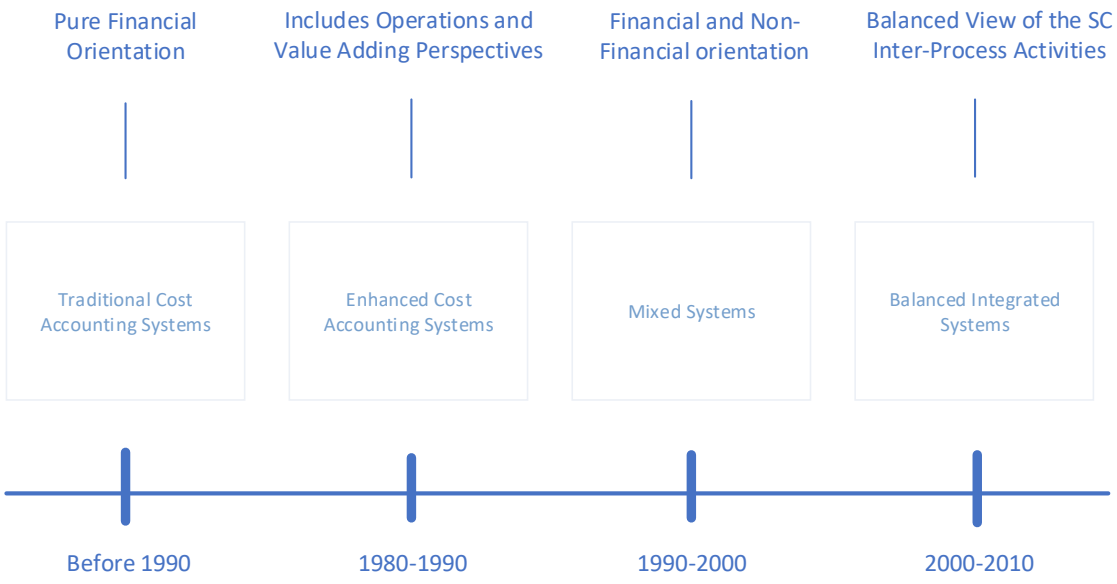

Figure 6. SCPM evolution timeline (adapted from Agami et al. 2012, 4)

The largest challenge in measuring supply chain performance is to generate appropriate metrics (Mertens & Björk 2007, Agami et al. 2012), as there are several ways to measure and define supply chain metrics. Moreover, the measures are frequently industry specific (Chaudhuri et al. 2016). Common to all supply chain measures is, however, that using them eases implementing new strategies in the supply chain (Elrod et al. 2013).

Consistent to literature regarding definition of supply chain performance, Beamon (1999) has stated that a single performance measure is in most cases not enough for estimating supply chain performance, for it does not consider relations between all the important supply chain characteristics, which is needed for objective and truthful evaluation of performance. She noted that when analyzing system performance, quantitative performance measures are often preferred as they provide more explicit information than qualitative measures, nevertheless she pointed out that numerical values do necessarily not describe the performance enough and can therefore be as imprecise measures as qualitative ones. In the beginning of 21st century, research on SCP management systems indicates that the need for holistic measurement still exists and that several issues related to that remain unsolved (Akyuz & Erkan 2010). This is logical in relation to the discussion going on about SCP itself, for as it cannot be explicitly defined it can also not easily be measured through a single indicator without compromising surrounding issues.

Based on a literature review, Gunasekaran et al. (2001) have developed a framework for measuring supply chain performance in strategic, tactical and operational level. They point out that companies should use a few good performance measures instead of increasing their volume and that a clear distinction between strategic, tactical and operational level metrics is necessary to ensure that each metric is assigned to a level where it is most appropriate. They also brought up that the environment influencing the delivery part of the process is dynamic and ever-changing, making it hard to be measured and improved.

Prior research has agreed that an effective SCPM system ought to be characterized by four features, which are inclusiveness, universality, measurability and consistency. With inclusiveness is meant that the SCPM system should cover all aspects and processes of a supply chain and with universality that it enables the comparison under different operating conditions. The perspective of measurability emphasizes that the output needs to be quantitative and measurable. Last feature, consistency, means that the metrics should be compatible with supply chain goals. (Agami et al. 2012)

3.2.1 Classification of measures

According to Beamon (1999), there are three types of measures that a supply chain performance measurement system should include. These types are resource, output and flexibility, each of which interacts with the others. The goal in type resources is to achieve high level of efficiency. In output, the goal is to have high level of customer service. The goal of the third type, flexibility, is to increase the ability to respond to a changing environment. (Beamon 1999) This classification can be seen in the background of several studies conducted later. Moreover, most supply chain metrics introduced in literature can be classified into these three groups, suggesting that the classification is one of the fundamental findings regarding the measurement of supply chain performance.

Resource

Resource measures are related to inputs of the process, which are mostly cost-type criteria for supply chain performance. According to Beamon (1999), these can include inventory levels, personnel requirements, equipment utilization, energy usage, distribution cost, total cost and return on investment. Last of these, however, describes the profitability of an organization instead of the whole supply chain process.

A general goal of supply chain analysis is minimizing resources. It is nevertheless to be noted that minimizing resources needs to be considered from the viewpoints of output and flexibility as well, because minimization of resources can lead to reduced flexibility in case of demand fluctuation. (Beamon 1999) Therefore, while the resource approach is taken in evaluation of supply chain performance, the risk of partial optimization needs to be considered.

The most important input performance measure in forest companies is cost per cubic meter (Larsson et al. 2015). The meter is important in the sense of incoming cost of raw material but also in the sense of cost of cubic meter in the end of the process, when the material reaches the customer.

Output

Output measures in the supply chain process are benefit-type criteria for supply chain performance. The measures describe the positive outcome of the production. Beamon (1999) presents number of items produced, time required to produce a particular item or set

of items, number of on-time deliveries and customer satisfaction as examples of measures belonging to this category. Moreover sales, profit, fill rate and customer response time are considered to belong to output type measures. She also indicates that questions regarding alternative costs of outputs are important to consider. According to her classification, time is included in this category, though it could be argued to also belong to resources as time connects to costs.

Output performance measures should correspond to the organization's strategic goals but also to customers' goals and values. An example of this is that lead times may be extremely important to the manufacturer, but the customer might give higher appreciation on-time delivery, in which case both measures should be included to the performance measurement system. (Beamon 1999)

The most important output performance measure in a forest company is volume of delivered raw material (Larsson et al. 2015). The measure being important on supply chain level as well, it can be declared to be one of the key supply chain performance indicators in forest companies.

Flexibility

Flexibility aspect describes the system's ability to accommodate volume and schedule fluctuations from suppliers, manufacturers and customers. For the success of the supply chain, flexibility is vital. Flexibility can be further classified into two categories: range flexibility and response flexibility, out of which first describes the extent to which the operation can be changed and the second of which describes the level of ease with which the operation can be changed. (Beamon 1999) The aspect of flexibility is amongst the most important ones in evaluating supply chain performance and there has been found evidence that superior flexibility capabilities connect positively to firm performance (Martínez Sánchez & Pérez Pérez 2005).

Flexibility can further be classified by several types of it. Beamon (1999) originally presents volume, delivery, mix and new product flexibility as measures for the category and suggests mathematical formula for calculation of those. These categories are important, but flexibility can also be evaluated on more levels and dimensions, as Martínez Sánchez & Pèrez Pérez (2005) later did by compiling a list of flexibility's dimensions in literature. Their comprehensive idea of the dimensions is presented in figure 7.

Measures of flexibility describe the level of potential behaviour and can therefore be difficult to estimate. According to Chuu (2011), managers often find it difficult to express their opinions of flexibility in numerical or financial measures, whereas linguistic descriptions have been found to provide more realistic evaluations. In estimation of supply chain flexibility, also fuzzy linguistic approach can be applied (Chuu 2011).

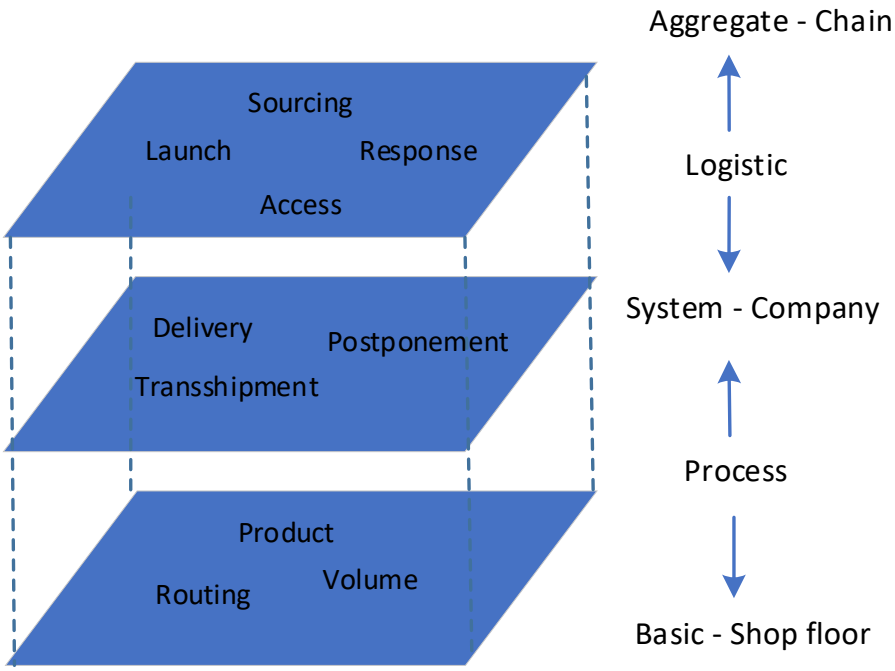

Figure 7. Dimensions of flexibility (adapted from Martínez Sánchez & Pérez Pérez, 685)

Based on the literature discussed in the preceding chapters, an outline of the key elements that influence the measurement of supply chain performance was formed and visualized in figure 8. The figure describes the factors that define the framework for the measurement and the ideal components in the measurement.

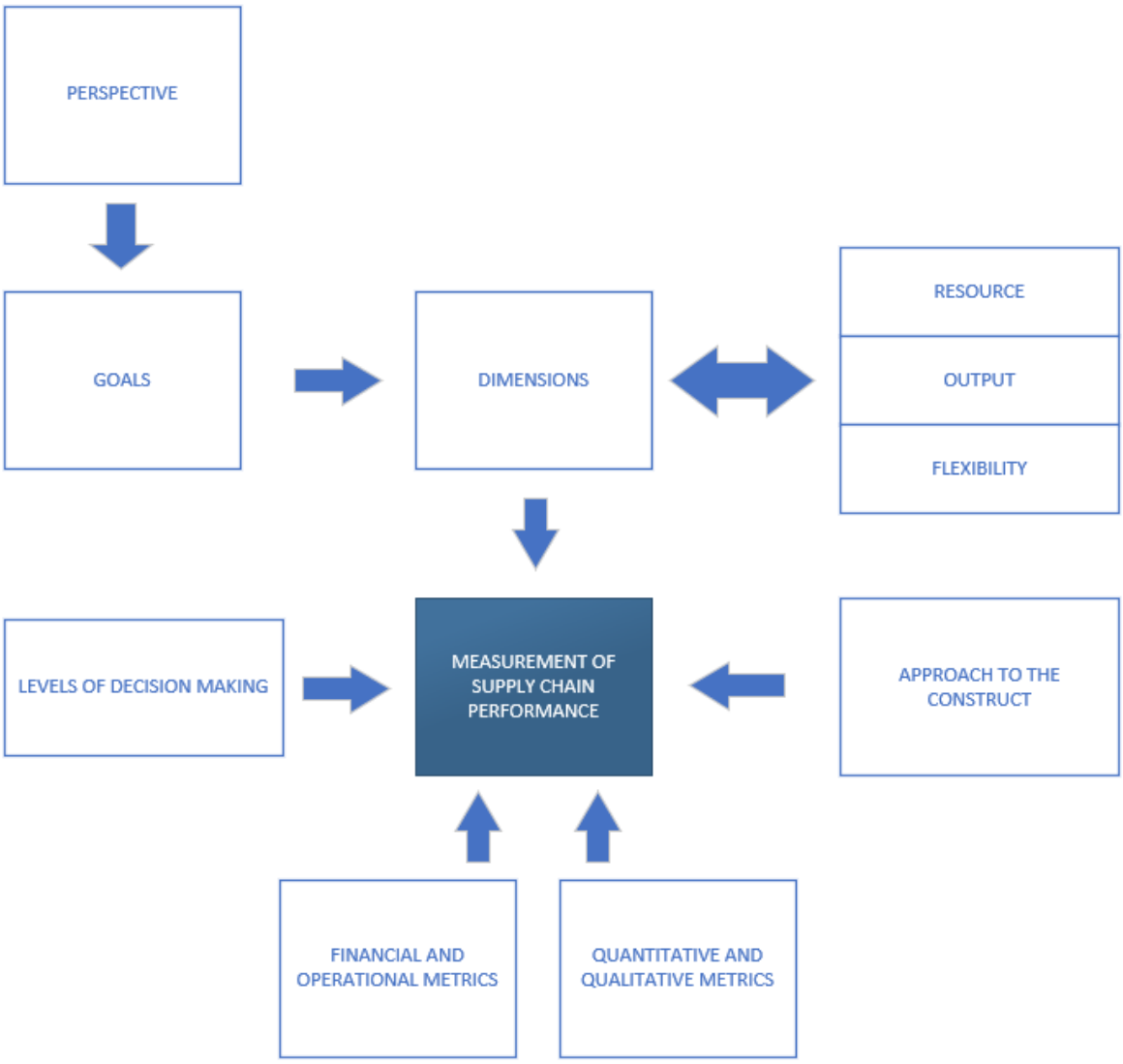

Figure 8. Outline of the key elements influencing the measurement of supply chain performance

In figure 8, the most important factor influencing the measurement of supply chain performance is the perspective from which it is being evaluated from. This perspective, let it be that of a government, buyer or a supplier, influences the definition of goals, which influence the definition of performance in the context. These goals affect the dimensions in which supply chain performance is being estimated from. The dimensions ought to be connected to the three categories of supply chain performance, which are resource, output and flexibility. In the measurement level, considerable aspects are the levels of decision-making (operational, tactical and strategic), approach to the construct (latent multidimensional, separate constructs or aggregate). Lastly, the metrics should include both

operational and financial metrics as well as quantitative and qualitative metrics in order to the measurement to provide a more holistic view on SCP.

3.2.2 Common frameworks

Performance measurement and improvement systems have significant influence in developing strategic plans and evaluating objectives of organization. Despite this, the proportion of firms implementing well-known performance measurement and management systems has remained low. (Alomar & Pasek 2014) In developing such a system, it is important to define the terms used in the development process (Pekkola & Ukko 2016).

A significant methodology that has influenced supply chain performance measurement (SCPM) literature has been the balanced scorecard developed by Kaplan and Norton (Akyuz & Erkan 2010). The balanced scorecard approach includes four perspectives: learning and growth, internal business process, customer and financial perspectives (Wake 2015). Using these perspectives, a somewhat holistic evaluation is pursued to be achieved.

It has been demonstrated that BSC's perspectives relate to business process performance to some degree. Despite BSC is primarily a strategic tool for organizational performance measurement, it is in fact based on indicators that originate from business processes. The BSC approach in business process performance measurement literature also seems to be omnipresent, as significant amount of papers mention or use BSC as a starting point and basis for their research and analysis. However, it appears that no comprehensive measurement framework regarding BSC perspectives and their extensions exists. (Looy & Shafagatova 2016)

In addition to the balanced scorecard methodology, which is rooted in the SCPM literature, also SCOR has been an important approach in SCP measurement literature. (Akyuz & Erkan 2010) SCOR stands for Supply Chain Operations Reference and it is a model for improving the performance of supply chain. The model is developed by a global non-profit organization, Supply Chain Council (SCC) (Alomar & Pasek 2014), which merged with APICS in 2014 (APICS SCC 2018a). The SCOR model has been founded by relying on process analysis, performance metrics and best practices to improve supply chains by identifying performance gaps, guiding organizational change management and providing the analysis needed to make improvement programs achieve increased levels of SCP. (APICS SCC 2018b) Also this approach attempts to include all the relevant perspectives into the measurement of performance.

A comprehensive literature review of Agami et al. (2012) presents the major trends in supply chain performance measurement literature and provides a list of approaches and characteristics of supply chain performance measurement systems. According to the study there are two types of common SCPM frameworks, which are financial performance measurement systems and non-financial performance measurement systems. Within the financial performance measurement systems, popular approaches are activity-based costing (ABC) and economic value added (EVA). This financial approach to supply chain performance is regarded as the traditional way of evaluating performance. The traditional way, however, lack the holistic view on the supply chain, which is a need on which the non-financial systems attempt to answer. Non-financial performance measurement systems are systems that can include both financial and non-financial metrics. In this category, popular systems are supply chain balanced scorecards (SCBS), supply chain operations reference model (SCOR) and dimension-based, interface-based, perspective-based, hierarchical-based, function-based, efficiency-based and generic performance measurement systems. (Agami et al. 2012) This massive list of characteristics in previous literature highlights the existence of diverse approaches to SCPM concretely.

In table 2 are listed the non-financial performance measurement systems with their measurement criteria, which is done according to the perception of Agami et al. (2012) The table provides a good overview on the different performance measurement systems and elucidates their differences.

Table 2. Non-financial performance measurement systems and their measurement criteria (columns 1 and 2 adapted from Agami et al. 2012, 10)

TYPE OF MEASUREMENT SYSTEM	CRITERIA OF MEASUREMENT	FOCUS
1. Function-based systems (FBMS)	Performance measures of functions within each process of the supply chain.	Functions
2. Dimension-based systems (DBMS)	Performance evaluation of predetermined key dimensions across the supply chain.	Criteria
3. Hierarchicy-based systems (HBMS)	Performance measures identified on three levels of management: strategic, tactical and operational.	Levels of decision-making
4. Interface-based systems (IBMS)	Performance measures defined between supply chain linkages, i.e. stages	Interfaces, different parties' view on performance
5. Perspective-based systems (PBMS)	Performance measures on *six perspectives* of the supply chain: operations research, system dynamics, logistics, marketing, organization and strategy.	Perspectives
6. Efficiency-based systems (EBMS)	Performance measures to evaluate the supply chain efficiency.	Ratio of output and resources
7. SC Operations Reference Model (SCOR)	Performance measures along the five main supply chain processes: Plan, Source, Make, Deliver and Return.	Key processes
8. SC Balanced Scorecard (SCBS)	Performance measures across four supply chain perspectives: Financial, customer, internal business processes and innovation and learning.	BSC's perspectives
9. Generic systems (GPMS)	Performance measures are strategy aligned.	Connection to strategy

Performance measurement in a network level is important for gaining a good insight on the behavior of performance factors in the collaboration. The importance of a network-level performance measurement system and its benefits in enhancing the success of a network have been well recognised by researchers as well as practitioners (Pekkola & Ukko 2016). A system for measuring the performance in a collaborative network can ease the disclosure of process-level opportunities for improvement. Such a performance measurement system is a set of metrics that are used to quantify the efficiency and effectiveness of purposeful actions and processes that have been produced in collaboration (Papakiriakopoulos and Pramatari 2010).

3.3 Improvement of supply chain performance

As supply chain performance crosses both functional and company boundaries, it can be challenging to manage and improve the supply chain (Najmi & Makui 2011). However, improvement of supply chain performance has been seen as a relevant objective which has been pursued in through varying approaches, discussed in the next chapters.

Examining certain parts of supply chain performance can reveal valuable details needed for the development of the performance. Measuring only supply chain performance is often not the most optimal solution, for breaking the whole into pieces or examining different aspects of a supply chain, such as supplier performance, is a good approach when pursuing a better insight into current and potential future problems in the supply chain (Elrod et al. 2013). This is especially useful when source of a certain change in chain-level performance is looked for.

Surprisingly, companies tend to pursue for improvement in their supply chain processes without systematic approach to performance. Nakano & Nobunori (2017) examined the success factors for continuous supply chain process improvement by investigating eight Japanese manufacturing firms as case studies and found out that firms with high scores in supply chain operations do not have supply chain performance systems and that the manufacturers have the tendency to improve their supply chain processes in the absence of such systems. The background of this case also supports the finding.

Continuous improvement itself has also been seen as an important aspect to supply chain performance improvement. According to the study of Nakano & Nobunori (2017), a key

success factor (KSF) for continuous improvement in supply chain processes is planning through cooperation and coordination amongst middle managers/SCM department staff. Secondly, conducting evaluations using a supply chain performance system that relates the cause-and-effect of SCM activities is identified as another KSF. The last factor is considered to be linking the evaluation phase with the improvement phase through a shared space for joint problem-solving, e.g. through regular meetings. (Nakano & Nobunori 2017)

3.3.1 Business analytics and the improvement of SCP

Business performance analytics comprises out of systematic use of data and analytical methods (mathematical, econometric and statistical) for performance measurement and management to create information. Rooted in the performance management systems literature, there is a growing consensus that business analytics have a great potential for performance management purposes. (Raffoni et al. 2018) The larger the area of performance being measured and estimated is, the more complicated the topic becomes, resulting in a need for greater analytical skills and tools. Three key factors have been addressed in research that promote the need for the application of business analytics: excessive data, organizational interdependencies and the need for holistic approach (Gashgari 2016). Each of these factors is present in the area of supply chain as well.

However, in the area of business analytics it has been found difficult to extract strategically valuable insights from the data and the focus in often in collection, cleansing and storing of all possible data instead of understanding what the data can deliver and what is relevant for supporting performance management. (Raffoni et al. 2018) Specifically the gathering of the required data for business analytics' effective use is in many cases acknowledged to be a challenge for an organization. Some performance drivers are hard to measure, especially those that are intangible. A limitation for business analytics is also the use of past data, which is always not good for the prediction of future development. (Schläfke et al. 2013)

Despite the challenges connected to the application of business analytics, the potential value that lies in it remains significant. According to Gashgari (2016), effective use of business analytics improves strategic decision-making and can ease managing the performance in a way that results in competitive advantage. Moreover, operational efficiency can be improved by the business analytics that can identify more efficient ways of processing in terms of cost and time (Gashgari 2016, Ramanathan et al. 2017).

There has been evidence that applying business analytics on certain supply chain areas can improve supply chain performance. Especially analytics applied into “Make”-aspect of SCOR-model can result into an effect in supply chain performance. In the other end, applying business analytics appears to be least effective while applied to the delivery aspect of the SCOR model. (Trkman et al. 2010)

4 Supplier development programs

Supplier development is any activity taken up by the buying firm to improve supplier capabilities and their performance (Yawar & Seuring 2018), which influences supply chain performance (Kumar et al. 2015). Common to the measurement of supplier and supply chain performance is that they are evaluated based on several criteria (Dey et al. 2015). The more the supplier influences the performance of the supply chain, the more significant impact can the development of that supplier result in.

Much of the early supplier development has focused on reaction to crises that might arise with basic requirements of performance, which has then evolved to joint efforts to improve the competitive positions of both, supplier and the buyer, or even the whole supply chain. The development of supplier typically includes current and desired performance evaluation together with an evaluation of the type of the relationship that exists between the parties. (Bai & Sarkis 2011)

A supplier development program consists out of several supplier improvement and development activities that are conducted to either one or several suppliers. These activities can influence buyer and supplier performance in a great extent and they are applied to maintain a capable and high-performance supply base, which supports the goal of staying competitive (Dalvi & Kant 2015). From strategic point of view, the development should be closely aligned with organisation's corporate strategy (Bai & Sarkis 2011).

Supplier development activities are undertaken by buying firms to increase and improve supplier capability and performance. Research has also found that performance of suppliers has significant effects on many production dimensions of a company, such as delivery and quality. (Dalvi & Kant 2015) Moreover, evidence has also been found that supplier performance influences buying firm's operational performance, with joint action and trust being important factors in enabling the development (Mohanty et al. 2014).

Activities conducted within a supplier development program can vary greatly. Fundamentally, supplier development refers to a group of company activities aimed at improving suppliers' performance by producing for example improvements in the offering of the supplier, which are needed to meet supply needs in a short- or long term. (Praxmarer-Carus et al. 2013) A prerequisite for the successfulness of these development activities is

that there exists a strong and long-term relationship between suppliers and buyers and that both of the actors recognize the value resulting out of the program (Dalvi & Kant 2015).

Supplier development activities can be conducted either directly or indirectly (Wagner 2006, Yawar & Steuring 2018). Direct supplier development activities are such that require significant relationship-specific resources from the buyer and indirect supplier development activities are contrary; those that do not require significant commitment from the buyer (Wagner 2010).

Different forms of supplier development activities seem to have also different impact. There has been found evidence that indirect supplier development improves suppliers' product and delivery performance and supplier capabilities, whereas direct supplier development influences only supplier capabilities. Moreover, applying both approaches at the same time has appeared to be less effective than applying only one approach at a time. (Wagner 2010) It has also recently been found that only investments on supplier development program do not result in desired effects of supplier development (Kumar et al. 2018), which suggests that other factors have a greater influence on the successfulness of the program.

Supplier development practices can be classified to belong in four major categories in the literature, which provide a general overview of the type of practices. These are knowledge transfer, investment and resource transfer, feedback and communication and management and organizational practices (Sarkis & Bai 2011), which's characteristics are presented in table 3**.** Despite being general, the classification provides a good basic view on the types of development practices presented in literature.

Table 3. Categorization of supplier development practices and activities in literature (adapted from Sarkis & Bai 2011, 13507)

Knowledge transfer	Investment and resource transfer	Feedback and communication	Management and organisational practices
Training suppliers' employees Train suppliers in buyer expectations Train users in capabilities Train suppliers in cost control Giving manufacturing, technological, product development or quality related advice to the supplier	Invest in simplify transaction processes Reduce supplier costs Solve supplier technical problem Finance supplier major capital expenditures Transferring supplier employees to buying firm Transferring own employees to supplier firm Investment in supplier capacity building Supplier rewards and incentives	Supplier evaluation and feedback Develop supplier assessment program Providing feedback about their performance Strong formal supplier evaluation Setting improvement targets Auditing suppliers Joint problem solving Information sharing Regular joint meetings with commodity and plant managers Ongoing communication with supplier community via supplier councils	Long-term contracts Introduce a cross-functional supply chain team Building top management commitment/support for buyer organization and supplier organization Organization management has formal long-term plans to improve supplier performance Formal process of supplier development and supplier cost reduction targets Identification of high-performing critical suppliers for cost reduction and other improvement opportunities Criteria established about when to enter into supplier development The participation level of suppliers in the design stage and in the process of procurement and production

Selection of the suppliers to be developed is an important decision in supplier development and especially the criteria used in the selection have a significant role. An inappropriate selection of suppliers may lead to failure of the supplier development objectives. (Dalvi & Kant 2015) An underlying axiom of supplier performance is that 20 percent of suppliers is responsible of 80 percent of poor performance (Handfield et al. 2000), which is why developing especially the worst-performing suppliers can pay off the effort for the buying company. The identification of these suppliers requires systematical analysis of performance data (Handfield et al. 2000), meaning that if no such data is already collected, targeting of such companies can be challenging.

The results of a supplier development program should be evaluated on the basis of both, the developmental and dimensional objectives (Hahn et al. 1990). The evaluation of results from both perspectives enables the better estimation of change that has taken place, as the dimensional metric does not necessarily indicate how much the improvement has required efforts to realize. A slight improvement in dimensional measure can have required a lot of development work, which should not be disregarded especially then when efforts have been taken by a committed supplier.

Interestingly, despite the popularity of supplier development programs, there is also less positive evidence of the realized effectivity of them. Moreover, multiple studies highlighting the positive influence of a supplier development to performance have been conducted but not all of them are fully free from bias. An example of positive results is a study of Humphreys et al. (2004), in which they examined transaction-specific supplier development and discovered that it was positively connected to buyer-supplier performance improvements. However, their study was based on a questionnaire that resulted in expert opinions, which leaves the basis of the evaluations of the respondents unrevealed. This is especially interesting in the light of a study from Rogers et al. (2007), in which it was examined if a supplier development program is rational process or institutional image construction and found stronger support on the latter suggestion. They concluded that in the investigated case there were contribution to substantial improvements made, but the performance measures were subject to various forms of manipulation and bias, due to which it was considered to be more likely that the actual development was not quite the same as the perception of the organization.

Partly negative results regarding the effectiveness of development programs have been acquired later as well. Arroyo-López et al. (2012) examined supplier development programs influence on supplier performance in automotive industry in Mexico. Their results suggest that basic and widely used forms of supplier development hardly lead to improved

operational and financial performance of suppliers. However, they also concluded that more demanding supplier development activities may improve supplier performance if the supplier has sufficient absorptive capacity and that there exists an adequate collaborative and relational learning context.

Not all of the studies that conclude with positive influence have been conducted in a deep level. An example of this is a study of Arraíz et al. (2013), in which it was concluded that Chilean Supplier Development Program influenced the performances of both, suppliers and buyers through e.g. increased in sales and sustainability. However, the supplier development program examined in their study was imposed by a government from which's perspective the study itself was conducted, and the examined measures were limited to numerical data possessed by the government, which does not provide deep information regarding the examined program. This might partly also explain why all of the examined measures of influence did also not react to the program.

Despite the negative examples presented here, the majority of literature largely supports the idea that supplier development activities influence performance positively (Ghijsen et al. 2010; Li et al. 2012), which can also be seen in the number of articles considering benefits of supplier development programs. The positive influence of programs has been reported in the form of multiple benefits, in addition to which the positive outcomes have been connected to activities connected within the program.

The influence of supplier development program on performance outcomes has been recently studied by Kumar et al. (2018). In this context, performance outcomes consisted of supplier performance improvement (SPI), buyer-supplier relationship improvement (BSRI) and buyer's competitive advantage improvement (BCAI), while supplier development program was examined through five constructs: strategic efforts, knowledge and information sharing, investment, working together with suppliers and involvement of buyer and supplier. It was found out that in the group of these three performance outcomes, strategic efforts have a direct impact only on SPI. Knowledge and information sharing, then, had a positive relation with each of the performance outcomes. Investments had no relation with these three outcomes. Working together did not have a significant relation with BSRI, but it did have a relation with BCAI and SPI. Last but not least, involvement of buyer and supplier did have a relation with SPI and BSRI. (Kumar et al. 2018) They suggested the most influential activities in supplier development programs to be strategic efforts, knowledge and information sharing, working together and involvement of both parties. Out of these activities, knowledge and information sharing in supplier development has also previously been found to be a factor that influences buyer's performance (Carr & Kaynak 2007).

Success factors in supplier development have often been studied from the perspective of the buying company. Krause & Ellram (1997) suggested buyer's involvement and communications efforts to have a key role in successful supplier development activities, with detected supplier performance improvements in the area of quality levels and the percentage of orders received complete. Also Routroy & Pradhan (2014) agreed this in their study where they approached the influencing factors on supplier development by identifying 13 critical success factors and their corresponding KPIs for supplier development in manufacturing environment. In the factors they found were also included strategic goals, incentives and information sharing, which have been mentioned by other researchers as well.

As a conclusion for the chapter the following points can be made. First, supplier development has interested researchers for long and there largely seems to be a consensus on the benefits of the program. However, as pointed out by Rogers et al. (2007), the results regarding the realized effectivity of supplier development can, in some circumstances, be reasonably questioned. It is usually expected by the initiators of a supplier development program that the activities will result in positive influence, which can then affect their evaluation of the successfulness of the program afterwards. Secondly, the forms of supplier development within programs vary, which influence the results of the programs. Thirdly, careful evaluation of activities and included suppliers ought to be conducted during the planning process, in addition to which the program itself should be evaluated afterwards from several perspectives. These connect to the fourth and the last point, which is that the frequently mentioned key success factors in literature connect to information sharing, strategic orientation and communications, that often induce positive results.

4.1 Benefits

In procurement, the improvement and development activities of suppliers are relevant management activities which can result in great earnings when conducted in a form of supplier development program. (Handfield et al. 2000; Praxmarer-Carus et al. 2013) The benefits can vary and consider both supplier and a buyer, or even the whole supply chain (Bai & Sarkis 2011), due to which also the benefits should be evaluated from all of these perspectives.

As the supplier development programs are usually conducted by a buyer, the benefits of the development are in literature also often described from the buyer's perspective (Ghijsen

et al. 2010). According to Dalvi & Kant (2015), three main benefits occurring from developing suppliers have been suggested to be competitive advantage, improving supplier performance and long-term or strategic benefits. Other benefits incurring are effective supply chain management, effective communication, improvement in supplier performance, quality, delivery performance and cost reduction. (Cormican & Cunningham 2007; Dalvi & Kant 2015) Also image contribution has been recognized as an important motive (Hales & Arumugam 2012).

Supplier commitment is also a valuable benefit that can be strengthened via supplier development. SCM literature emphasizes that supplier commitment and satisfaction are important elements to establish successful exchange relationships. To enhance the level of supplier commitment, manufacturers have been recommended to build relationships with their suppliers and encourage them to involve in the supply chain. (Ghijsen et al. 2010) Supplier's relationship commitment reflects the intrinsic motivation of the supplier to contribute to the relationship with the buyer, over and above economic factors (Chae et al. 2017).

From the supplier perspective, the benefits occurring from the development are less studied than benefits from the buyer's perspective (Ghijsen et al. 2010). Some benefits have, however, been recognized from that viewpoint as well. One of these is operational performance improvement (Nagati & Rebolledo 2013), which is a considerable incentive for participation in a supplier development program. The improvement of operational performance of the supplier is undoubtedly a benefit from the perspective of the buyer as well, but in this case the development does not reward solely the parties of the development program, due to which it might be that this kind of benefit does not enhance the competitive position of the buyer as much as expected.

Some advantages of development programs also benefit both parties, the buyer and supplier. An example of such benefits is the alleviation of social and societal issues through supplier development that aims at improving economic performance (Yawar & Seuring 2018). This, however, is not a common setting in Finland.

Supplier development programs can also include changes in supply base and reducing the number of suppliers is often mentioned as an objective in procurement practice. There are at least three approaches to supply base reduction discussed in literature, which are systematic elimination, standardization and tiering (Ogden & Carter 2008). The chosen reduction method influences to the gained results, but on general level the reduction in the

number of suppliers has been connected to increased quality, reduced lead time and decreased amount of errors and defects (Cormican & Cunningham 2007).

For benefits from supplier development programs to occur, major investments do not have to take place, as undertaking small kaizen events often uncovers significant benefits without major resource commitments (Handfield et al. 2000). Continuous improvement itself plays an important role in supply chain development (Bai & Sarkis 2011, Nakano & Nobunori 2017).

4.2 Challenges

Developing suppliers includes its challenges, one of which is the spillover of increased supplier performance to other, competing customers as well. This can take place especially when quality is improved, as the supplier will likely produce the improved quality products for all of its customers. Another challenge relates to the ability of a supplier to develop as planned, as the development capability can necessarily not be predicted accurately in beforehand. (Agrawal et al. 2016)

Axiomatic risk related to development programs is their failure. Supplier development programs can fail from the perspective of either the buyer or the supplier, or in worst case from the perspective of both and it can be caused by a variety of reasons. Some significant predominant reasons for the failure can be opportunistic behaviour of supplier and low-cost target of the buyer (Dalvi & Kant 2015). Other reasons for failure can be unrealistic expectations regarding the development, lack of adequate support for the program in buyer or supplier side and drastic changes in the markets, which either cause poor results or discontinuation of the program.

Critical factors for supplier development program are trust, commitment, personal resource engagement, information sharing and technology sharing and if the program is implemented in an environment that lacks these, it is likely to fail. (Handfield et al. 2000, Cormican & Cunningham 2007, Mohanty et al. 2014) From supplier perspective, critical factors for supplier development programs are availability of information, formal structure of communication, geographical proximity, competence level of the buyer's employees (level of buyer support), supplier proactivity, buyer attractiveness and buyer volume dependency. (Svenson & Gustafssson 2014) These factors seem to especially relate to the easiness of conducting the program from the supplier perspective. The idea of easiness of conducting

the program as a determinant of supplier motivation would also seem logical in relation to a study conducted in Tanzania, where it was found that most of the examined suppliers were reluctant to invest much time or funds on development activities (Calignano & Vaaland 2017).

Moreover, the perception of buyer as exploitative can be a challenge for SDPs. (Kumar & Routroy 2017b) This could be related to the negative connection that exploitation has on trust, which has been recognized as a key element in supplier development's success.

The pitfalls of supplier development programs often arise in four stages: meetings of buyer and supplier management teams, in the stage of defining key projects, in defining agreement terms and metrics and in monitoring project status with subsequently monitoring strategies. (Handfield et al. 2000) This should be considered in both, the planning and execution stage of a supplier development program.

4.3 Motivating suppliers

Tangible economic benefits of a supplier development program are always not enough for motivating the suppliers to engage into the program. Due to this it is necessary to examine the sources of motivation the suppliers can have in order to understand the situation from supplier's perspective and to promote the participation to the program effectively.

An important source of supplier motivation is customer attractiveness, which in several cases has been found to be a significant factor that influences the motivation of supplier to engage in supplier development program (Mortensen & Arlbjørn 2012; Nagati & Rebolledo 2013). Buyer attractiveness has been described as a buyer's interaction strategy that aims to increase supplier dedication to the buyer in relation to supplier's other customers. It is relational and multifaceted by its nature. Buyer attractiveness also seems to be connected to experienced and expected business outcomes within the focal relationship and to the leverage impact of the relationship on supplier's other relationships in order to realize business outcomes elsewhere. The attractiveness enhances supplier adaptation, which leads to increased supplier attractiveness, followed by buyer adaptation and increased buyer attractiveness. (Makkonen et al. 2016)

Moreover, strategic fit between the organizations seems to have a role in the motivation as well (Mortensen & Arlbjørn 2012). This can be especially important in programs where suppliers are required to develop new skills, for supplier development activities that require

the suppliers to develop new skills are such that require long-term orientation (Nagati & Rebolledo 2013), i.e. long-term prospects need to exist.

Decreased uncertainty related to business is also a source of motivation. Buying firms can motivate suppliers and develop them by giving a feeling of secure long-term business prospects, reliable markets and customer satisfaction. (Mohanty et al. 2014) This connects to results of Nagati & Rebolledo (2013), which underline that contingency of environment motivates suppliers to participate in SD activities to improve their competitiveness. The long-term prospects also connect to the strategic fit between the organizations mentioned by Mortensen and Arlbjørn (2012).

Supplier motivation can be intrinsic or extrinsic. Intrinsic motivation reflects the motivation that results out of customer attractiveness in relation to supplier's purposes, which does not require buyer activities to be created. Extrinsic motivation results from reward and coercive powers, which the buyer can use to influence motivation. The powers do not influence the buyer-supplier relationship the same way, which needs to be considered while they are used. There has been found evidence that buyer's reward power enhances the supplier's relationship commitment while buyer's coercive power inhibits it. This is especially important, for supplier commitment is a stronger predictor on performance than supplier compliance. (Chae et al. 2017)

All of the matters presented in these chapters are such that are worth considering in a planning or estimation stage of a supplier development program. In planning stage, it is especially important to evaluate the benefits and possible challenges against another, but also to understand aspect of supplier motivation to engage into such a program. After a program has been conducted, the estimation of benefits, challenges, motivation of suppliers and both pitfalls and success factors can also provide valuable insight on the reasons of the realized development, out of which especially the buyer can learn. The key aspects and examples of them are gathered in table 4.

Table 4. Key aspects to developing and evaluating a supplier development program

Benefits	Challenges	Sources of motivation	Pitfalls	Success factors
Competitive advantage Increased supplier and buyer performance Long-term benefits Strategic benefits	Perception of exploitative buyer Spillover of increased supplier performance to competitors Ability of supplier to develop	Experienced and expected business outcomes Leverage impact of the relationship to business goals elsewhere Long-term business prospects Reliable markets Customer satisfaction Strategic fit between the organizations	Opportunistic behaviour of supplier + low-cost target of buyer	Joint action, involvement of both parties Trust Long-term relationship Knowledge and information sharing

5 Empirical study

The empirical part of the study has been conducted in Finnish forest industry with a large case company that is a part of a corporation manufacturing versatile wood-based products. The company has operated in the field for long and they manage their supply chain processes with a firm experience. In the context of this study it is also to be noted that they have supplier negotiation power resulting out of the significant size differences between the parties, as they are more than hundred times larger than any of the suppliers. This is a factor that influences the likelihood of supplier development's effective implementation.

The area of focus of the study was on supply chain actors between raw material source and factory, who operate the process for the case company. This area of focus is described in figure 9. The situation was optimal for evaluation of the performance of the supply chain, for in most of the cases the company controls both, the starting point of the process and the finishing point of it, so it was possible to evaluate the performance of the process from both ends of it.

Improving the supply chain efficiency in this part of sourcing supply chain is not a new case, as e.g. Chauhan et al. (2011) developed a mathematical model aiming to increase efficiency particularly in this area. As in their paper, also in this study is considered a two-echelon timber supply chain in which the first echelon consists of multiple stands to be harvested and the second echelon consists of mills to be supplied with this raw material.

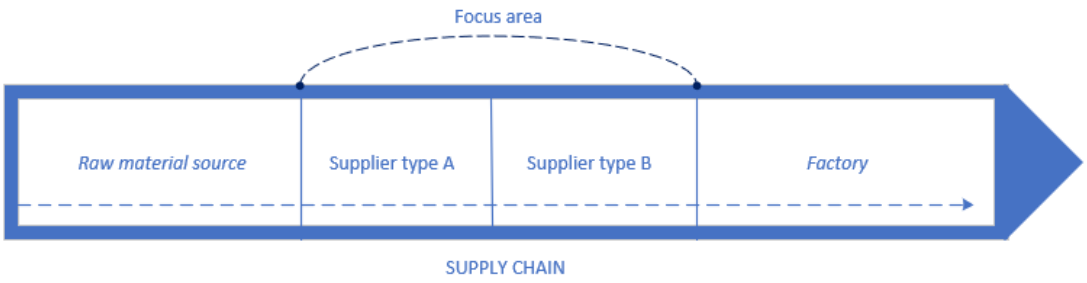

Figure 9. Focus area in the supply chain process

Moreover, the focus of the empirical work was on influence that takes place through improvements in supplier performance. The influence of the supplier development program was examined through focus on parallel changes in both, supplier and supply chain performance. The assumption of the path of the influence is presented in figure 10.

Figure 10. Supplier development program's expected influence on supply chain performance

5.1 Background

Due to the highlighted transparency requirements regarding validity and reliability in mixed methods research, the background of the case and characteristics of the research setting are separately described in this chapter to provide the reader with a clear insight on the environment in which this study was conducted. First is introduced the examined supplier development program, after which the characteristics of the research process are presented.

5.1.1 Development program

The case company started to develop its type A suppliers in 2010 and type B suppliers from year 2016 on. This development was conducted through three smaller cycles introduced as “visions”: two considering type A and one considering type B. Common to these visions were the major goals of them. The development program, consisting out of the three visions, was launched in order to improve the performance in the supply chain, for the company saw development potential within these groups of suppliers and the operations processes. This development potential was expected to realize in a way that could be seen as e.g. increased productivity, decreased costs, decreased supply risk and satisfied customers within both ends of considered part of the supply chain.

The common goals were pursued by conducting three major changes. First of these had to do with the size of the suppliers. Previously, the case company had collaborated with a large number of suppliers, some of which were extremely small. This meant a large number of transactions with the suppliers and high coordination costs. Due to this the first goal of the program was to decrease the number of suppliers dealt with. However, especially in type A suppliers it was considered important not to lose any actors during the process, excluding the option of pure competitive bidding from the list of options. Instead, the suppliers were encouraged to merge with each other in order to reduce amount of the transaction costs and to improve efficiency in the process. In other words, the supplier development program used tiering as tool for changes in the supply base and as a source of benefits. This has been expected to benefit the supplier, the buyer and the performance of the supply chain.

A second idea behind the program was to reorganize work in a way that increased suppliers' responsibility in the process, i.e. they received a larger share of the activities to be conducted. This could be performed after suppliers had merged into a sufficient extent, for in a larger organizational unit they were better capable of receiving new responsibilities. The reorganization of work was carried out so that the suppliers received access to planning information regarding their core capabilities, which they then could process more efficiently due to their area of specialization. Previously, the case company had interfered with the planning that considered the way the supplier operates, which caused unpredictability from the suppliers' perspective and in some cases added the amount of overlapping work between the buyer and the supplier. Now the supplier was enabled to plan their own operations and case company's task shifted from managing the operations into managing the suppliers. This idea applied to both groups of suppliers, those in type A and those in type B; however, only in type A this change was fully completed by 2018. In class B, this was yet not the case.

Moreover, the type A suppliers also received a larger share of operative tasks (regarding silviculture) to be conducted under their contract. These added tasks were related to the needs of the forest owners. It was expected that after this change was conducted, the forest owners would get better quality in these services, which could then result in improved satisfaction degree in this group of stakeholders.

Third idea behind the program was related to resources within the supplying company. In the beginning of the development program, not all companies had a clerk who could take care of the supporting activities. Instead, in several companies the entrepreneurs were both handling the operative tasks and conducting the supporting activities. Hence, an important goal of the program was that the supplying company hired a clerk for the support activities. This was expected to improve the quality of the process by encouraging the entrepreneurs to focus on their core tasks and by enabling a better coordination of these tasks and better customer service for the buying company.

Other ideas of the development program related to improving the level of collaboration with the suppliers, especially those in class A, and improving the commitment of suppliers. These ideas were, however, not as important, clearly implemented or enough old that they would be expected to have had quantifiable implications by 2018, due to which they were left out from the scope of this description.

5.1.2 Characteristics of the research process

The reliability in a mixed method study can be enhanced through three techniques: the investigator's position, triangulation and audit trail (Mohammad 2013).These aspects are considered by presenting the the related matters in separate chapters.

The study has been conducted within close collaboration with the case company. The researcher has had a direct access on system data regarding the process and ability to directly connect to the interviewees throughout the process. The investigator had not had prior contact with the topic nor the interviewees before starting the research process and had no prejudices regarding the development during the program. All practical information and aspects introduced have been learned during the research process and the theoretical background of the investigator originates in business and supply management. Hence the risk that prior experience in similar setting would influence the interpretation of research results is minimal.

In the data collection phase, the triangulation is increased by both, data and method triangulation. Data has been collected from the case company's operating system and from interviews conducted during the process. These two information sources provided the study with objective numeric data (main source of performance measurement information), qualitative system information (how performance is built, how it has appeared and what has

it been influenced by) and classifying information (to be combined with quantitative information in order to ensure the reliability of the results). Theoretic triangulation, then, takes place in the analysis phase where the results of the two sections are compared with theories that are connected to the topic.

The aspect of audit trail has been taken into consideration throughout the text by providing the reader with detailed information on the process itself, on the trail through which interpretations have been made and by providing visual presentations of the connection of research elements on a conceptual level. This provides a multifaceted explanation on the trail itself, which is expected to provide the reader with a clear insight of the research process.

5.2 Qualitative part

The qualitative part of the research process was prepared during the first month of the research process while semi-structured interviews were designed. In preparation stage, two separate interview forms were created to serve three purposes. First of these was to gain information contributing to the research questions from the qualitative point of view. Second purpose of the part was to gather information for classifying the suppliers in the quantitative part. The last purpose of the qualitative section was to provide information on relevant measures of SCP in this part of the supply chain in the company.

Sampling method used was elite sampling. Elite sampling is a method in which only those people, who are considered to have the best ability to provide information regarding the phenomenon, are selected as informants for the study (Tuomi & Sarajärvi 2018). The method was reasonable for this study due to the fact that it was clear which part of the case company's personnel had the best knowledge regarding the supplier development program. There were both, personnel working in the supplier interface and personnel working in the management, involved to provide a rich view on the phenomenon.

In this section are first briefly described the method that have been used. After this, the results regarding the interview questions are presented in the order of the interview. Lastly, aggregating analysis regarding the results is presented.

5.2.1 Interviews

Interviews were conducted during the research weeks 3 to 5. For efficiency reasons, part of the interviews were conducted via Skype and part face to face. The viewpoints of the interviewees were classified to be either from the type A or from the type B operations. However, in some interviews there were also comments regarding the other area of operations given, which were not disregarded. During the Skype interviews the participants could see their answers written in the answer sheet, which enabled them to check that the answer is correctly recorded. The interviews were also conducted in the native language of each of the participants, which decreases the risk of misinterpretation in the analysis stage.

In each interview, first the basic information regarding the interviewees was checked, after which there were two concepts defined: supply chain and performance. The definition of the first concept was “the part of the process conducted by type A and type B suppliers” and the second “the extent to which predefined goals are reached”. These definitions were used only in this context and in order to ease answering to context-specific questions that could otherwise be understood in a too large scale and hence result in decreased quality of data.

Interview statistics are provided in table 5. Most of the interviews were conducted via phone due to distance but three interviews were conducted personally. In phone interviews, the list of questions was provided in beforehand. As described before, there were two interview forms used in the data collection. These forms included partially same questions. The form 1 regarding supply chain performance was used in interviews with managers and form 2 with focus on supplier performance was used in interviewing foremans. This division was made due to the areas of expertise of the personnel and the ability to provide information on that particular phenomenon. Interview forms used are attached in appendices 1 and 2.

Table 5. Statistical information on the interviews

Position	Number of interviewees	Average duration (hours)	Method
Foreman	5	1:04:00	Phone
Manager	3	1:16:00	Face-to-face
Altogether	8		

5.2.2 Goals of the supplier development program

The first question in the interviews was same in both forms and it considered the goals of the supplier development program. Through this question the SDP goals, that on the interview moment were experienced as important, were clarified. In other words, the purpose of the question was to bring up those goals that have had the greatest probability of realizing as an influence on SCP. The answers to the question are presented in table 6.

Table 6. Answers to the first question of the interviews

1st question: answers by viewpoints			
Type A	No. of times mentioned	Type B	No. of times mentioned
Cost control	3	Cost savings	2
Increasing performance	3	Redefining areas of responsibility	3
Redefining areas of responsibility	4	Efficiency	1
Improving operations management (hiring a clerk)	2	Flexibility	1
Increasing the size of suppliers	2		
Decreasing supply risk	1		
Enhancing communications	2		
Decreasing the amount of overlapping work	1		

5.2.3 Most important goals of the supplier development program

The question of goals in the development program was complemented by asking the interviewees to yet name the most important goal. This was done in order to shed light on the relative importance of the goals. Despite the form of the question, some respondents were unable to provide a single answer and provided several equally important goals, which can be seen in the number of times the topics were mentioned. The answers are presented in table 7.

Variety of topics in the answers of question two was less than in the first question, which confirms that the interviewees have somewhat similar ideas regarding the priorities of the

program. For example, answers related to productivity and efficiency were popular in field A, while in field B cost savings where mentioned by every interviewee.

Table 7. Answers to the second question of the interviews

2nd question: answers by viewpoints			
Type A	No. of times mentioned	Type B	No. of times mentioned
Productivity	2	Cost savings	3
Efficiency	3	Flexibility	1
Improving operations management (hiring a clerk)	2	Committing of suppliers	1

5.2.4 Currently used measures

Questions 4.-8. in the interview forms considered current measures and measurement practices within the operational areas. The measures were partly the same in both categories but there were also some differences in the answers.

The measures were compiled from the interviews by adding relevant measures to the list and removing such that had no relevance (such as number of faulty invoices, which was presented in literature, but did not apply to the circumstances in this case). The ultimate list of the most important measures, that came up in as a result to these questions, is presented in appendix 5.

Most often were mentioned the costs that occur from the process, in addition to which quality and quantity were mentioned as current objects of measurement in category A. In category B, the most often mentioned measures had to do with quantities. Also costs were followed, but the emphasis on the answers in the type B seemed to be on operational measures instead of on financial measures.

Important measures in both categories were identified to be the number of cubic meters and cost per cubic meter, which have also been mentioned to be one of the most important performance measures in a forest company by Larsson et al. (2015)**.** It was seen that the performance of the process was largely defined by these measures. In addition to this, lead time of the process, order fulfillment ratio and reclamations were seen as relevant measures for the process.

The most important measures, cubic meters and cost per cubic meter, were considered as such that should react to the changes conducted in the supplier development program.

Moreover, the changes in the number of personnel was considered as an indicator of the SDP's success, for the reorganization of the work should have resulted in decreased number of certain group of buyer's personnel. Some other measures, such as the lead time of the process and reclamations, which were also mentioned as good performance measures, were not seen to be good indicators from the supplier development program's point of view, as they would likely not have reacted to the activities.

While the best common indicators for the supplier development program were considered to be the number of cubic meters and the cost per cubic meter, it was simultaneously pointed out that there are several factors that influence the capability of a supplier to perform in these areas. In both supplier classes the number of vehicles was the most obvious one but in addition to this also some other factors were repeatedly mentioned. These factors are presented in table 8.

Table 8. KPIs and significant influencing factors

Type A suppliers		Type B suppliers	
Key measure	Influencing factors	Key measure	Influencing factors
m^3	stem size, cutting area, harvesting method	m^3	number of vehicles
€/m^3	harvesting method, haulage distance, inflation	€/m^3	average transportation distance, inflation

It was also pointed out that the efficiency in the work conducted by the supplier should have increased as a reaction to the reorganization of the work. The measures that would directly reflect this increase were, however, such that were out of the reach of the buyer, as details regarding suppliers' operations were not available.

5.2.5 Experiences regarding the SDP

The question of the experiences regarding the supplier development program provided the interviewees a chance to describe the development based on their viewpoint and understanding of the critical matters. This resulted in a greater variety of answers compared to those of questions 1 and 2, which can be detected from table 9.

In both supplier classes there are mentioned benefits regarding the decreased workload. Within type A suppliers, the suppliers are reported to have been satisfied with the program, while in type B no comments regarding this was made. This might result from the different time spans that the program has considered the supplier classes, as type B suppliers were not developed until year 2016 on but type A suppliers had been developed from already 2010 on.

Table 9. Reported experiences regarding the supplier development program

3rd question: answers by viewpoints			
Type A	No. of times mentioned	Type B	No. of times mentioned
The whole has become easier to handle	2	Number of contracts has decreased	2
Suppliers have considered the SDP as positive	2	Workload has decreased	2
Soil improvement work included in the new contracts has not been considered to be very positive	1	Some stiffness regarding change has been detected	2
Produced amount has increased	1	Good preparation is a key	2
Changing suppliers has been difficult	1	Has launched slowly	2
Communications within the network could be improved	1	Case company still controls the loads	1
Challenges and regional differences regarding soil improvement work	1	Reorganizing supplier structures has been found to be difficult	1
Suppliers have not been forced to reorganize	1	Not all suppliers have a clerk	1
Foundation stage (agreeing prices) was relatively easy	1	Costs have decreased	1
Later cooperation has had issues: old supplier structures have influenced in the background	1	The workload of foremen has decreased in areas where cooperation works and there is a separate supervisor	1
No rush with the program	1		
Some suppliers did not expect the program to take place and did therefore not have motivation to proceed	1	Flexibility has increased	1
Suppliers have been encouraged to reorganize	1		
After the new model has started to work the feedback has been positive	1		
It took 3-4 years until the program visibly started to work	1		
Some changes have taken place in the supplier base	1		
Purely cost-focused bidding is not reasonable	1		

In interview form 1 the question of supplier attitude towards the supplier development program was in all of the interviews answered to be positive. It was mentioned that the current system is preferred to the previous one especially within type A suppliers.

5.2.6 Emerged matters

In the interviews some side notes were brought up as important topics while examining the development during the program. These matters complement the perception about the supplier development program are briefly presented in this section. This is done by listing the most important factors first and then moving into smaller notes.

Regional differences were emphasized in several interviews. Especially one of the managers highlighted that the influence of the development program might not have been regionally equal due to a variety of reasons, most important being the differences in the operating environments. This was considered as a factor that definitely needs to be taken into consideration while comparing the suppliers against another.

It was also pointed out that silos in the process might have had an impact on the performance of the supply chain. Type A and type B suppliers were reported not to communicate extensively with each other, which in some cases has an effect on the performance on the supply chain level. Moreover, some suppliers were reported to have a somewhat narrow view of the supply chain processes.

Dominating overall perception of the supplier development program was that the program has resulted in benefits for the organization. Exact benefits that were reported had to do with reduced stock levels and increased output quantities during the years. The output quantities, which were considered to have increased by the program, were reported as a percentage, suggesting that the matter had already been previously looked into.

A significant difference regarding information flows to categories A and B were found. Type A suppliers receive information regarding their upcoming work well beforehand and they are have more time to prepare their schedules than type B suppliers. Type B suppliers receive the information less than a week before and they are required to be much more flexible. In future this information is expected to be available earlier and the supplier to receive the information earlier.

5.2.7 Analysis

The overall perception of the organization supports the idea that the supplier development program has influenced performance positively, which is in line with the common understanding in literature. Specific performance measures, which were mentioned in the interviews, had to do with both output and input measures. However, flexibility was not commonly mentioned as a target of improvement in the SDP. Hence, as this aspect of supply chain performance was not attempted to be influenced, it was also disregarded in this study.

Finding the measures for estimating supplier development program's influence on supply chain performance was performed with three criteria in mind. First criterion was that the performance measure should reflect performance in both functional areas A and B. Secondly, the performance measures ought to connect to at least some of the supplier development program's goals, which were mentioned in the interviews. Thirdly, the KPIs needed to be measurable in supplier and supply chain level, so that the comparison of the KPIs between better suppliers (who match the goals of the development program) and worse suppliers (who do not match the goals of the development program) has a connection to the performance on supply chain level as well.

As described in section 5.2.4, the key measures for estimating the influence of the supplier development program were the amount of cubic meters, cost per cubic meter and the amount of personnel that has previously conducted the work that was reorganized in the program. As these KPIs were mirrored against the three selection criteria, the last indicator, the amount of personnel in the buying company, was left out from the focus of this study because it could not be reasonably measured on a supplier level. The amount of cubic meters and the cost per cubic meter, however, were measures that also fulfill the last condition. Hence, these two measures were selected to be examined in the quantitative stage.

The selected KPIs indicate both, the performance of supply chain process and the target indicators of supplier development program. As such, they do not holistically describe either the concept of supply chain performance or supplier development program′s performance, but a part of them. The position of the selected KPIs between the concepts of supplier development program and supply chain performance is visualized in figure 11.

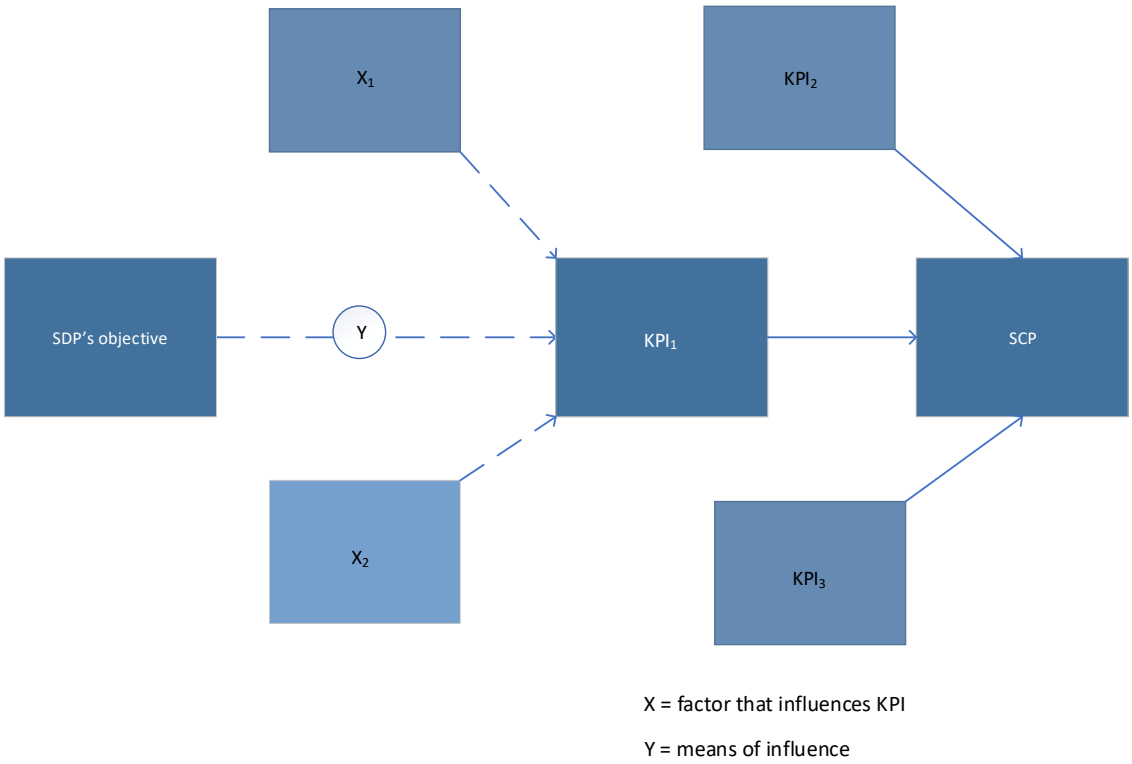

Figure 11. Connection of supplier development program and supply chain performance in the context of other influencing factors and KPIs

As stated, the selected KPIs did not include all the relevant supply chain performance KPIs in the case environment or in the supplier development program, but only those that represented the both constructs. The position of the selected KPIs in the sets of performance indicators is presented in figure 12.

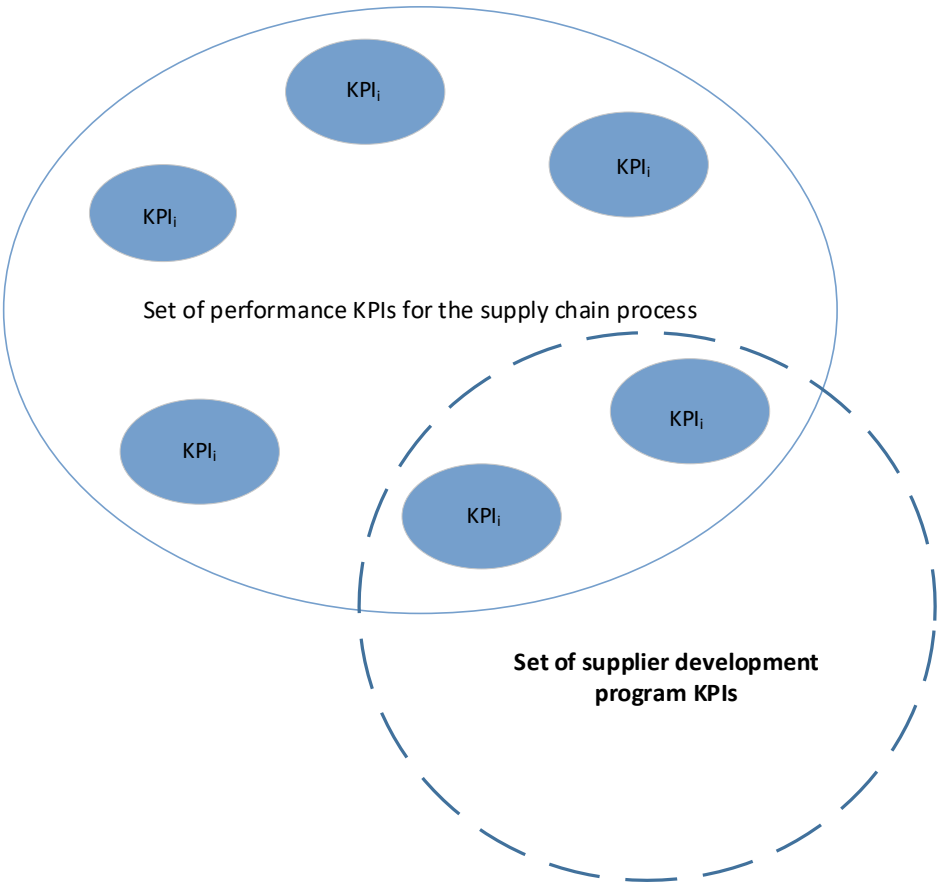

Figure 12. The position of the examined KPIs in the constructs' sets of KPIs

5.3 Quantitative part

After the interpretation of the results in the qualitative stage, the quantitative section was conducted. In this section, the main objective was to examine the development of the KPIs throughout the years and to examine the influence of the supplier development program. This was conducted with the findings of the qualitative stage in mind.

In this chapter are first presented the details regarding the quantitative process. This aims to increase the transparency and reliability of the study. This is then followed by the presentation of the results in both interesting topics, the development of the KPIs over the years and then the influence of the supplier development program in these KPIs. Finally, the results of the quantitative stage are analyzed.

5.3.1 Data

The quantitative data that was collected was originated in the operative system of the case company. The data was collected from relevant databases from the time period of the supplier development program. In type A suppliers, data from year 2010 was available and from type B suppliers, data from year 2015 on was considered in the context of the case.

Panel data regarding the KPIs was collected from all suppliers that had collaborated with the buyer during the time of the program, for the collaboration meant that the supplier simultaneously participated in the program. The number of observations, i.e. monthly observations regarding the KPI data within the period, is graphically presented in the following figures. The number simultaneously stands for the number of suppliers within a period, which can be detected to have decreased in both supplier groups during the time supplier development program has taken place. In figure 13, the number of type A suppliers are presented.

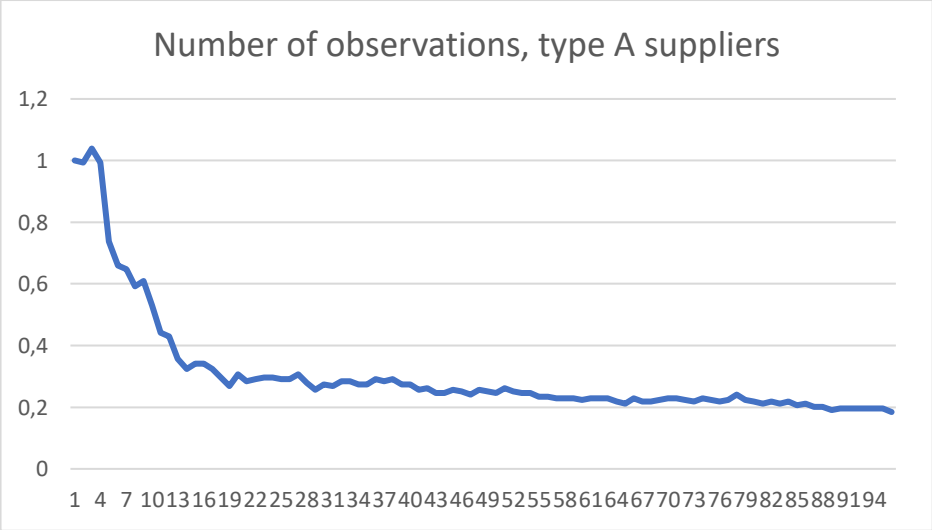

Figure 13. The development of number of observations in type A suppliers

In type A suppliers, the number of individual suppliers has decreased into less than 25% of the top number of suppliers. In addition to this, the number of vehicles per supplier was a significant factor influencing the interpretation of the data, due to which it is reasonable to consider the amount of vehicles in this connection. From figure 14 it can be detected that the number of vehicles per supplier has increased significantly within type A suppliers.

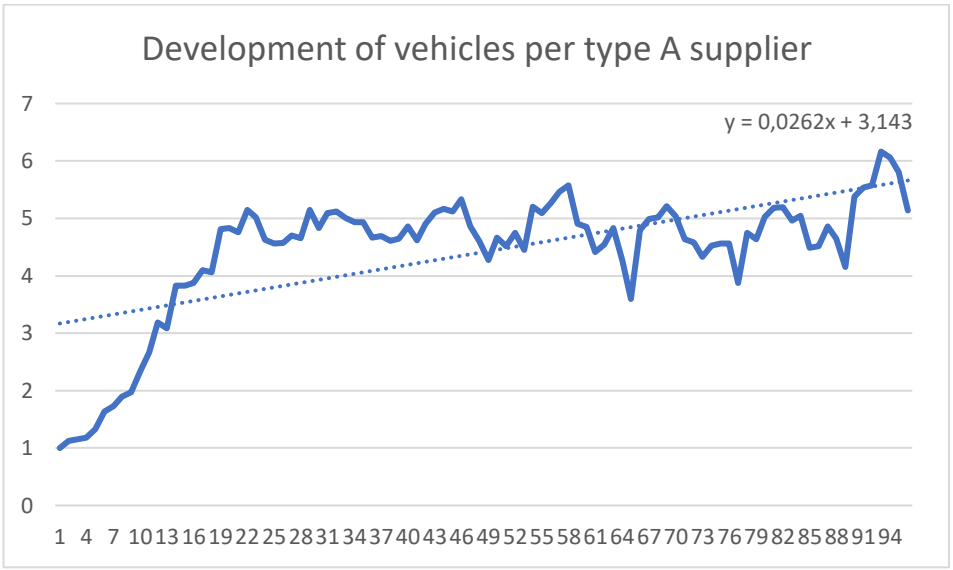

Figure 14. The development of vehicles per type A supplier (beginning of year 2010 = 1)

In type B suppliers, number of observations decreased in a similar way as did the number of type A suppliers. This development is presented in figure 15.

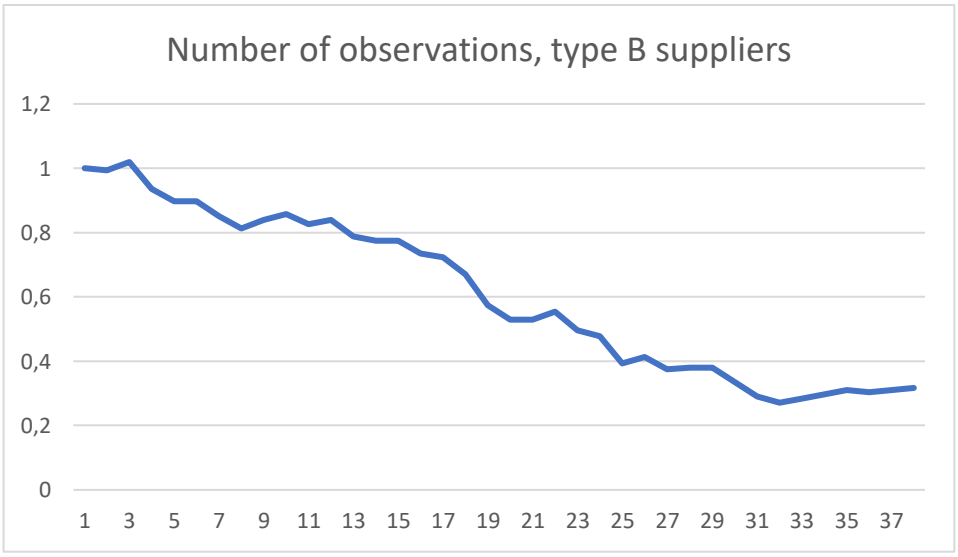

Figure 15. The number of observations in type B suppliers (beginning of year 2015 = 1)

The number of individual suppliers has decreased into less than 30% of the original number of suppliers. Simultaneously, the number of vehicles per supplier has increased also in this group of suppliers, which can be seen in figure 16.

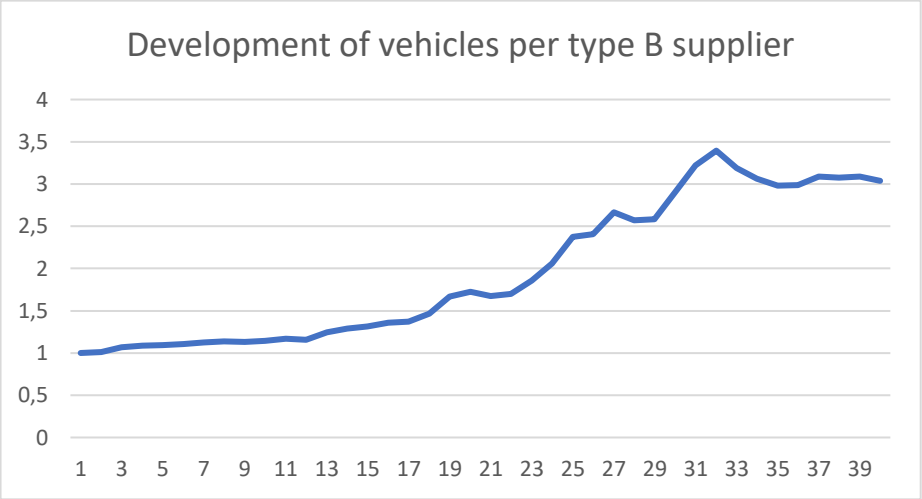

Figure 16. The development of vehicles per type B supplier beginning of year 2015 = 1)

5.3.2 Formulae for the selected key performance indicators

The KPIs selected were the amount of cubic meters and cost per cubic meter. However, as in the interviews it was emphasized that there are several factors that cause differences between suppliers, it was necessary to neutralize the influence of these factors in the KPIs to enable a more reliable examination of them. In this section, the formulas used to correct the KPIs are introduced.

Face validity, in the context of a new measure, means that the measure apparently reflects the content of the concept in question. This type of validity can be established by asking experienced people whether the measure reflects the content. (Bryman & Bell 2011) While building the KPIs, the opinions of five company experts were asked and their notes were taken into consideration. For this particular research purpose, all of the measures were granted validity.

Volume of raw material processed

First of the selected KPIs was the volume of raw material handled, which is an output measure in the context of supply chain performance. As discovered in the qualitative stage,

the KPI of the cubic meters should also consider a couple of significantly influencing factors to provide comparable information between the suppliers. This was the case with especially type A suppliers, for the type of the work they conducted, influenced the efficiency of their operations. The first KPI, volume of raw material, is considered in KPIs 1 and 2, which consider type A and type B suppliers. Out of these two, the formula of KPI1 is presented next.

Equation 1. KPI1: Volume of processed material in relation to significant influencing factors, type A suppliers

$$KPI1 = \frac{m^3}{s*a} \qquad (1)$$

s = average stem size in work class (dm^3)

a = size of cutting area (hectare)

Equation 1 was built with the following remarks in mind. First, the amount of cubic meters a supplier can handle is significantly influenced by the work class (harvesting method) they are obliged to conduct. Work class b is remarkably lighter for the supplier to conduct and work class a vice versa in terms of collected cubic meters. The class is also determined by circumstances that are out of suppliers' reach, in addition to which the relation of the work classes changes from one supplier to another (i.e. some suppliers conduct more work in class a, while others can have work only in class b), due to which there exists a clear need to eliminate the influence of the work class factor from the KPI. This was performed by calculating the efficiency numbers separately by work class. In the evaluation stage, KPI1a stands for the KPI in work class a and KPI1b stands for the work conducted in class b.

Secondly, the stem size of the raw material significantly influences the efficiency and is out of supplier's reach, due to which it needed to be considered in the formula as well. Stem size behaves in a similar way as the work area does in relation to the volume: the larger the sturdiness and the larger the area, the more volume should the supplier be able to handle. Due to this, the product of sturdiness and work area is used as a denominator in the formula, which evened out the differences between the suppliers.

The formula 1 results in efficiency numbers where e.g. the efficiency of a supplier with a small work area and large stem size is comparable to the efficiency of a supplier with a large

work area and stem size. Hence, the KPI enables the comparison between the suppliers and is a suitable indicator to be used as an instrument in the tests.

Equation 2. KPI2: Volume of processed material per vehicle, type B suppliers

$$KPI2 = \frac{m^3}{n} \qquad (2)$$

n = number of vehicles used

KPI2 was neutralized by number of vehicles used, which was seen to be a relevant factor that influences the ability of the supplier to handle the cubic meters. Another factor that was considered were the average lot sizes, but they were left out due to the fact that the lot sizes are also a sign of the efficiency of the supplier, meaning that if they are neutralized, the validity of the indicator would deteriorate. Hence, the KPI2 was kept relatively simple.

Cost per cubic meter

Second of the selected KPIs was the cost per cubic meter, which is categorized as an input measure. This measure was also to be examined with certain influencing factors in mind, which caused the need to build mathematical formulae for the calculation of this KPI as well. Formulae for KPIs 3 and 4 are corrected versions from this indicator. Next is presented the KPI3.

Equation 3. KPI3: Cost per cubic meter cleaned from the effect of significant influencing factors in type A suppliers

$$KPI3 = \frac{€ * i}{f * m^3} \qquad (3)$$

i = inflation multiplier (to the level of year 2017)

f = haulage distance (meters)

KPI3 was neutralized by haulage distance and inflation, in addition to which it was necessary to divide it with the amount of cubic meters to enable the comparison between suppliers. Haulage distance was also factor in which the supplier could not influence in but which affected the cost of the collected amount of wood. The influence of inflation needed to be also considered, as the trend in the development of the KPI would otherwise have been biased. Moreover, the KPI was also influenced by the work class the supplier conducted, due to which the indicator needed to be divided into two parts.

Equation 4. KPI4: Cost per cubic meter cleaned from the effect of significant influencing factors in type B suppliers

$$KPI4 = \frac{€ * i}{km * m^3} \qquad (4)$$

i = inflation multiplier (to the level of year 2017)

KPI4 was considered with transportation distance and inflation as influencing factors. Transportation distance was also a factor that the supplier can not affect, which was the reason for the neutralization of the factor. Dividing the resulting number with cubic meters enabled the comparison of suppliers without bias caused by sizes of the suppliers.

5.3.3 Development of relevant indicators throughout the years

The selected KPIs were built from the data collected and their development analyzed in the whole population. As already described, the population has changed over the years and not all of the current suppliers have been part of the supply base in the beginning, so it was seen to be a better solution to include the whole supply base's values into the examination of the development KPIs.

The KPIs behaved differently in time compared to each other, which can be seen by observing figures 17 and 18. In both cost-based indicators there was, however, seasonal effect detected which considered both of these KPIs. In those indicators belonging to quantity category, clear seasonal effect was not observed.

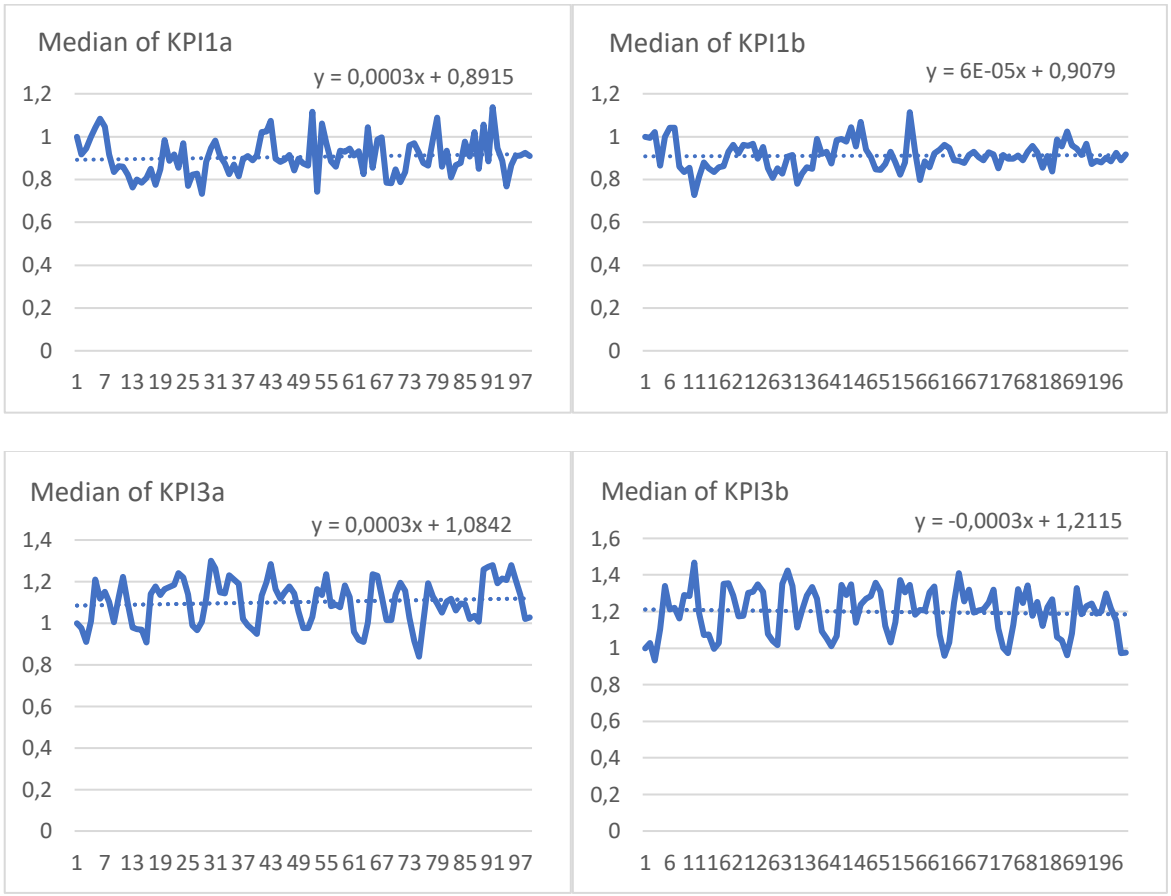

Figure 17. Development of type A suppliers' overall median in the selected KPIs (year 2010 = 1)

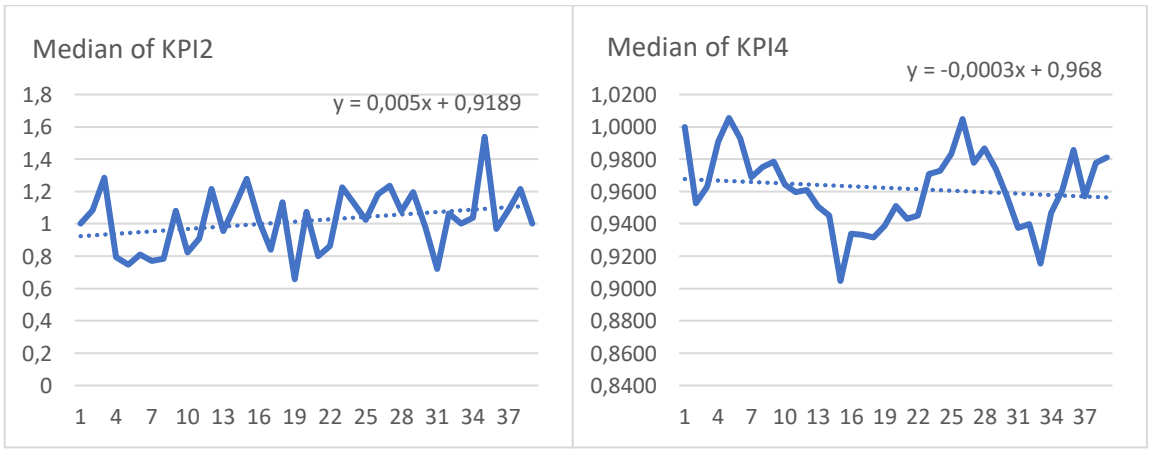

Figure 18. Development of type B suppliers' overall median in the selected KPIs (year 2015 = 1)

The non-manipulated KPIs' development is also interesting in the context of the study, as they describe the real values of quantities and costs that occurred from the process. The development is presented in figures 19 & 20. This descriptive information complements the view on the behavior of the KPIs.

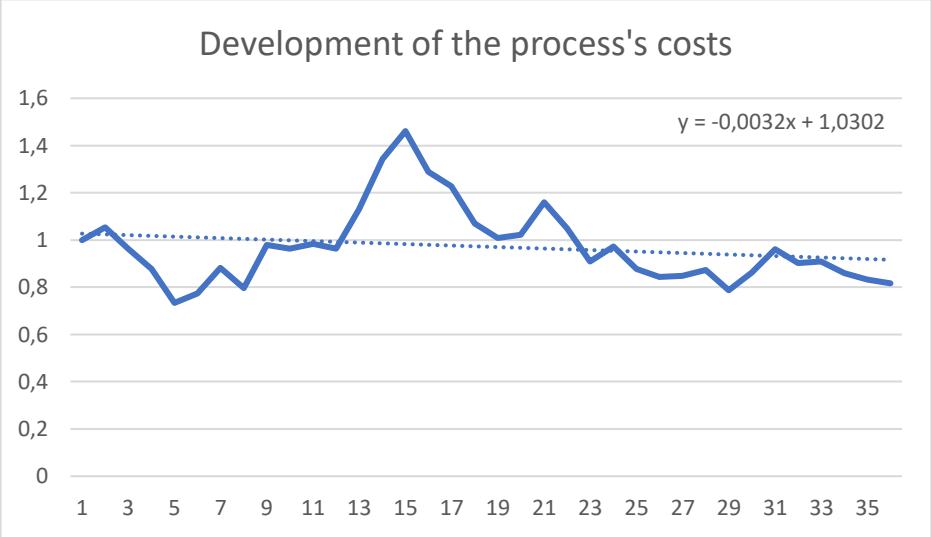

Figure 19. Development of the raw material handling costs (amount of costs in 2015 = 1)

The costs in figure 19 were corrected from inflation effect and weighted with the amount of cubic meters. As can be detected from the trendline presented in the figure, the development of costs regarding the raw material have decreased throughout the period when both types of suppliers have been developed. The development is positive in light of the supplier development program's goals.

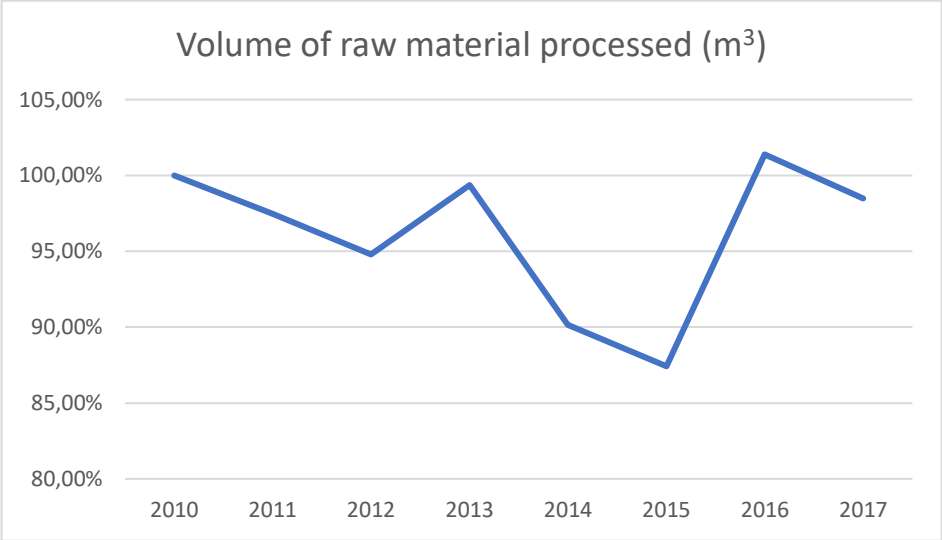

Figure 20. Development of the volume of raw material processed (quantity of m^3 in 2010 = 100%)

In figure 20 can be seen the varying development of volume of raw material processed by type A and type B suppliers. The amount of material has been less in all other years except in 2016. However, the volume of raw material is also affected by other factors than the only the supplier development program. Moreover, the development program aimed to influence the number of operative personnel needed to handle the material flow. Due to this it is meaningful to examine the amount of material handled by person working within the operative process in the buying company. This ratio is presented in figure 23.

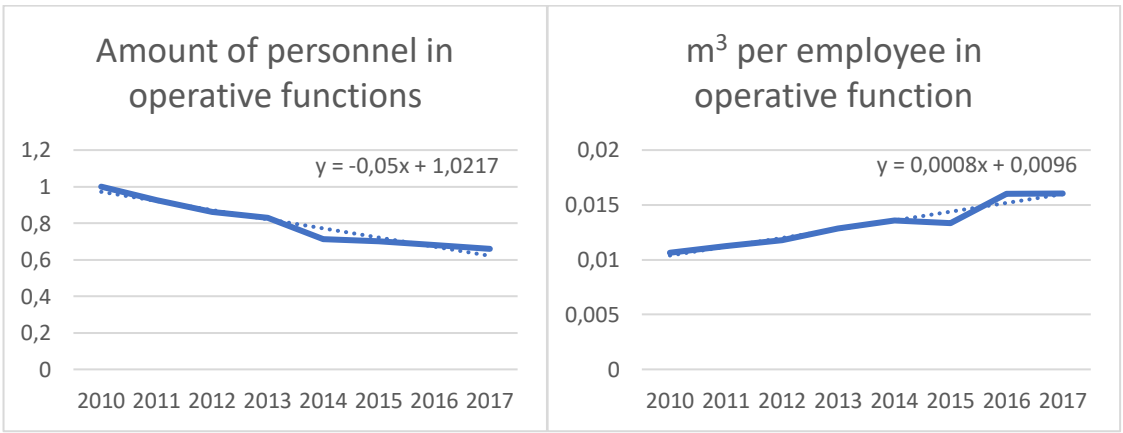

Figure 21. Volume of material per operative employee (quantity of m^3 in 2010 = 100%) and the amount of personnel in the operative functions (amount in 2010 = 1)

In the figure 23 it can be seen that unlike the volume of raw material itself, the ratio between volume and personnel has risen almost constantly each year the development program has taken place, while the number of personnel has decreased significantly. As the supplier development program was considered as the most influencing factor in the number of personnel, it can be suggested that the program has succeeded in decreasing the personnel without causing the company to suffer from a decreased performance in this ratio.

5.3.4 The influence of supplier development program on supplier performance KPIs

The SDP's influence on the selected KPIs was examined based on differences between observations in the groups of suppliers. The supplier classification provided by the interviewees was a crucial element in the comparison. The comparison of observations was performed by area and between the two groups of suppliers.

Test design was based on tests which indicate the difference between groups in the selected KPIs. The groups examined were formed from those suppliers, that match the goals of the program and those who are far from the goals of the program during the time this study was conducted. The tests themselves were conducted in the both ends of the program: in the beginning and in the end of it. The design is visually presented in figure 24.

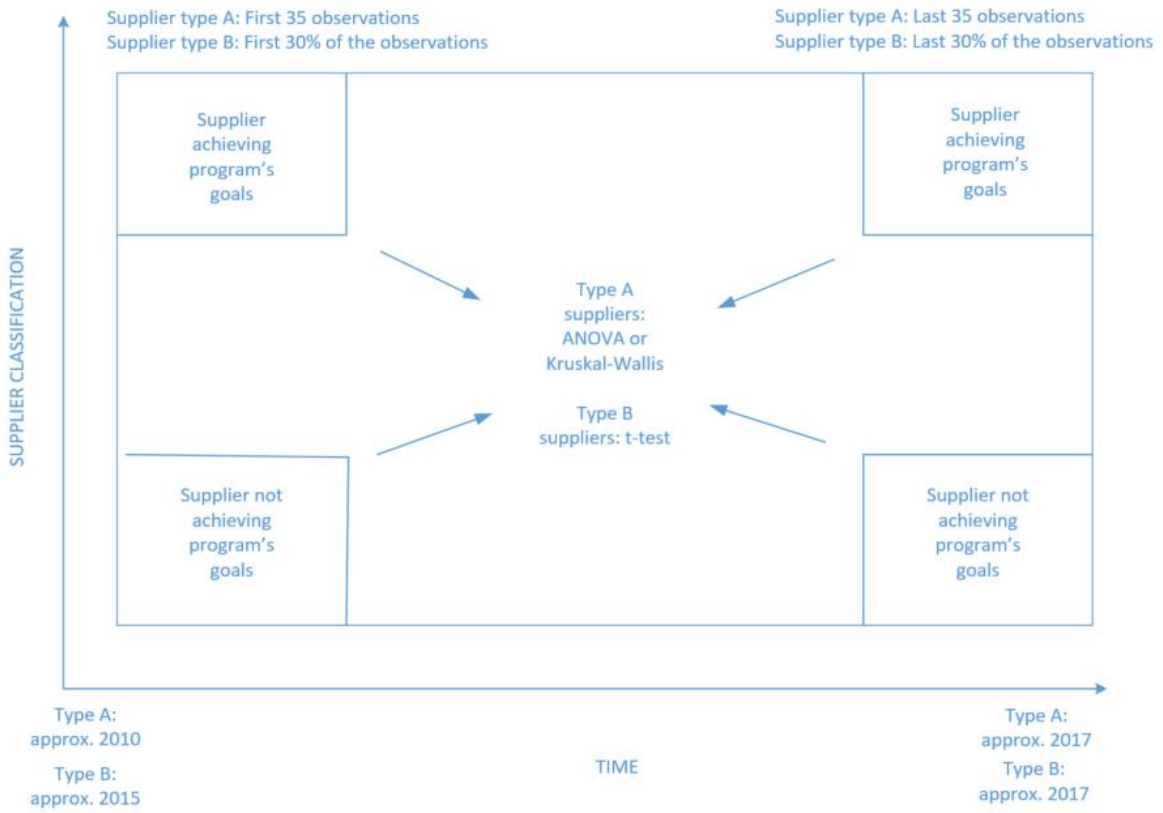

Figure 22. Test design in the quantitative part

Observations of suppliers that belong to category A were examined with ANOVA or Kruskal-Wallis tests. The amount of observations in each group of observations was over 30, due to which it was reasonable to use these methods. If ANOVA was used, the assumption of equality of variances was tested by using Bartlett's test. In case the null hypothesis was rejected, Kruskal-Wallis was applied.

Observations of suppliers belonging to category B were not numerous, due to which it was not reasonable to apply the same methods as in case of category A suppliers. The first observations regarding category B suppliers were taken from year 2015 and the last values from the end of 2017, meaning that it was not possible to take over 30 observations from each group, simply because there was not so many of them. The amount of observations was also limited by the start month in which the supplier had started to cooperate with the buying company, which was not in the beginning of year 2015 in all cases.

In case of suppliers belonging to category B, it was decided to take 30% of the observations from the beginning and 30% of the observations from the end of the period of examination. This meant 6 to 11 values per group of observations. Due to the small number of them, t-

test was applied to test the differences between the groups in the beginning and in the end of the period. The background assumption of normal distribution of the observations were tested using Kolmogorov-Smirnov test. If the null hypothesis was rejected, t-test was not applied.

The commonly used probability level of 0,05 (Bryman & Bell 2011) was applied while testing the hypotheses. The risk level was same in each test that was performed. The software used in analysis was SAS Enterprise Guide 7.1.

In each test the null hypothesis was that there is no significant difference between the suppliers, who match the goals of the development program, and the suppliers who do not match the development program. In case the null hypothesis was rejected, the differences themselves were interpreted. The results of the tests are presented in tables 10 and 11, In table 10, with the significant p-values highlighted with grey color.

Table 10. Test results of type A suppliers

KPI1a	Area	ANOVA		Wilcoxon/Kruskal-Wallis	
		p-value F35	p-value L35	p-value F35	p-value L35
n=69	1	--	--	0,2721	0,0175
n=70	2	<0,001	<0,001	--	--
n=69	3	<0,001	<0,001	--	--
KPI1b	Area	ANOVA		Wilcoxon/Kruskal-Wallis	
		p-value F35	p-value L35	p-value F35	p-value L35
n=70	1	--	--	0.0001	0.0002
n=70	2	0,0139	--	--	<0.0001
n=70	3	0,0001	0,6484	--	--
KPI3a	Area	ANOVA		Wilcoxon/Kruskal-Wallis	
		p-value F35	p-value L35	p-value F35	p-value L35
n=69	1	--	0,2445	0,2473	--
n=69	2	0,2187	--	--	0,9859
n=70	3	--	--	0,0087	0,0081
KPI3b	Area	ANOVA		Wilcoxon/Kruskal-Wallis	
		p-value F35	p-value L35	p-value F35	p-value L35
n=69	1	0,0526	0,7521	--	--
n=69-70	2	0,1807	0,7271	--	--
n=70	3	<0,0001	0,004	--	--

In KPI1a, the tests from area 1 resulted in difference in the end of the program, where the last 35 observations of suppliers were considered. The result was that the supplier, that according to the classification of the interviewees, was matching the program's goals, was actually performing worse than the compared supplier who did not match the goals of the program. In area 2, this was also the case in the end, but in comparing the first 35 values the supplier, who matched the goals, was yet performing better than the worse and during the period had performed worse in this KPI. In area 3, then, the supplier matching the program was better in both ends of the development program than the compared supplier.

Results regarding KPI1b did also not promote the idea of the effectiveness of the program. In the first area, the supplier matching the goals of the SDP was performing better in the both classes of observations. In area 2, the result was equal to that regarding KPI1a. In the third area, the supplier matching the goals was performing better in the beginning, while in the end there was no difference between the suppliers.

In KPI3a, no significant differences were found in areas 1 or 2. In area 3, the supplier matching the goals of the program performed worse in both ends of the program than the supplier who was not matching the goals. In KPI3b, the results were similar. Hence, the results in this key performance indicator do not promote the idea of effectiveness of the program.

Table 11. Test results for type B suppliers

KPI2	Area	Kolmogorov-Smirnov		t-test	
		p-value F30%	p-value L30%	p-value F30%	p-value L30%
n=22	2	>0,150	>0,150	0,5344	0,6049
n=12	3	>0,150	0,067	0,25	0,1716
KPI4	Area	Kolmogorov-Smirnov		t-test	
		p-value F30%	p-value L30%	p-value F30%	p-value L30%
n=22	2	>0,150	>0,150	0,0012	<0,0001
n=12	3	0,027	0,108	--	<0,0001

Tests regarding type B suppliers could only be conducted for areas 2 and 3, for there was not enough data from the suppliers in area 1. The results regarding KPI2 did not indicate any significant difference between the suppliers, whereas in KPI4 there was difference. In area 2, the supplier who did not match the program, was performing worse in both ends of the development program. In area 3, no t-test could be run for the first 30% of the

observations, for the assumption of normally distributed sample did not apply. The test run for the last 30% of the values suggested, that the difference between the suppliers was positive for the supplier matching the goals of the program. However, as no baseline regarding the first 30% values can be derived, no conclusions regarding the development can be drawn.

5.3.5 Analysis

The quantitative data provided contradicting results regarding the successfulness of the activities. The data appeared out both positively and negatively with regards to the influence of the SDP.

Based on figures 13 and 15, the numbers of suppliers were decreased significantly by the program. Moreover, the volume of raw material in relation to the number of buyer's personnel has risen, indicating that efficiency in that sense has increased. The development of volume, instead, has varied greatly, which could react to the changes conducted in the development program. However, the volume is also greatly influenced by other external factors, due to which no direct conclusions can be drawn.

Moreover, while the number of suppliers had decreased, the number of vehicles per supplier had increased during the time period. These two facts together indicate the successfulness of the tiering aspect of the program.

The KPIs used to precisely evaluate the supplier development program's influence on volumes and costs per cubic meter did not result in positive effect in either of the two categories of suppliers. Neither of the KPIs showed such difference between the suppliers, who do match the goals of the program, and those, that do not match the program, which would indicate a significant improvement caused by the program. This would suggest that the program has not had such an impact on supplier performance that would be visible in the selected indicators.

5.4 Integration of analysis

The empirical work provided contradicting results from successfulness of the development program. Organization's overall perception in the qualitative stage was that the program

has been successful, and the goals have been reached, but in the quantitative stage the indicators of supplier performance, which considered the goals of the program, did not match the perception. Hence, the integrative analysis needs to be performed by considering the individual goals of the program.

The consistent results in qualitative and quantitative stages considered two of the programs' goals, which were connected to tiering and the reorganization of work. Tiering, which in the interviews was described as increasing the size of suppliers and decreasing the number of them, was mentioned as a goal in the SDP and it was also reported to have taken place. The figures 13 and 15 in the quantitative stage support this argument, as in both types of suppliers the number of individual suppliers has decreased significantly: in type A suppliers, the current amount is less than 25% from the starting value and in type B suppliers, the amount is less than 30% from the value in the beginning. Moreover, the amount of raw material handled has not decreased in the same extent (figure 20) and the number of vehicles per supplier has increased (figures 14 and 16), which both indicate that the size of the individual suppliers has increased. This is can be interpreted as a sign of successfulness of the program.

Reorganization of work was another goal mentioned in the interviews. This reorganization meant that part of the work that was previously conducted in the buyer organization, was now performed by the supplier. This was reported to have realized by the interviewees. In the quantitative stage, data regarding the personnel working with the suppliers supports this finding. As described in figure 23, the amount of people that previously conducted also the reorganized work, has decreased significantly by 37,4 percent.

Both goals, in which the program seems to have succeeded, are such that can be directly affected by the buyer. The decision of the number of the suppliers is in the buyer's hands, as is the number of personnel working with the tasks that were reorganized to the supplier. Hence, the conclusion of the successfulness in relation to the goals cannot be made based on these changes only. However, as it was reported that the number of cubic meters processed yearly has not been affected by the changes, it can be concluded that the goals of reorganization of work and tiering have succeeded in relation to the amount of raw material processed yearly. The practical implication of this is that there currently is less transactions with the suppliers and less people working with the operative tasks connected to the supply chain process, both of which influence the costs of the process.

The contradicting results obtained considered the influence of the SDP to the efficiency and costs of raw material, which were expected to be improved in the supplier and supply chain

level. In the interviews the perception was that efficiency in timber flow has increased due to the reorganization of work, which was also expected to improve supplier efficiency in terms of timber flow. This was also expected to be seen in the costs per cubic meter, which should have decreased.

While the KPIs of volumes and costs were tested, no clear pattern could be detected that would have suggested that the program had been successful. None of the KPIs suggested that the supplier that nowadays matches the vision, would have improved to a better level than the worse performing supplier during the program. In the results indicating a difference between suppliers it either appeared out that the better supplier that matched the vision had already started from a better level and ended on that better level, or that the supplier was actually worse than the compared supplier that did not match the vision. In several tests, there was also no difference detected.

Based on this it seems that the supplier development program has not influenced to efficiency or costs on a supplier level, which is against the overall perception of the organization had.

6 Discussion

Literature regarding the influence of supplier development programs has been contradicting and the operationalization of performance has varied from one study to another. The trail between supplier development and performance improvement has in many studies not been fully consistent or transparent, which might be one of the reasons to the varying results. Moreover, the performance measures used have in some cases been prone to manipulation or bias.

In this study, the trail between supplier development program and supply chain performance was constructed by connecting supplier development program through its goals to relevant supply chain performance key performance indicators (KPIs), which could also be measured in supplier performance level, and by examining these KPIs during the time of the program. Data considering these KPIs was collected from an operating system of the case company, which ensured the objectivity of the evaluation material.

Supply chain performance (SCP) as a concept was examined from a separate constructs approach and the focus of the study was in indicators from input and output categories. The key performance indicators selected were industry-specific, which is usual for SCP evaluation (Elrod et al. 2013). The selected KPIs were volume of raw material and cost per cubic meter, which are have also been recognized to be the most important performance indicators in a forest company in general (Larsson et al. 2015) The supply chain performance KPIs were used in evaluation of supplier performance in a modified form, which was done by cleaning the indicators from the effect of other significant determinants of supplier performance. Formulae used in the cleansing were introduced in chapter 5.3.2.

The results suggest that the supplier development program did not influence the performance of the suppliers in the selected KPIs in such way that is visible in same supply chain performance KPIs. In other words, the program did not influence supply chain performance through increased supplier performance in this group of indicators. However, when data regarding the number of suppliers and the delivered volume per buyer's operative employee were examined, it seems that the development program has influenced supply chain performance through these indicators. Both indicators are such that can be directly influenced by the company, without changes in the supplier behaviour.

Based on this, the results also suggest that the buyer managed to influence supply chain performance through the supplier development program, but not through increased supplier performance in the KPIs relevant to the program's goals as was expected. Instead, direct

influence on supply base and on organizational structure seem to be the main sources of performance improvements in the relevant KPIs, for positive effects were seen in such indicators as the number of personnel and the increased sizes of suppliers.

Moreover, the organization's perception of the effectiveness of the supplier development program was more positive than that provided by the selected KPIs. This is in line with the findings of Rogers et al. (2007), which suggested that organization's perception of the influence of a supplier development program was more optimistic than reality. The managers can have felt pressure to demonstrate the successfulness of the program also in this case, which can then have influenced the perception formed in the organization.

From the managerial perspective, some remarks were made. First, in planning supplier development activities it would be useful to already evaluate the measurability of them to be able to later evaluate the conducted activities and to develop them further. In case the measurability is not evaluated in the beginning, there is a risk of conducting development activities which's influence is spread on several unavailable or unreliable indicators, out of which follows that it is not necessarily possible to measure the influence reliably or use this information to develop the activities further. Secondly, the path through which the influence travels should be understood to analyze the reasons for the absence or partial occurrence of the influence in KPI's development. For example, if price reduction is pursued through increase of efficiency in supplier operations, the point of contract re-negotiation might pose a critical bottleneck on the path that can slow down or even inhibit the appearance of the influence in buyer's KPI. Thirdly, building a light documentation of actualized experiences of the program could provide good support for both, further development activities and the future management of the developed suppliers. In addition to this, following and managing supplier and supply chain performance by applying business analytics could result in added value.

This study is limited by the facts that this was a single case study, the sample sizes were limited and that the measures analyzed were partly new. Moreover, the study has considered only some aspects of supply chain performance instead of examining all of them. Despite having considered the phenomenon from several perspectives, the study only shed a narrow light on the matter.

Future research could continue to examine the trail of influence between supplier development program and supply chain performance improvement. This could reveal interesting points regarding the effective supplier development policies and provide information that could explain the varying results considering supplier development

programs' effectivity. In addition to this, the connection of supplier development program on flexibility dimension of supply chain performance is another interesting topic, which would deserve to be examined in future research.

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APPENDICES

Appendix 1. Interview form with focus on supply chain performance

INTERVIEW FORM 1
SUPPLY CHAIN PERFORMANCE METRICS

BASIC INFORMATION			
Interviewee		Date	
Position		Interview method	
Perspective		Time elapsed	

Concepts defined	

1. From your perspective, what have been important goals in the SDP? Why has the program been conducted?
2. Out of these goals, what is the most important goal? Why has this been the most important?
3. How has the program been implemented in your area?
4. What has been the response of the suppliers?
5. Please describe the performance metrics that are currently used in your area. In which sense are these metrics used (internal benchmarking/as a pressure for supplier/for some other use)?
6. Which performance metrics do you see as valuable for the supply chain?
7. Which of these performance metrics fit the SDP in your opinion?
8. Here are preliminary metrics for measuring supply chain performance. How do you think that these will reflect the SCP?
9. Is there anything else you'd like to mention at this point?

Appendix 2. Interview form with focus on supplier performance metrics

INTERVIEW FORM 2
SUPPLIER PERFORMANCE METRICS

BASIC INFORMATION			
Interviewee		Date	
Position		Interview method	
Perspective		Time elapsed	

Concepts defined	

PART I. SUPPLIER PERFORMANCE MEASUREMENT

1. From your perspective, what have been important goals in the SDP? Why has the program been conducted?
2. Out of these goals, what is the most important goal? Why has this been the most important one?
3. How has the development been? Which benefits have emerged? What issues have emerged?
4. Please describe generally the performance metrics that are currently used in your area. In which sense are these metrics used (internal benchmarking/as a pressure for supplier/for some other use)?
5. Which performance metrics do you see as valuable for measuring supplier performance?
6. Here are preliminary metrics for measuring supplier performance. How do you think that these will reflect the SP?
7. Is there anything else you'd like to mention at this point?

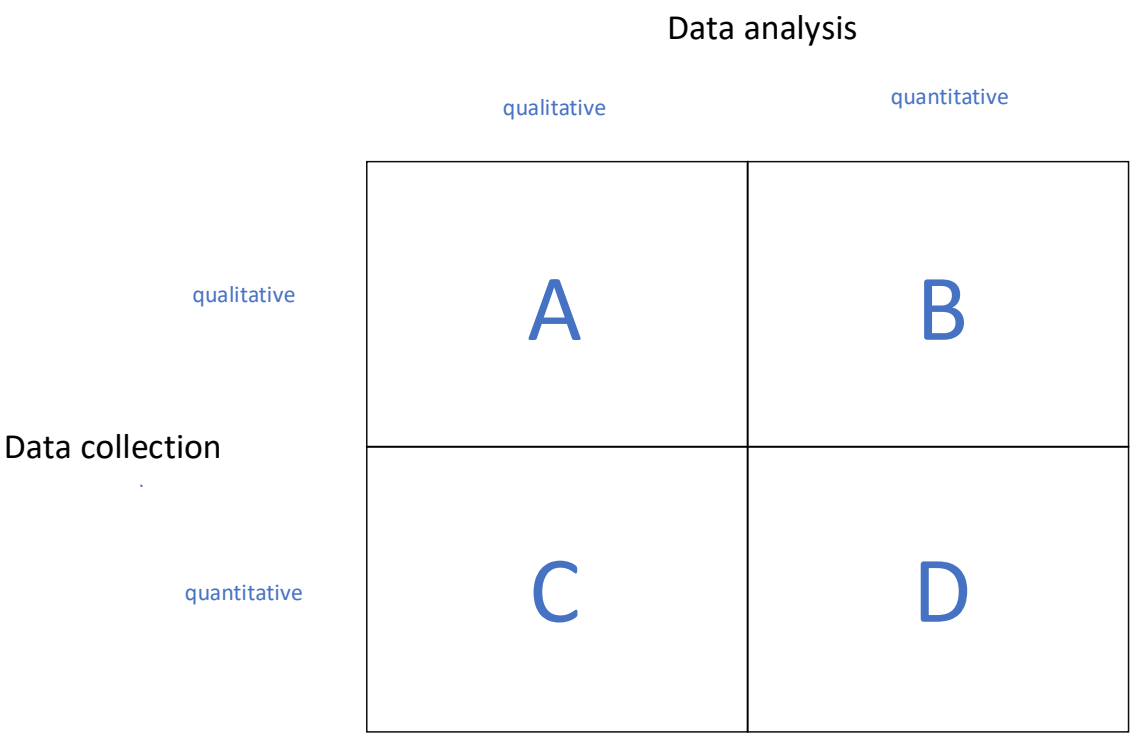
INTERVIEW FORM 2
SUPPLIER PERFORMANCE METRICS

PART II. SUPPLIER CLASSIFICATION

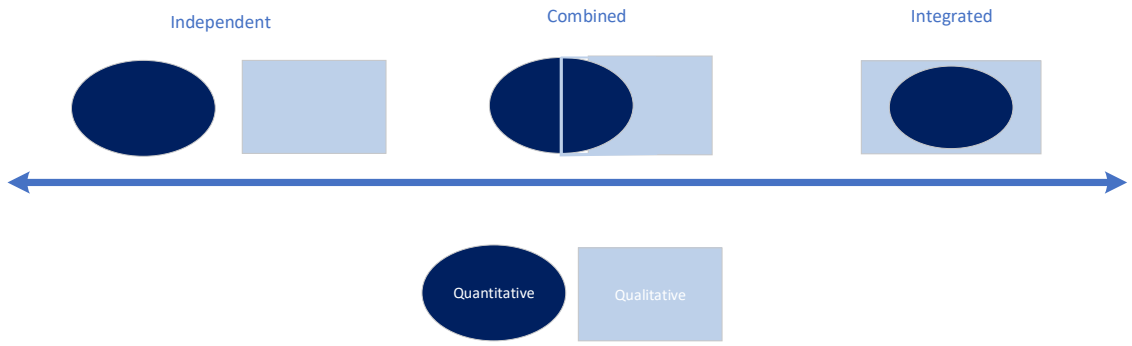
1. Which suppliers are best in accordance with SDP's goals? SDP goals are:
   - increasing the responsibility area of suppliers
   - suppliers operating independently, the company focusing on managing and directing the network
   - increased size of suppliers
   - increased efficiency

2. Which suppliers are not performing in accordance with the SDP?

Appendix 3. A classification tool for mixed method studies (adapted from Hurmerinta-Peltomäki & Nummela 2006, 446)



Appendix 4. Level of integration in mixed methods (adapted from Hurmerinta-Peltomäki & Nummela 2006)



Appendix 5. Ultimate list of important performance measures

TYPE A	TYPE B
Supply chain level	Supply chain level
Cost per cubic meter Volume of raw material Lead time Reclamations	Cost per kilometer Average size of the load
Supplier level	Supplier level
Costs Volume Reclamations Realized volumes/goal volumes	Costs per kilometer Volume Average mileage in a year