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Measuring Sustainability in Supply Chain with Key Performance Indicators

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Abstract

Background: The existing literature addresses the emerge of sustainability issues being one of the main concerns in organizations' supply chains. Constantly growing environmental, social, and ethical concerns have increased the pressure of organizations to adopt sustainable business practices into their operations.

Purpose: The aim of the study was to examine the current status of sustainability of supply chains and how it is measured. The goal of this study is to answer the research question: How organizations measure their sustainable supply chain performance with Key Performance Indicators?

Method: To comprehensively answer the research question, a qualitative research approach was chosen, and the primary empirical data was collected through semi-structured interviews. Sufficient data was also gathered from companies' websites and annual reports which is complimentary for data gathered from interviews. For data analysis, an abductive approach was followed.

Conclusion: The results show that the sustainability in manufacturing industry is a growing trend. Commonly used Key Performance Indicators in manufacturing industry were identified and comparison was made between three companies, to finally find out how performance measurement is carried out in manufacturing companies.

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List of Abbreviations

SC	Supply Chain
SCM	Supply Chain Management
NGO	Non-governmental Organization
IT	Information Technology
SD	Sustainable Development
SSCM	Sustainable Supply Chain Management
KPI	Key Performance Indicator
TBL	Triple Bottom Line
SM	Sustainable Manufacturing
UN	United Nations
SMEs	Small- and Medium sized Enterprises
(QMS)	Quality Management System

Introduction

The first part focuses on presenting the background of the topic, followed by the problem discussion and then the purpose of the study is introduced. The research question and sub-questions are listed, following with scope and delimitations imposed for studying the topic of sustainability in supply chains. Lastly, the outline of the study is explicated.

1.1 Background of the study

It has been witnessed that the emerge of sustainability issues is one of the most important business concerns in organizations' supply chains (SC) (Lee J.S, Kim, Lee S, 2016). Growing environmental, social, and ethical concerns have increased the pressure of organizations to adopt sustainable way of thinking in their operations. Such as water scarcity, population growth, climate change, energy, pollution, health and safety, human rights and poverty are typical sustainability issues which have both direct and indirect impacts on the way of designing and managing SCs. These impacts drive companies to focus more on their social, environmental, and financial performance (Allaoui & Choudhary, 2015).

Consumers', NGOs (non-governmental organizations), local communities' and other stakeholders' preference towards products that are produced and sourced sustainable, lead companies for more responsible SC practices (Grosvold, Hoejmoose & Roehrich, 2014). Companies and their stakeholders are becoming increasingly interested in the environmental and social impact of products and organizations, not just their economic performance (Schöggl, Fritz & Baumgartner, 2016). SCs are complex formations including such as purchasing and procurement, logistics and all the way from raw materials to end customers (Tseng, Islam, Karia, Fauzi & Afrin, 2019). These formations have become central in companies' sustainability effort over the past decade since the focus on sustainability has shifted from local optimization to entire SCs (Mann H, Kumar U, Kumar I & Mann V, 2010; Grosvold, et al. 2014)

The importance of supply chain management (SSCM) has been growing ever since the concept was introduced in the early 1980s (Svensson, 2007). Growing global competition, outsourcing of companies' non-core activities and the shorter product life cycles have increased companies' interest towards strong SCM (Ortas, Moneva & Álvarez2014). SCM has been used to describe the planning and control of information, material flows, logistics and manufacturing activities coordinated internally within company and externally among stakeholders (Gualandris & Kalchschmidt, 2014). Emerging trends in SCM such as globalization and increasing demands of customers due awareness has led towards more competitive and complex SCs (Saeed & Kersten, 2019). Manufacturers were the forerunners of the SCs by managing which products are manufactured and distributed. Nowadays, manufacturers must adopt to customer's desires and demands to remain competitive. SMC is a diverse combination of logistics and transportation, operations management, information technologies (IT), marketing, purchasing and distribution management. By enhancing each of these SC sectors organizations can develop efficient SC strategy which has direct impact on organizations' overall SC performance (Jain, Dangayach, Agarwal & Banerjee, 2010). SCM is an important environmental and social subject relating to corporate sustainability (Ortas, et al. 2014). SCM provides a valuable opportunity for the company to incorporate the objectives of sustainability performance into its decision-making processes (Meixell & Luoma, 2015).

As stated earlier, interest towards more sustainable SCM has risen significantly during past years. This can be authenticated by the number of papers and journals published around the current topic (Seuring & Müller, 2008). Increasing attention over the social and environmental impact of businesses has led companies to actively account and manage their environmental footprint (Adams & Frost, 2008). As previous researches highlights, main industrial issues in sustainability are currently related to global warming, gas emissions, energy consumption and waste from manufacturing (Demartini, Pinna, Aliakbarian, Tonelli & Terzi, 2018). Sustainability attention and pressures have led the instants for sustainable management of SCs (Gualandris & Kalchschmidt, 2014). Companies have broadened their approach of SCM by taking into account social

and environmental concerns which has led to develop a new concept: sustainable supply chain management (SSCM). SSCM is defined as an approach which manages the material, information and capital flows as well as cooperation among companies along the SC while taking goals from all three dimensions of sustainable development (SD); economic, environmental and social (Ortas, et al. 2014).

SSCM is established as a new approach for companies to meet stakeholders' requirements and to improve profitability and competitiveness while improving ecological efficiency and social responsibility in their SCs (Gualandris & Kalchschmidt, 2014). In SSCs, environmental and social criterias need to be fulfilled by the members within the SC (Seuring & Müller, 2008). In today's economy, where corporate social responsibility has gained importance by customers and stakeholders, by striving to more sustainable SC solutions, businesses gain competitive advantages – as well as economic advantages (Yildiz Cankaya & Sezen, 2019). This makes it advisable for decision-makers to consider, determine and utilize a set of relevant key performance indicators (KPI) characterized and tailored on the field where operated to monitor their SC and to make it more responsive and efficient (Chorfi, Berrado & Benabbou, 2015). When KPIs are successfully defined and implemented, they enable a company to monitor their process performances more efficiently and to gain tighter control over processes (Ammara, Fradette & Paris, 2016).

Organizations are be able to monitor their sustainable performance. Such monitoring required to set correct KPIs. With KPIs an organization ensures that they are going on the right direction in implementing SSC approach. KPIs are defined as measurable values which are used to compare and manage organizations performance and includes such as quality, cost, customer satisfaction and delivery accuracy. Measuring the performance in these terms, has significant impact on organizations performance and makes it easier to monitor and stay up to date in the motion (Bhatti et al. 2014). KPIs can be categorized to financial and non-financial KPIs and they vary among different industries. Therefore, comparison of KPIs can be difficult (Smith & Van Der Heijden, 2017). The four key SC concepts of this thesis: procurement,

warehousing, production and transportation has their own characterized KPIs to measure sustainable performance. Although, there are similarities and consistencies identifiable between concepts' own KPIs, which are discussed later on.

1.2 Problem discussion

There have been many interesting researches concerning environmental issues in SCM in the recent years. The attention for SSCM is still fairly low and received limited attention compared to other topics in the field of SCM (Mann, et al. 2010; Allaoui & Choudhary, 2015). Currently, research in the area of SSC has mainly focused on the improvement of individual process or firms, rather than the design of entire SC (Allaoui & Choudhary, 2015).

There is consistent and large body of literature dealing with sustainability in SC and special issues have been pointed out (Meixell & Luoma, 2015). Still, more research is needed in the future especially to examine the importance of measuring sustainability of a SC (Touboulic & Walker 2015; Meixell & Luoma, 2015). According to Hassini, Surti and Searcy (2012) there is a need for more research on developing an appropriate framework for sustainability performance measurements in SC.

The interest towards SSCM has driven companies to develop innovative tools to measure sustainability performance of their SCs. Measuring sustainability is essential to improve companies' environmental and social performance, including suppliers, customers and other stakeholders (Ortas, et al. 2014). The complexity of SCM creates some challenges when measuring sustainability. One of the common challenge or difficulty is to identify stakeholder's sustainability which are part of the company's SC (Mann, et al. 2010). SSC is hard to reach with incorporating SSCM practices and environmental benefits, if all the stakeholders have not adopted the same sustainable practices and ideologies (Meixell & Luoma, 2015).

Sustainability indicators in SC need to be evaluated and assembled in an intelligent way in order to improve decision-making, to identify possibilities for efficiency improvements, and to help to define strategic orientation. The currently used approaches for measuring SC sustainability performance have some limitations. The existing approach recommend to set separate KPIs for each sustainability indicator in SC. Basically this means that all the sectors of SC need to be measured separately, for example procurement, warehousing, purchasing and other parts of SC are measured individually, which means that this method does not really tell the truth of sustainability of the whole the SC. The method has received also other criticism because all separate components need to be measured together to find the overall sustainability level of the SC. All indicators that the collection needs, need to be weighted, and such weighting is nearly always based on the perception, norms and values of individual decision makers. The current approaches are also challenging, particularly in complex SCs. While measuring SSC, the whole SC needs to be covered, at least to know how many companies participate in the SC sustainability assessment (Schöggl, Fritz & Baumgartner, 2016). By measuring sustainable performance through KPIs, the process is systematic and helps organizations to observe to which way the development is going and if improvements are required (Bhatti, Awan & Razaq, 2014).

1.3 Purpose of the study

Determining supply chains' sustainable performance is challenging. It requires measurement tools to capture and analyse data from each SC activity and from all perspectives of sustainability (Qorri, Mujkić & Kraslawski, 2018). It is stated that decision makers cannot manage what they cannot measure. As stated in problem discussion section, current research has less focused on the development of integrated frameworks for measuring the performance of SCs (Taticchi, Tonelli & Pasqualino 2013). Especially social and environmental goals are, in most cases, new to many organizations, and these goals need to be integrated into their existing KPI measurement. Ideally, organizations should extend their SC KPI measurement to include social and environmental measures

and incorporate sustainable values to organizations' overall performance outcome (Cetinkaya, 2010).

In past decades, performance measurement has been traditionally determined through financial performance. In today's volatile and competitive business environment, organizations are facing more challenges and pressure to improve their SC performance which has led to develop also non-financial KPIs (Chorfi, et. al., 2015). All functions on SC need to be integrated into the planning, performance management and risk management operations of an organisation, especially considering how organisation is developing and refining KPIs and benchmarking various aspects of performance. Management decisions are influenced by sustainability KPIs. The task of identifying appropriate KPIs should be done in consultation with all stakeholders (Adams & Frost, 2008).

The purpose of this thesis is to identify financial and non-financial KPIs in SSC context, their characteristics and how they can be used to measure sustainable supply chain performance.

1.3.1 Research question

The research purpose is to conduct an empirical analysis of how organizations measure their sustainable performance by using KPIs. Analysis' goal is to gather disclosed information of interviews and sustainability reports of leading manufacturing companies operating in Finland, to answer the following research question:

“How organizations measure their sustainable supply chain performance with Key Performance Indicators?”

The research question is current due increased pressure on organizations to act more sustainable and take the responsibility on the environment, therefore it is advisable to investigate the theme comprehensively.

Answering the first research question requires defining the KPIs used in overall SC performance measurement, their importance and what are the particular KPIs

used when sustainability is in the centre of attention, and how do they differ from traditional supply chain performance measurement KPIs.

In order to achieve the aim of the thesis, authors have divided the main question into sub-questions as followed:

SQ1: What types of KPIs measure sustainable supply chain performance?

The first sub-question summarizes the characteristics of particular sustainability KPIs and answering the sub-question gives greater knowledge and understanding of what are the different types of sustainability KPIs and how are they used to evaluate and measure sustainability in SC. Sustainability reports provide shallow information regarding the usage of KPIs, and therefore interviews are required to gain in depth information.

SQ2: What key performance indicators do companies use to assess sustainability in their supply chains?

Second sub-question requires empirical material from interviewees and literature of previous researches made in the field of SSCM. Second sub-question clarifies how do target companies assess their sustainable performance and what indicators and measures are used pursuing towards more sustainable operation.

1.4 Scope and Delimitations

This study is written in the field of Business Administration and covers research within the area of sustainability in SCM. More precisely, the primary focus of this study will be on examining how do large Finnish companies measure their SC sustainability with KPIs. To delimit our study, we focus on Finnish manufacturing companies only.

Finland received the 2nd place in Robecosam country sustainability ranking 2018 (Robecosam, 2018). Due Finland's high ranking in sustainability, it helped researchers to find appropriate companies in the field of the topic to be

interviewed, and to find quality sources of data such as sustainability reports and annual publications.

At present, most literature in this field focuses on measuring components of the SC. Finland's status in sustainability of manufacturing companies provides possibility for researchers to find out how the whole SC performance can be measured by KPIs. Hence, this study lays its focus on KPIs and their role of measuring sustainable supply chain.

1.5. Outline

In the following sector, the overview of the outline of the study is introduced. The introduction chapter consists of study's background followed by problem discussion. The purpose of the study is instructed, and research questions introduced and elucidated. Research scope and delimitations are concluding the chapter. The next chapter, literature review comprehensively describes and explains the theoretical frame of the study. All the key concepts are clarified systematically. In the third chapter, research methodology, approach, strategy and data collection are explained, reader to get insight what has been done and how. Research methodology chapter is followed by empirical findings where the empirical data is analysed, and results and outcomes revealed. Last chapter is about discussion, concluding the research and proposing topics for future research.

2. Literature review

The literature review starts from the definition of sustainable development following with sustainable supply chain concepts. Literature review continues by listing the supply chain sectors, the research is focusing, following with definition of appropriate key performance indicators.

2.1. Sustainable development

Sustainability is about meeting the present needs without compromising the ability of future generations to meet their forthcoming needs (Brundtland, Khalid, Agnelli & Al-Athel, 1987). The three essential aspects of SD which have gained increasing recognition are economic, environmental and social aspects (Pathak, Singh & Sharma, 2017). SD is increasingly being presented as the desired state in society to where everything should strive in everyday actions. SD increased its importance as a concept in Rio De Janeiro in 2012 where United Nations Conference on SD was held (Holden, Linnerud, & Banister, 2014). Even though, the idea towards SD was first launched in 1983, when the United Nations Commission on Environment and Development was created and the first leap was in 1987, when Brundtland Report was issued. The report addressed how equity, growth and environmental maintenance are possible for all nations to achieve by simultaneously improving their actions. The three essential components of SD were issued: environmental protection, economic growth and social equity. These three key components are still in the centre of SD and cherished in the 21st century (Shah, 2008).

2.1.1. Triple bottom line

The triple bottom line (TBL) indicates the combination of economic, social, and environmental criteria which must be integrated into performance objectives of the management of the entire supply chain. This is why the management of environmental and social issues in the SC, namely SSCM, has been increasingly paid much attention at (Lee et. al, 2016).

In recent years, attention has shifted on “triple bottom line reporting” which purpose is to provide information about TBL segments: economic, environmental and social performance as a one entity. If TBL reporting is implemented successfully, it will lead on organizations to assess sustainability in their operations. The economic line of TBL refers to the business operations’ impacts on the economic systems. It is focusing on the organization's’ ability to provide economic value to the national or international economic system, that supports future generations ability to maintain the economic growth and to survive financially. The social line on the other hand, refers to organizations’ ability to conduct fair business practices for labour, human capital and the community. Simplified, it means “giving back” to the community, for example by providing health care coverage and higher wages. The third, environmental line of TBL refers to organizations’ success not to compromise future generations ability to access on environmental resources. It refers to the efficient and sustainable use of energy, reducing emissions and to minimize the carbon footprint (Arowoshegbe, Uniamikogbo & Atu, 2018).

2.1.2. Sustainability in manufacturing industry

SD has gained significant attention in the manufacturing sector and it was recognized in the late 1990s. Customers are becoming more aware about sustainability and them demanding transparency, together with global restrictions and legislations has pushed companies to consider their impact on TBL (Taghavi, Adams & Berlin, 2014). Sustainable manufacturing (SM) is a result of combining sustainable actions with manufacturing. The definition of “manufacturing” has traditionally and presumably been associated with unpleasant environmental side effects such as emissions and uncompromised usage of natural resources. Environmental pressures have led on developing a new concept of SM which main objective is to lower the environmental impact of manufacturing sector. Manufacturing industries are responsible for a significant amount of the world’s consumption of resources and waste output. In 2014, the share was almost 20% of world’s total fuel combustion (World Bank, 2014). However, manufacturing industries have little potential becoming the leading forces and Avant-guards of SD, therefore it is essential to be aware of origins of raw materials in order to shift

to better environmental performance on product and service development (Pathak et al. 2017).

Manufacturing industry, like any other industries, balance in between the pressure coming from customers, investors, competitors, communities as well as local and national legislations and expectations (Pathak et al. 2017).

2.2. Supply Chain management

The ultimate definition of SCM has been construed by several researchers as well has the final outcome and it vary depending on the point of view and researchers' perspectives. By some researchers, SCM has been roughly defined as a network of manufacturing facilities and distribution channels which purpose is to deliver the final product from factory to fulfil customer's request. However, recent development of supply chain literature discovers how supply chains are about much more, not just about simple and physical order fulfilments. Other researchers see SCM as an integrated network of various activities such as procurement and purchasing, materials management and manufacturing, logistics and distribution, marketing, IT and knowledge transfer. SCM is the strategic and systematic cooperation between these functions inside the network and these activities must cooperate seamlessly to gain functioning SC among all the parties involved (Jain et al. 2010).

Apart from manufacturing, procurement, warehousing and transportation are in key positions to influence on SCs. By absorbing sustainable practises into procurement, warehousing and transportation, environmental benefits can be significant. These three sectors are explained next:

2.2.1 Supplier evaluation

In unusual cases where a firm has full and complete vertical integration, the environmental impact and actions to develop sustainably, is under firm's own control. More often it is not the case and many of the operations are outsourced to suppliers or external service providers. Therefore, it is important to note that a

firm's overall environmental impact consists of performance of all the members belonging to the supply network. A firm's environmental impact is primarily based on an average value determined by its' supplier's environmental performance. In order a firm to succeed sustainable, it needs sustainable supply networks (Tate, Ellram & Dooley, 2012).

Constantly increasing competition and global development is pushing companies to strive to operate on higher global level. By outsourcing, the number of different companies involved in a single SC has increased significantly. Since the competition is intense, companies have developed supplier evaluation schemes including environmental and social criteria of evaluation. Such schemes include supplier's self-evaluation where suppliers need to introduce how they are taking environmental and social issues into account in their operations (Seuring & Müller, 2008). Supplier selection process is complex including a series of activities in the beginning of supplier identification, analysis, evaluation and lastly, selection and post-selection performance monitoring. In the past, suppliers were mainly evaluated and selected by their financial measures but in the recent years, green and sustainable practices have become popular and gained foothold in today's economy. This has challenged companies to re-evaluate traditional supplier selection criteria such as delivery times, quality and costs and to consolidate them with green attributes (Mendoza-Fong, García-Alcaraz, Díaz-Reza, Sáenz Diez Muro & Blanco Fernández, 2017).

2.2.2 Warehousing and inventory management

Warehouses' impact on environmental, social and economic dimensions of sustainability are not as widely researched as other sectors in SC such as logistics and procurement. This is observed through the amount of scientific literature found when searching in terms of sustainable warehousing. By adopting sustainable principles on warehousing has a great potential on organization to achieve its' sustainable development goals (Amjed & Harrison, 2013).

In past decades, the focus has pointed to global warming and greenhouse gas emissions while the energy consumption is continuously increasing. In global

supply chains, warehousing together with transportation are seen as the biggest causes of environmental pollution. Warehouses and sortation facilities covers 15% of total SC emissions. Most of the emissions caused by warehouses are from basic heating and cooling systems and lighting, and generally the bigger the warehouse, the bigger the emissions (Fichtinger, Ries, Grosse & Baker, 2015).

As it was stated before, the lack of researches regarding sustainable warehousing hampers to examine the total emissions and their impact on the environment and therefore the total picture is uncertain (Fichtinger et al. 2015). Recent developments in the field of inventory management have focused on information sharing and communication technologies, which, for their part, have enabled fluent collaboration between business partners such as manufacturers and their suppliers. With accurate information sharing, suppliers are able to maintain proper stock level to support their customers' needs and to aim for adequate stock velocity (Jung & Jeong, 2018). Like all SC sectors, alike sustainable inventory management strives towards more environmentally friendly solutions to reduce pollution, but without detriment of its profitability (Tiwari, Daryanto & Wee, 2018).

2.2.2.1 Waste management

Waste has become an increasing issue in nowadays economy and it originates mainly from businesses, government and households. Waste is defined by European Union Waste Framework Directive 2008/98/EC as following: "any substance or object which the holder discards or intends or is required to discard is defined as waste". Waste is produced by all activities and therefore it is locally arising problem, having both local and global effects (Halkos, 2018). Industrial waste is the by-product of industrial activities during manufacturing process such as chemical solvents, metals or paper products (Awuchi, 2017). Sustainable waste management requires the combination of knowledge and engineering together with good governance and human behaviour (Halkos, 2018).

As global standards continue to tighten, manufacturing industries are facing challenges to meet the continuously increasing demand for products whilst using

less material and energy and to keep the amount of waste as small as possible (Smith & Ball, 2012).

2.2.3. Production

The main causes of environmental issues are unsustainable production and consumption, especially in countries that are industrialized in large extent. To succeed developing sustainably, transformation requires changes in industrial processes, in the types and amounts of resources used, in waste management, in the control of emissions and in the final products produced (Krajnc & Glavič, 2003).

The industrial production sector is responsible for most of the material flows within human society as well as responsible for material and energy consumption. Current production systems are not sustainable in the long term relating on their demand of non-renewable natural resources such as oil. The concept of sustainable production was invented in UN Conference on Environment and Development in 1992 which main agenda was to launch sustainable production respecting TBL. Even if the concept is old, the shift towards sustainable production has been relatively slow (Krajnc & Glavič, 2003).

Manufacturers have become more aware of their operations' impacts on the TBL with increasing pressure them to monitor their resource consumption and environmental causations (Alayon, Säfsten & Johansson, 2016).

2.2.4. Transportation

Freight transportation is one of the SC's most significant and cost-intensive activity. Transportation's function is to link together all the partners among SC. The main objective of freight transportation is to deliver the goods to assigned customers as efficiently and cost-effectively as possible. Transportation is playing an essential role in the economy, it contributes to one-fifth of greenhouse gas emissions alone in European Union countries and globally, accounting about

19% of energy consumption (Pathak et al. 2019). There are three main sources arising from transportation that have the impact on the environment: construction of transport networks, operation of transportation vehicles and disposal of transportation vehicles (Dunn & Wu 1995). Therefore, by implementing sustainable practises into freight transportation, the integrity has significant positive impact on the environment (Pathak et al. 2019). This is leading organizations to search for alternative transportation solutions to minimize their negative impact on the environment (Hrusovsky, Demir, Jammerneegg & Woensel, 2016).

To reduce the environmental impact of transportation, there are several tools to make the transportation more efficient through optimization. Transportation optimization is defined as the process of finding the most efficient ways of moving goods while maintaining a desired service level (Craig, 2014). Optimization can be done by using for example multimodal transportation, consolidating freights and by using new trucks with efficient fuel consumption and favour renewable energy sources.

2.3 Sustainable Supply Chain Management

Number of researches and practical procedures of sustainable supply chain management (SSCM) made, have been increasing continuously in recent years (Beske & Seuring, 2014). There is wider understanding that firm's environmental practices are directly linked to its overall business performance. Firms see sustainability as an opportunity to gain competitive advantage via sustainable and responsible reputation, since consumers are environmentally conscious and favour good image. Organizations are also facing mandates from Governments and general public and they together with customers and consumers demand transparent SC knowing under which conditions their consumables are manufactured and distributed (Amjed & Harrison, 2013).

Sustainability is not only the right thing to, but it also provides ways to reduce costs and increase revenues (Tate, et al. 2012). Even if the SCM in general is an

old topic, the concept of SSCM is relatively new appearing to academic literature in mid-90's (Seuring & Müller, 2008).

The combination of sustainability and SCs is the critical next leap from previous speculations of operations and the environment towards more sustainable outlook of operations. Systematic SCM is a key element in global business, and therefore SCM has a huge impact on the environment, economics and future generation's welfare (Yun, Hales & Kwon,2019). In past two decades, the focus has changed from optimizing only organizations' operations to optimizing the entire SCs. In the past, these operations, such as logistics, information sharing, supplier selection and material management were seen more as independent sectors, than as a whole ensemble, which has not led to integrated development towards more sustainable SC as a whole (Linton, Klassen & Jayaraman, 2007).

According to Cazeri, Anholon, Ordoñez, & Novaski (2017), the importance of sustainability in SCs has risen due rapid over-consumption of raw materials, dystrophy of environment and increased level of pollution. Over the last few decades the issue has been increasingly discussed, recognized and incorporated by different industries. Organizations that are global leaders in their market sector and seek for superior environmental performance are in the front line of adopting SSCM practises to their operations. Social and environmental responsibilities are increasingly recognized and gradually something considered as self-evident, thus putting pressure on management to develop their organizational sustainability.

2.4 Drivers for sustainable supply chain management

Organizations are forced to modify their behaviour towards more sustainable, by both external and internal factors. Internal factors are such as employees, suppliers and customers when external are government and communities. These influencing factors can be defined as pressures, drivers and triggers. SSCM drivers are seen as pressures that force organizations to make sustainable initiatives whereas drivers are seen as positive factors, motivating and encouraging to implement sustainable practices into SC. Depending on a driver, they have different impact in different extend on SC decisions. When for example

media and social standards can influence on purchasing decisions, stakeholders have “to say” on logistics-related decisions (Saeed & Kersten, 2019).

In the literature, institutional theory is used to observe how different drivers of SSCM effects on decision making regarding sustainability. Institutional theory categorizes these pressures under three section: coercive, normative and mimetic. From these three, coercive pressure is seen as the most influential, including such as authorities and governmental regulations. Normative pressures come from common social responsibilities and society and mimetic pressures are related organizations to remain competitive, by organizations’ competitors adopting sustainable practices, no one wants to point out as being the least sustainable. Among institutional theory classification, drivers are also categorized as primary and secondary drivers. Primary drivers, as the name indicates, have direct impact on organizations and their whole SC network, originating from shareholders, customers, suppliers, competitors, investors and regulations, whereas secondary drivers have indirect impact, pushing organizations to consider their reputation and company image, arising from social groups and media (Saeed & Kersten, 2019).

Countries different regulations as well as other intergovernmental bodies, such as United Nations (UN) and international organizations have developed to define acceptable business codes of conduct. An organization's’ business code of conduct is an internal driver to implement sustainable initiatives and ways of operating which are modified by national and international laws and guidelines to meet stakeholders’ expectations. Especially when an organization is operating internationally, governmental laws vary between different nations (Saeed & Kersten, 2019).

UN’s sustainable development goals are the guidelines to achieve better and more sustainable future for everyone. They address the current global challenges related to climate and environmental degradation. UN goal 13, addresses the importance of organizations using renewable energy sources and to reduce emissions (UN, sustainable development goals)

2.5 Key Performance Indicators

Generally, KPIs are measurable values that demonstrate how well a company is or is not operating. Organizations use KPIs at multiple levels to evaluate and monitor their success and to reach their targets. High-level KPIs are focusing on the overall performance of an organization when low-level KPIs are focusing on different business parts such as sales, marketing, procurement of logistics. To formulate relevant and useful KPIs, an organization must clarify their desired business goals and objectives. To formulate KPIs, following questions must be asked: what the desired outcome is and, how the progress will be measured and how often the process is reviewed and what authenticates that the desired goal has been achieved (Klipfolio Inc, 2019). Since organizations' operations are complex systems, especially the international organizations', the performance cannot be measured only by a single KPI. In order to be successful and to remain competitive, organizations must be able to capture both objective and subjective performances. Objectives, also called financial KPIs are such as unit cost and profit, when subjectives also known non-financial KPIs are quality and customer satisfaction. Balancing between these two categories is essential for overall success (Sawand, 2009).

2.5.1. KPIs in SCM context

According to Cazeri et al. (2017) today's highly competitive business environment encourages organizations to differentiate from competitors by searching and adopting ways to gain better environmental performance. It is challenging due the complexity of supply chains and how one another's performance is linked to all the members inside the whole supply network. In order to remain competitiveness, organizations must implement sustainable practices without compromising the economic result. In order to evaluate and improve SSC performance, it requires identifying and developing measurable performance measurement systems (Bai & Sarkis, 2014).

In the SCM, performance measurement tools are important to be used for several purposes such as evaluating and selecting suppliers, overall operating

performance monitoring and development. Investigating and defining performance measurement systems thoroughly, guides towards coherent supply chain management sustainability. These measurement tools are key performance indicators (KPIs). There are hundreds of different measurements for business and supply chain evaluations, and they vary on different organizations, depending what are the one's individual motives and goals of using KPIs. This is a result of increased competitiveness of supply chains. Before, different organizations used to compete against each other's, now it is a contest of whole supply chains (Bai & Sarkis, 2014).

Formerly, supply chain performance measures have been financial, measuring mainly costs, time and accuracy. However, organizations are forced to obey environmental and social responsibility due increased scrutiny from customers' and stakeholders' side (Cazeri, et al. 2017). Common metrics used in supply chain performance assessment have mainly been planned to measure company's operational performance, including such as evaluation of enhanced effectiveness and strategic alignments of the entire SCM. These measurables in SCM context have usually been classified into four main categories: quality, time, cost and flexibility. Also, depending on what will be measured, these measures can be grouped by following quality and quantity, cost and non-cost, and whether the focus is operational, tactical or strategic. There are dozens of KPIs, but the most commonly used and beneficial measures for SCs are: manufacturing cost, inventory cost and turnover, cash-to cash time cycle and sales, order fulfilment lead time, gross margin return on investment, flexibility and information accuracy (Cai, Liu X, Xiao & Liu J, 2009).

2.5.2 KPIs in SSCM

Improving supply chain performance is a continuously ongoing process which requires comprehensive and analytical performance measurement system (Cai, et al. 2009). Traditional supply chain performance measurement tools focus more on operational and financial performance. By adding sustainability dimensions on measuring, it increases the complexity and size of measure set, making it challenging to measure the sustainability of a supply chain (Bai & Sarkis, 2014).

Having too many KPIs is better than having none but cutting down the amount and using carefully selected KPIs simplifies and clarifies the measuring process (Benchmarking success, 2018). Development of the TBL concept has been playing the key role incorporating the non-financial measures to KPI reporting, leading to increased transparency in supply chains (Taghavi, et al. 2014).

3. Research Methodology

This following chapter demonstrates the methods that were used on this study. First the research philosophy, research design and the theoretical framework will be described. Then, the chapter moves onto presenting data collection strategy and data analysis. Finally, the trustworthiness of the research is introduced.

3.1 Research philosophy

According to Easterby-Smith, Thorpe and Jackson (2015) research philosophy is made up by the perspective and viewpoints of how researchers see the world. When deciding upon the philosophical standpoint, the researcher needs to consider both ontological and epistemological perspectives. Both the epistemological and ontological standpoint of the researcher have a crucial influence on their ways of thinking the research progress (Saunders, Lewis, and Thornhill, 2009). It is essential for the researchers to be clear on respective standpoint. Guba (1981) means that by clearly stating ones epistemological and ontological perspective, researcher will ensure confirmability and reflexivity of their research. The philosophical standpoints will guide the researcher to choose appropriate designs and methods for the specific research (Easterby-Smith, et al., 2015). In the following chapter, the different forms of epistemology and ontology are described, and it is also explained why we decided to take particular epistemological and ontological standpoint in this research.

Bryman and Bell (2011) separate the two dimensions of research philosophy as ontology and epistemology. Ontology is an assumption and nature of reality and existence. Epistemology is the theory of knowledge which helps researchers to understand the best ways of studying the nature of the world. The most common forms of ontology are realism, internal realism, relativism and nominalism. Realism and internal realism indicate that that there is only one reality which we have access through information. Relativism indicates that reality depends on

personal perspective. Nominalism denies the existence of universals and abstract objects (Easterby-Smith, et al., 2015).

The most common forms of epistemology are positivism and constructionism. The main idea of positivism is that the social world exists externally and that its properties can be measured through objective methods rather than being inferred subjectively through sensation, reflection or intuition. Constructionism indicates from the view that ‘reality’ is not objective and exterior but is socially constructed and is given meaning by people in their daily interactions with others” (Easterby-Smith, et al., 2015). Based on the above definitions there are different philosophies that can be adopted, and it is the research purpose and further, its research questions that dictate what philosophy is best suited to apply: relativism and constructionism.

Since the purpose of this study was to answer the research purpose related to business concepts, practices and capabilities that cannot be probed through an external, positivistic manner (Saunders et al. 2009). Partly due to the social nature of the studied phenomena, and partly due to lacking academic research to allow such an approach, the philosophical standpoint used in this thesis related to a qualitative research approach, having an ontological standpoint relating to relativism, assuming that multiple ‘truths’ exist, and experiences can be perceived differently depending on the viewpoint of the observer. This ontology subscribes that the way how data was collected can significantly influence the study’s results. In terms of epistemological viewpoint, since relativism is the main anchor point for our “reality”, it connects with constructionism (Easterby-Smith et al., 2015; Saunders et al., 2009). The main reason why these philosophies were chosen was because our topic delves in uncovering the criticality of measuring sustainability in SC. It can entail that the phenomena in question is created by individuals and organisations, including different views, opinions and experiences (Easterby-Smith et al. 2015; Saunders et al. 2009). The reason to use this viewpoint and not another, was related to the fact that the individuals taking part in this research had different levels of knowledge and experience related to the studied topic.

3.1.1 Research Approach

After formulating the topic with a clear purpose for the research and finding the appropriate information, theories and models in the existing literature, the next step was to decide the research approach that was implemented (Saunders, et.al. 2009). Research approach is vital for researchers to be aware of their research. A well-developed approach is important, because the researchers will then be able to make an informed decision how to design their research (Easterby-Smith et al 2015).

When it comes to the available research approaches, the most commonly discussed theories in the literature are related to deductive or inductive theories (Bryman & Bell, 2011). In the deductive approach the researcher formulates a theory which is tested. The researcher creates hypotheses on a basis of current knowledge from the relevant field of study while in an inductive approach the theory is seen as a result of the research findings (Bryman, 2012). The deductive approach is commonly used in the natural sciences, since there are basic principles and laws for the explanation of a phenomenon, the theories can be tested based on those basic principles (Collis & Hussey, 2003).

There are five stages in the deductive approach. On the first stage the researchers formulate a hypothesis which is a testable proposition. The next stage is to express the hypothesis in operational terms. Then the hypothesis is tested, and the results examined. Finally, modifications in the theory are made if it is necessary based on the results. The inductive approach is the reverse process. The researcher creates a theory based on the observations which are the results of the research (Robson 2002).

The inductive approach is more suitable for exploring and understanding a phenomenon. In contrast with the deductive approach, which is mainly used in natural science, the inductive approach is mainly used in social sciences. Most people associate scientific research with deductive approaches since it is tested rigorously and is often used in natural sciences, where laws are the mean of explanation. Generally, deductive approaches are more applicable to positivistic philosophy and quantitative methods, whereas inductive approaches are more

applicable to constructionist philosophy and qualitative methods. An inductive approach aims to collect data, analysing it and building theory afterward. It is deemed to be a useful approach to pay attention to different perspectives and people from the social world we live in (Bryman, 2012).

Deductive and inductive research approaches are generally regarded as exclusive alternatives. The third theory is abductive theory and focuses on gathering data to generate categories and ideas, which afterwards are tested again with new empirical data (Saunders et al. 2009). Using an abductive approach generally means that the researcher starts from an empirical basis for sense making, just like induction, but do in addition to let new data emerge to develop existent theories, in line with deduction (Bryman, 2012). Dubois and Gadde (2002) described the abductive approach as something more than just a mixture of a deductive and inductive approach. Abductive approach is much more rewarding when the researchers want to discover new things, relationships or variables. The emphasis is put on theory development rather than theory generation, with the use of systematic combining, a theory is refined and not invented. Other than in deductive and inductive approaches, the abductive framework may very well be modified over time, depending on the empirical findings.

In this thesis research was used a mix of both deductive and inductive reasoning approaches, also called an abductive approach as above mentioned. In this research, this was shown in the first part of the research, the theory study, which is part of the deduction. Other aspects, such as the collection of qualitative data, deep understanding of the research context and understanding that researchers are part of the research process, are indications of an inductive approach. This type of research approach combination is possible, and it can also be stated that the inductive reasoning can have more weight in this research due to a scarcity of literature on the topic at hand (Saunders, 2009).

We expected to create extensions to the model based on measuring SSC with KPIs, as explained in chapter 2.3 "Sustainable supply chain management". We argue that this research approach was the most applicable to the purpose of the

thesis as the phenomenon of measuring SSC with KPIs is a relatively new field of study with a limited amount of existent research. An abductive approach enabled for creativity from the research since we were able to go back and forth between theory and empirical findings in their attempts to develop new knowledge.

3.2 Research Purpose

When the foundation of our research study was set up by classifying our standpoint on the research philosophy and our research approach, the next step was to identify the research design of our study. First the research purpose was defined. The research purpose can be either exploratory, descriptive, or explanatory (Saunders et al. 2009).

The aim of descriptive research is to portray an accurate profile of persons, events or situations, and the phenomenon has to be entirely clear to the researcher (Robson, 2002). Descriptive research is often used to delineate features of certain chosen population or social phenomenon being studied. This type of research is not evaluating or concluding data, it is rather seen as a means to an end. However, inability to address questions like “how”, “when” or “why” are the characteristic for descriptive researches. In most instances the questions like “what” are answered. Since descriptive researches seldomly provide a satisfactory explanatory level, hence it is recommended for researchers to carry out explanatory research to study a phenomenon more in-depth and broader (Saunders et al. 2009).

Explanatory studies investigate causal relationships between variables and thus, are mostly subject of quantitative studies. Explanatory research is termed as an attempt to examine cause and effect relationships, meaning that researchers want to explain what is going on between dependent and independent variables which have been formed on the basis of prior researches (Saunders et al. 2009). In other word, explanatory research looks into how things come across and react in order to investigate the factors why something happens (Neuman & Kreuger, 2003). This is done by firstly proposing hypotheses as well as defining dependent

and independent variables, and finding empirical data then subsequently testing on statistical tools. The focus of explanatory research is flexible because it was broad from the very beginning, then gradually becoming narrower in the process of research enabling to study a research phenomenon as precisely as possible (Saunders et al. 2009).

Lastly, exploratory studies go a step further than descriptive research and try to find out about “what is happening”. Exploratory studies try to seek new insights and also ask questions and to assess phenomena in a new light. These studies are mostly subjecting of qualitative studies. These studies can deepen the understanding of a particular problem, but may also show, that the research is not worth pursuing. Exploratory studies are flexible, the aim of the study may very well change over time, and the focus can change from a broad perspective to a narrow one. This is usually used to study new phenomenal or barely known topics, due such topics are normally difficult to be studied in a structured way (Robson, 2002).

Since this study aims to the understanding of different sectors of SC and how their performance can be measured in SSC, the exploratory research purpose is the most appropriate. More specific, this thesis explains how to measure SSC with KPIs and show if there are any differences between sectors of SC in this context. Hence, information was collected from several individuals inside the company. Conducting an exploratory study or descriptive study would require a broader foundation in literature than the one that is given and a clear notion of the expected outcomes of the study. (Saunders et al. 2009). Both of these requirements are not present in our research purpose. Furthermore, the adoption of KPIs in SSC measuring has not been determined yet, which hampered the execution of an explanatory study significantly.

3.3 Research design

The nature of the research question determines the research content, participants and the type of data required for the study or research (Davies 2007). The research design chapter describes the entire plans for the collection of data as well as its analysis (Ghauri & Gronhaug, 2010). The aim of the research design was about making decisions on what will be observed, and how (Easterby-Smith et al. 2015).

3.4 Data collection

According to Yin (2014), a good case study should rely on a variety of sources for data collection. In studying the topic at hand, secondary data as well as primary data was collected to reach our research purpose. Secondary data was used through academic literature inquiry, to allow the researchers determining and focusing on the most important factors for measuring SSC, and primary data through interviews to obtain answers and clarifications for our purpose from the business world. Moreover, Guba (1981) suggests that the use of several sources of data collection will increase trustworthiness of a study.

3.4.1 Article review

We followed a systematic approach to cover the relevant literature in the field of measuring sustainability in SCs with KPIs. Systematic review approach was applied to this paper with an overall aim to evaluate and analyse academic literature in order to provide a summary of the specific research problem with identification of flaws and gaps. A systematic approach in literature reviews should result in having an increased scope with high transparency and replicability. (Easterby-Smith et al. 2015.)

The review focused on evaluating available literature in the subject of SSCM. In the search for relevant literature for the review the database Web of Science as well as Google Scholar and ResearchGate were used to find the most suitable articles for the research.

3.4.2 Type of Data

The data collection of this paper was based on two sources in order to answer the research questions. Secondary and primary data was combined to achieve the desired results.

Primary Data

This is the type of data or information collected directly from first-hand experience through sources such as observation, experiments, surveys or questionnaires, and interviews by the person doing the research (Ghuri & Grohaug, 2010). The use of interviews helps to gather reliable and valid data and there is room for elaboration and more in-depth conception, depending on which type of interview is chosen to be suitable for research strategy and objectives (Saunders et al, 2009). As this research has its focus on measuring SSC, the selected respondents work or are involved directly in the SC activities. In other words, procurement and materials management as well as warehousing and logistics are appropriate for this study, since they are the main actors in SC. Although primary data is costly and time consuming to collect, it still proves to be more consistent with the research at hand being that the information is collected directly for the specific purpose (Ghuri & Gronhaug, 2010). Through gathering of primary data, researchers gain insights of new perspectives (Patton, 2015) and may successfully add value to the specific research field. Primary data also adds richness and credibility to a qualitative study (Myers, 2009). For this thesis, in-depth interviews made up the substantial part of primary data collection. We conducted interviews with five individuals in each case company. Based on the purpose of this thesis it was certain that all the interviews provide us enough depth and insights to fully understand of measuring SSC in manufacturing companies in Finland.

Secondary Data

Secondary data plays vital role in research studies by providing information for us to understand, explain, and solve our research problems. Other benefits of sourcing secondary data are time and costs savings. Considering the benefits, a researcher can derive from secondary data, many scholars have therefore recommended that it is a good idea for all researches to begin with secondary

data sources (Ghauri & Gronhaug, 2010). Secondary data includes written documents and materials such as records books, journal and magazine articles and newspapers. Written documents can also include notices, reports to shareholders, diaries, transcripts of speeches and administrative and public reports (Saunders et al. 2011). In this research, companies' sustainability reports were the most relevant secondary data collected. The case companies' own websites provided as important sources of secondary data collection and used for sense making of primary data. The secondary data was a useful complement to support the primary data as it allowed us to spend more focused time on to create more specific questions for interviews during the limited timeframes.

3.5 Interviews

Companies asked to have the interview questions before the face-to-face interviews. Interviews consisted of semi-structured questions dealing with respondents' perceptions on the sustainability inside the organization's SC network. The objective was to get data of how sustainability is implemented and monitored in SC sectors, focusing on procurement, warehousing, production and transportation. As Saunders et al. (2009) states, in semi-structured interview, the researchers have a list of themes and questions to be covered and inside these frames there is room for respondents to respond on their distinctive ways.

Company A	Job title	Interview Type	Interview Duration	Interview Language	Employments with the Company
	CEO	Telephone/e mail	25 min	Finnish	10 years
	Plant manager	Face-to-face	45 min	Finnish	35 years
	Procurement manager	Face-to-face	35 min	Finnish	15 years
	Material manager	Face-to-face	40 min	Finnish	20 years
	Logistics manager	Face-to-face	25 min	Finnish	2 years

Company B	Job title	Interview Type	Interview Duration	Interview Language	Employments with the Company
	CEO	Face-to-face	45 min	Finnish	10 years
	Procurement manager	Face-to face	30 min	Finnish	12 years
	Materials manager	Face-to-face	30 min	Finnish	5 years
	Logistics manager	Face-to-face	35 min	Finnish	30 years
	Quality manager	Face-to-face	40 min	Finnish	7 years

Company C	Job title	Interview Type	Interview Duration	Interview Language	Employments with the Company
	CEO	Face-to-face	45 min	Finnish	13 years
	Marketing manager	Telephone	20 min	Finnish	5 years
	Production manager	Face-to-face	35 min	Finnish	6 years
	Quality manager	Telephone	25 min	Finnish	2 years
	Material manager	Face-to-face	40 min	Finnish	10 years

Table 2. Information on Interviewees

The interview time was set and agreed with the case firms, settled upon 3 hours allowing enough time to probe into complex aspects. Apart from only 3 phone interviews, all the rest were conducted face to face. Approximately 10 hours' worth of empirical data was collected from the interviews. After interviews the authors had opportunity to call companies on phone to clarify some of the points that were not explicit enough, and also to ask more questions.

3.6. Data analysis

According to Yin (2003), the data analysis part of the research is difficult and complex, and it might require different techniques and strategies. The suitable selection of technique and strategy for the data analysis process is very important (Kumar, 1999).

For this research, interviews, articles, and reports were used to collect the data. Data collection is an interactive set of processes that allows recognizing substantial patterns, themes, and relationships (Saunders et al. 2009). After the primary data was transcribed and secondary data was collected, the raw data was processed, and unnecessary data was filtered out. We started to get familiar with the data, reminding ourselves about the purpose of the study and the theoretical framework.

According to Hancock (2002) qualitative data should be analysed based on the theory relevant for the study. As we have taken on an abductive research approach, we applied systematic combining of theory and empirical findings during the analysis process. Analysing the data by systematic combination meant that we went back and forth between the theoretical framework, data sources, and analysis. Easterby-Smith et al. (2015) suggest that organizing codes help the researcher to identify themes. The data was first categorized by the different sectors of SC depending on the respondents' position in the company. The different categories were defined as; warehousing and inventory management, procurement, transportation, and production.

As mentioned earlier, the primary data collected was recorded and then transcribed. Interview summaries were made in English but in order to reduce the risk of translation errors, they were all first analysed in Finnish. This procedure was executed in order to decrease the risk of missing out crucial information or create bias in results. Transcribed interviews and additional material were looked through with a pursuit of finding terms or patterns that re-occurred in separate interviews to create codes out of them. The analysis was structured based on the purpose as well as the different crucial themes that were established in the empirical findings. After these processes, a conclusion was drawn and the answers to the research questions and to the purpose are presented

3.7. Trustworthiness

One of the most important issues in any kind of research is the quality of the data. Halldorsson and Aastrup (2013) state that trustworthiness can be used to increase the credibility of research related to logistics problems. The trustworthiness of the study always needs to be discussed in a thesis in order to minimize the possibility of misleading results (Saunders et al. 2009). The trustworthiness refers to the enabling of validity and reliability of the results. According to Crowther and Lancaster (2009), reliability and validity are the most relevant criteria to evaluate qualitative research.

The term reliability is concerned with the question if the results of the study are repeatable (Bryman & Bell, 2011). In other words, Crowther and Lancaster (2009) define the term as the possibility that another researcher should be able to do the same research again and get the same results on different occasions. If research can be replicated by a third party and would achieve the same findings, seeing the research as being reliable (Saunders et al. 2009). This can be ensured by demonstrating the procedures, showing transparency and giving thorough explanations about the methodological choices, data collection and analytical steps as detailed as possible (Yin, 2014). Basically, if nothing changes in a population, two different studies with the same purpose and method should give the same result. Reliability also refers to the degree of which results are consistent over time and how accurate the entire population under study is represented (Ghauri & Gronhaug, 2010). Researchers can use several techniques to ensure that the results are reliable, and the goal is to establish that the results are consistent with the collected data.

According to Robson (2002), there are four threats related to reliability. The first threat is the subject of participant error which indicates that different times of conducting the research might generate different results. In order to avoid the first threat, Saunders et al. (2009) suggest conducting the research in neutral moments. The second threat is subject or participant bias. The third threat is the observer error which means that different observers have different perceptions regarding a topic and also ask questions in a different way. The last threat is the observer bias which indicates the different ways of interpreting the results.

Moreover, some aspects such as the respondent's mood, the interviewer's mood and the regression effect of an instrument can affect the reliability of a research instrument (Kumar, 2010).

Relevant theories and articles about the topic were carefully studied to gain more knowledge within the field before the interviews to avoid any bias of the observer's side which made the research more reliable. In order to ensure reliability in this study, the interview template was shown to the tutor of this thesis to ensure that the questions were relevant for the intended purpose and that no questions were left out. Similar questions related to the subject of the matter were asked from all participants which also leads to better reliability. All the interviews were conducted with the same strategy to facilitate the accuracy of the results. Also, both interviewers were present during the face-to-face interviews in order to minimize the threat of observer bias and both took notes that were compared at the end of each interview to achieve higher reliability for the research. Another procedure used to augment the reliability was to respect the order of the questions in the interview guide where the same interviewer asked and formulated the same question during each face-to-face interview occasion. Also, the interview guide was sent to the respondents some days before the interview was arranged in order to offer the interviewees the possibility to follow the interview guide and read the questions at the same time they were addressed. This contributed on avoiding misinterpretations and provided satisfactory results. Since we recorded all face-to-face interviews, no information was left out and we were always able to get to back to interviews to check some details. The interviews conducted provided a large amount of data, as most of the discussions delved into various areas in relation to the research purpose, allowing better results. Due to the semi-structured format of the interview guide, multiple views on the topic at hand were obtained during the interviews, which allowed the researchers to obtain more and more accurate picture of the phenomena.

According to Saunders et al. (2009), validity refers to the extent of where the findings are about what they appear to be. Validity is also related to the extent to which data collection method is appropriate and that it measures what it measures, or to what extent the research results are truthful. According to Saunders et al. (2009) validity is related to whether the findings are really about

what they seem to be about. Validity is of various forms, but the types commonly accepted in qualitative research are internal validity and external validity (Saunders et al. 2009). Internal validity concerns the degree of causal relationships that exist between two or more variables, while external validity deals with how well the findings can be applied in other settings; particular persons, times, and population (Ghauri & Gronhaug, 2010).

In order to assure this paper's validity, the majority of the terms, definitions, and perspectives utilized in the literature review were compared, based on a number of different authors. This process permitted the researchers of this paper to include data with enhanced validity and at the same time reduce the reliance on, for example, a single article, journal or report. Different data collection techniques and strategies were evaluated at the beginning of the research for this thesis in order to guarantee a higher level of validity. In order to ensure the validity of this thesis, the authors decided to interview the right companies and persons, the interviewees were people with a wealth of experience in the field of the study. To increase the internal validity the researchers visited the businesses to get to know how they operated, this enabled them to understand how different KPIs are used to measure SSC. On the aspect of the secondary data, the literature search was done by carefully gathering necessary information within the scope of the study and also ensured that the sources of the information were verified and accurate. During the study, the same data gathering procedures were applied in all case study firms, in terms of questions and processes, to obtain stronger results that can then be replicated with more accuracy. To avoid any misinterpretations or the probability of misconceptions, we applied the accuracy of expression to assure that each stated questions and statements were easily understandable and that they mirrored the purpose of this study. The methods chosen in this research are applicable in more situations than the one presented here, which creates external validity for this research making it possible to recreate it in other industries and from there draw broader conclusions.

The result is presented in a manner that enhances the credibility, similarities and differences within and between interviewee groups as well as between interviewees are distinguished. The transcripts and the summaries of all interviews were conducted together by the authors in order to present relevant

information and communicate it without bias. These actions were in order to enhance the trustworthiness of this thesis and moreover to enabling the presentation of reliable and unbiased results and conclusions. While this study focused on a multiple case study, to allow better results, it does have, however, several weaknesses. Among the biggest, is the issue of allowing other studies to replicate the same result and allow generalization (Easterby-Smith et al. 2015). While this study had difficulties in providing repeatability of results, due to the very specific nature of the topic, the specific characteristics of the studied case firms and studied industry/country, however, the detailed description of the results can provide useful insight and allow for further theory building or testing. As it focuses on measuring SSC in Finland, in turn it allows other researchers to use the findings, categories, ideas and factors evidenced in this study for further scientific research.

3.8 Ethical Considerations

Qualitative research process can unveil several ethical issues, especially in the field of management and business. The research process was performed taking ethical considerations into account. Easterby-Smith et al. (2015) presents the ten key principles which were considered in the research and are further explained next:

First key principle is ensuring that no harm is caused to participants, second key principle is about respecting the dignity of research participants. Together these first two principles are related to protection of research participants. The third key principle, ensuring a fully informed consent of research participants, in the context of the research these three first principles were obeyed by respecting respondents time and effort. From the very beginning, the topic and the purpose were presented thoroughly and transparently, and so were agreed the interview appointments and permissions for audio recordings (Easterby-Smith et al. 2015).

Following three key principles: protecting the privacy of research participant, ensuring the confidentiality of research data and protecting the anonymity of individuals and organizations were ensured when gathering and presenting the

data. Research participants were treated anonymously, and company descriptions are presented as they cannot be appointed out. Only researchers and thesis supervisor were accessible to the data and it is stored confidentially by not allowing anyone unconcerned to access.

The last four ethical principles are about protecting the research community by avoiding deception about the nature or aims of the research, avoiding conflicts of interests, being honest and transparent in communicating about the research and to avoid any misleading or false reporting of research findings. Interviewees were provided with detailed description of the execution and aim of the study. Also, the study was conducted in teams of two, and therefore it was not influenced by personal interests.

4. Empirical Findings

This chapter presents the empirical findings from the interviews and secondary data used. The findings are presented in the order according to the literature review.

The following table 3. provides an overview of the chosen companies, the industry they are operating in, to what they are specialized, approximate revenue, year when established and the number of employees. All the chosen companies are operating globally, but the focus was only in manufacturing facilities located in Finland.

Company	Industry	Specialization	Approx Revenue	Established year	Number of Employees
A	Manufacturing	Building materials	10 million	1951	49
B	Manufacturing	Cranes	Confidential	1993	300
C	Manufacturing	Packing materials	562 000	2009	25

Table 3. Company Overview 2

4.1. Sustainability in manufacturing organizations

All of our interview questions were based on sustainability in SC, still we did not define the term 'sustainability' in the beginning of the interviews and therefore we received a broad range of views of sustainability. All companies are aware of the importance of sustainability in their operations and sustainability is clearly mentioned in two of the companies' mission. As several national and global organizations have adopted sustainability in their business strategies, also our interview companies have done the same. The findings were based on interviews as well on secondary data, composed primarily from companies' sustainability

reports. Our first interview question aimed to examine, how sustainability is taken into account in companies' strategies.

Company A has implemented sustainability roadmap in 2017 in order to continuously improve their ecological, social and societal performance in all their everyday operations. As company B is one of the biggest players in the technology industry, it is obvious that environmental, social and economic impacts are precisely monitored and taken into account in everyday operations. Company C as an environmentally friendly operator, main initiatives of their responsibility strategy include minimizing environmental effects of its own production.

Company A has divided its sustainability roadmap in to four main focus areas: sustainability in the supply chain, environmental aspects in production, social aspects in production and sustainable products. As mentioned, this roadmap represents a deliberate, self-imposed commitment to continuously improving company's ecological social, societal and economic performance. During the interview with company A, TBL was not mentioned but it can be easily noticed that this roadmap covering all of the aspects of TBL. The sustainability roadmap is introduced below with its main initiatives.

Sustainability in the supply chain	Availability of raw materials
	Avoidance of hazardous substance
	Protection of local residents and employees, nature conservation, re-use of depleted extraction sites
Sustainable products	Innovative and durable products
	Recyclability, recycling, and re-use of products
	Product-group-specific properties
Environmental aspects in production	Energy efficiency
	Climate production
	Resource efficiency and waste management
	Sparing use of water
Social aspects in production	Health and safety of employees
	Business ethics and compliance
	Employee satisfaction and training
	Communication with and involvement of employees

Table 4. Sustainability Roadmap

Company B has divided its responsibility strategy in to four main focus areas: safety, environment, people and integrity. These key areas are similar to TBL and are easier to follow and measure when the whole integrity is divided into smaller sectors. Business performance is monitored through sustainable development goals set by United Nations, and it is a long-term process to achieve these goals. Especially in long-term processes, systematic monitoring and reporting is fundamental. These goals are introduced below, and objective is to achieve them by 2020.

Safety goals	Ultimate goal to have zero accidents (subcontractors included)
	Reduction of serious injuries and no fatalities
Environmental goals	Reducing energy consumption and emission intensity
	ISO 14001
People goals	Gender diversity and equality in management, globally and nationally
Integrity goals	Strong maintenance of code of conduct
	Monitoring sustainability of suppliers

Table 5. Responsibility strategy

Company C has divided its responsibility goals in three main categories: social, environmental and sustainable. These themes are covering all their operations. TBL can be recognized also in this company's responsibility goals. Company C minimize environmental effect in its own production by using renewable energy sources, by using optimisation program to purchase materials and by having a closed water circulation. Company is responding to the demand for sustainably manufactured products made from renewable raw materials.

Social goals	Responsible corporate culture
	Accident-free work environment
Environmental goals	Increase biogas production
	Resource efficient production
Sustainable goals	Recycle raw materials
	Sustainable supply chain

Table 6. Responsibility Goals

The first interview question led to more questions about products and raw materials. As we already got to answer how companies are taking account sustainability of their operation we wanted to figure out if their raw materials fulfilled the standards of sustainability and how final products can be recycled.

Company C's main raw material consist of completely recycled paper. Company A's main raw materials are sand and clay, and they are currently studying the opportunities of substituting secondary raw materials for primary raw materials without compromising product's quality. Company A also highlighted the option to use recycled products as their raw materials:

“We continuously use resources to innovate our production with recycled products. Last year the biggest innovation was to use recycled toilet seats as raw material in our production. “(Plant Manager Company A)

Another major point was the sustainability of products. CEO of company A mentioned that their products are an integral part of sustainable building concepts. These products fight against climate change, not least on account of their heat storage capacity and long lifecycle. These advantages are also mentioned in their marketing materials. As already mentioned, Company C's products are made only from recycled paper. Even if this is already huge sustainable advantage, also end products are light and durable and their shock absorption is very good. These products are easy to recycle to be used again in production or dispose.

Company B is using the advantages of circular economy business model, and it is followed when it comes to sustainability and recycling. Circular economy creates value by minimizing waste and the usage of energy and decreasing the use of natural resources. The statement can be found in company's B sustainability report. Circular economy business model helps Company B to increase their energy and resource efficiency and to reduce their customers' environmental footprints. Company B's strategy is to provide customers high-quality products which are easy to re-design and customize, maintain, repair and disassembly. Company C also stated the importance of customization on reducing waste. Marketing manager of company C pointed out their idea of the marketing plan:

“Customer-oriented production is in centre of our business.”

Their production is based on customer demand, which leads to lower inventory cost and minimizes the obsolete of products.

All interviewed companies also mentioned the importance of the quality of products. Quality is one of Company A's values. The production manager pointed out that quality management system (QMS) has been installed at their plant and certified according to ISO 9001. Also, environmentally relevant aspects have been integrated into this quality management system. CEO of Company B said:

“because of high quality, our products have very long lifespan lasting for decades”. “It is enabled by product’s capabilities to be modified to meet customers’ changing needs through modernization as well.”

Therefore, the whole product does not have to be replaced by new equipment - being beneficial for customer and for environment.

Due the complex nature of products, company B provides professional equipment maintenance service for customers, therefore product's lifespan can be extended, but when it has reached its top, product can be easily disassembled and recycled. Recycled materials consist of metals, copper and electricity components, which are profitable when recycled properly. Company B has its own values supported by corporate governance framework and code of conduct.

CEO of company A also pointed out that they are expected not only to guarantee the quality of their finished products, but also to guarantee compliance with social and ecological minimum standards of their services they need when producing and marketing their products. These aspects are more detail explained in following chapters. Also, employee training is playing a key role in all companies when setting basic guidelines for responsible business behaviour from the early stage.

4.2 Supplier selection and procurement

During the interviews we recognized how differently manufacturing companies are selecting their suppliers in Finland. The biggest difference of supplier selection can be found between company A and B, since they are operating in totally different markets. Company B's final products are way more complex than

products of company A and C and the reason of product complexity affect to the amount of suppliers.

Company B pointed out the importance of strategic sourcing in their operations. Company B has numerous suppliers where the significance of strategic sourcing is emphasized. Its function is to continuously improve and re-evaluate the purchasing activities in order to find the most efficient suppliers. Company B has strict standards on with who to collaborate with.

Company A's procurement mainly consists of raw material purchasing. Supplier selection is based on availability and quality of the raw materials. Furthermore, different regulations and legislations were found on affecting procurement since raw materials are natural materials. The company needs permission from the above parties to obtain the natural material purchase rights. The most influenced by these decisions is how the input of the raw materials affects the environment, for example, if the mining of the raw material affects the biodiversity, no permission is given. Other purchased products are spare parts and the main selection criteria is the price. Procurement manager stated that if there are two products with almost same price available but one of these has been produced with sustainable ideology, the company will select doubtless this supplier. Also, the 'supplier code of conduct' has been made available for all local companies as a binding instrument. Procurement Manager of Company A mentioned:

“The percent of supplier spend covered by our Supplier Code of Conduct is one KPI which we are monitoring and measuring”.

It demands that suppliers respect human rights and the principles of environmental protection. Procurement in company C as well as in company A focus on raw materials purchasing. Since products are produced by using recycled fibre the main criteria for supplier is material availability.

Moreover, local sourcing was mentioned as another approach to procurement. All interviewed companies have the aim to support regional suppliers in order to shorten lead times, this also effects on company image positively when preferring local suppliers. Company A has a strategy for the avoidance of supply shortages, they had developed a list of the main product groups and their suppliers.

Company B is using a “toolbox” to identify and categorizing primary sourcing activities. Toolbox consists of improving product specification and joint processes, restructuring relationships, global sourcing, best price evaluation and volume concentration. With the toolbox, the whole sourcing entity is easier to manage and monitor.

Communication with the suppliers was also mentioned as a part of supplier selection by all companies. To thicken customer-supplier relationships, open and transparent communication corporate wide is essential for smooth and reliable relationships. Procurement manager of company B stated:

“long-term business relationships are worthwhile to maintain”

In long-term business relationships risks are smaller and unexpected is more unlikely to happen. It is important to value strong business relationships if cooperation is beneficial for both. It was also stated that in long-term business relationships trust is more important than price.

“It would be silly to replace something that has been firming for decades to compromise it only for lower price”

Aforementioned procurement decisions do make sense with regards to sustainability, but also in a more general business sense. Procurement manager of company B pointed out that the company is ready to improve their procurement strategies if customers require it. All interviewed companies are aware of higher expectations of customers side and they are thinking their future actions are based on these expectations and on taking account other requirements which are coming from other stakeholders.

4.3. Warehousing and inventory management

The level of inventory has significant effect on warehousing operations. Accurate information of customer demand and forecasting helps to carry on correct inventory levels to keep inventory cost as low as possible. It helps as well minimizing the percent of obsoleted finished products. Main KPIs for warehousing management and inventory management are inventory turnover and service

level. The inventory turnover indicates the number of times that a company turns its inventory around in a year. Service level is mostly related to customer satisfaction and can be explained by how many times a company has fulfilled customer's demand within a certain amount of time.

Warehouses cover significant amount of the total energy consumption. Warehouses and other facilities require constant heating - or refrigerating and lighting which takes a lot electricity or fuels depending on what energy source is used.

Company A has warehouse facilities located close the production site which helps the company to handle inventory issues easier than if warehouses located farther. The location of warehouses has also limited the cost of transportation of finished goods to warehouses. Products of company A does not require cool or warm circumstances which keeps warehouse energy consumptions relatively low. Raw materials are placed on the silos outside of the plant. Production manager of company A has mentioned that sometimes is more efficient to produce more product than needed to minimize production cost since their warehouse cost are pretty low. Logistics manager of company A pointed out that this kind of production strategy is challenging sometimes for warehouse planning and packing.

Our products can be warehoused also outside and sometimes this is needed if our current facilities are full. In summertime this is not a problem but when there is two meters of snow, it is challenging. Also, products warehoused outside need to be packed as required in order to remain in good condition in the changing circumstances (Logistics manager Company A)

The issues of packaging efficiency and the recycling of packaging material were investigated in cooperation with suppliers of packaging material. Company C is dealing with the following sustainability question: *Can we use packing materials which are not classified as sustainable in order to keep our product safe and minimize the percent of obsolete product?* It would be ideal to find packing

material which fulfils sustainable requirements and keep the quality of the product good even in difficult weather conditions.

Company B has solved the lighting issue by switching to light-emitting diodes (LED). Using LEDs rather than old traditional bulbs is more energy efficient, leading to financial savings. Warehousing facilities are all warm or not heated, because the products do not require cool circumstances. Refrigerated warehouses consume significantly more energy than warehouses that are heated. Company B also uses only electricity which has been produced by using renewable energy sources. No fossil fuels are used. The production planning of company C is based only on customers demand. The production starts when customer has placed the order and therefore there is no need for massive warehouse facilities. Also, the shape of the products, save space in a warehouse. These products are possible to be piled one inside another.

Since company B has expensive components stored in warehouses, the importance of inventory management is emphasized. Components are stored in conditions which does not effect on their quality negatively. With good warehousing unnecessary scrapping is avoided and resources are not wasted. Inventory levels are kept minimum and warehouse velocity is kept rapid to keep the components in move. Company A follow ABC product classification approach to keep inventory levels low and service levels high. The components company B is using may lose their product warranty if stored in warehouse for too long. Also, since new development and product designs are made, it is advisable to use old items before new generation items take over. When it comes to warehousing products, first in - first out principle is followed by Company A and B. By leaving old components unused, company B loses notable amount of money due the expensiveness of components. Company A and C reverse old, poor-quality and obsolete products back into production as raw materials.

Company B is not particularly measuring the sustainability of their warehouses, but the evaluation is based on the monetary value of scrapped components. It can be noted that financial measurements determine the sustainability of a warehouse to an organization. This financial KPI can be easily measured through

numeric values, and therefore the result indicates directly if the benefit is positive or unpleasant. The same ideology is mentioned by other interviewed companies.

4.4. Waste management

According to Demartini et al. (2018) one of the main industrial issues in sustainability are currently related to waste from manufacturing. All interviewed companies have mentioned more efficient waste management as one of the future goals. EU regulations, Finnish legislation and other organizations require manufacturing companies to measure, report as well as improving their waste management. These regulations provide frames for waste management in Finnish manufacturing companies.

Company B requires their suppliers to use standardised packing materials so the packages can be recycled or reused. Packing materials such as paper, cardboard and plastic are all separated and recycled. Standardised pallets such as EUR and industrial pallets are used among majority of suppliers and clients so those wooden pallets can be reused until the lifecycle ends, then the pallets are easily recycled. As mentioned, company C produces packing materials which are recyclable as well compostable. They try to minimize energy use and other environmental load abilities and resources in all their activities.

Company B has high value inventory and primary policy is trying to use all the components and avoid materials going to waste. In these cases where materials need to be scrapped due them being broken or out of date, everything that can be recycled, will be. The main raw material of these products is steel or other metals which can be easily recycled and reused. Steel which is used for company B's products is made out of half new raw materials and half scrap, which is very environmentally friendly solution. Company C re-use all wood fibres which originate as a waste-product of production. Other waste as plastic and steel, they send to recycle centres which are professional companies of handling such materials. The waste of company A's production mainly consists of materials which they can crush, and then they can add these to the pulp of new products at a certain stage of production. Company A is also working on a continuous

reduction of scrap rates and the recycling of production waste and increase residual substances into production.

Industrial wastewater is defined as wastewater that is conveyed to sewers and differs from normal domestic wastewater in its quality (Finnish wastewater guide 2018). Finnish wastewater guide describes the industrial wastewater related to legislation currently valid in Finland, information on different types of industrial waters, instructions for preparing an industrial wastewater agreement, formula of increased fee, monitoring of industrial wastewater and practical examples of functional solutions. CEO of Company C said that in their production there is no wastewater to discharge into drain. Only outgoing water comes from drying department as steam. Also drying energy recovering is maximised. Company A is measuring and reporting process water as discharge per saleable tonne.

Company B is committed to provide customers efficient solutions while lowering its environmental footprint. New ways and innovations are constantly developed to reduce negative environmental impacts of manufacturing products. Targets for the contribution of innovative products are placed also in Company A. Targets are described as new products and system solutions that are durable and cost-efficient, contributing to the energy efficiency of buildings and to climate protection, ensuring safety and health for users.

4.4 Production

The most significant environmental impacts arise from production, mainly from energy consumption that heavy manufacturing requires. Producing components from raw materials takes energy and so does the manufacturing facilities themselves. Manufacturing industry affect the European environment therefore EU has stated EU Industrial Policy Strategy. The strategy is to maintain strong, evolving and low-carbon industry based on circular material flows. The goal of the strategy is to create a growing industrial sector that draws less and less on natural resources, reduces pollutant emissions to air, water and land, and generates decreasing amounts of waste over time (EU Environmental Agency 2019).

All interviewed companies are building management systems around ISO 14001 (Environmental Management System) standard, which helps to develop more sustainable solutions and to set minimum requirements that must be overcome. ISO 14001 standard helps an organization to achieve the desired objectives of its environmental management system, which provides value for stakeholders, environment and for the organization itself. Standard can be achieved if an organization fulfills the necessary environmental requirements, regardless of company's size, type or nature (International Organization for Standardization). Among developing production, much attention is paid to efficient logistics and packaging, to reduce waste and to recycle as much as possible. Company A has reached almost all its environmental goals years ahead of original schedule, which indicates the commitment and desire towards more sustainable operations and image. Production site of Company A has been certified according to ISO 14001. More than half of company B's factories have ISO 14001 environmental management system. The same is expected from suppliers. Supplier manual is used, where there are listed for example restricted materials which applies as well to suppliers, to also company B's own production. Also, code of conduct must be respected by suppliers in order to become a collaborator.

Company A is measuring the usage of energy per produced ton. In the year 2018 in the main production site the consumption of natural gas was reduced by 4% compared to 2015. It was due to the conversion of selected production site from high-emission energy sources to natural gas which was the defined target of reducing the absolute consumption. The Company A has potential to use biogas in the future but this needs customers to change their purchasing habits.

We have the opportunity to produce all our products using biogas. However, this kind of production is more expensive, thus also affecting product prices. Customers are not yet ready to pay more of alternative ecological produced products. (Plant Manager Company A)

Quality management systems (QMS) have been installed to Company A plant, and it is certified according to ISO 9001. Since the quality is one of the companies' values, products have highly quality standards. If the produced product doesn't

meet these standards it will be rejected. Company A measuring and reporting product rejection rate. Company is measuring this on a monthly and annual basis. Company C has also installed quality management system and it is certified according to ISO 9001. They strive to minimize energy use and other environmental impacts in accordance with our capabilities and resources all their operations.

In company B's product design, eco-efficiency, usability and safety are the key principles along with whole product life-cycle consideration, and all the products can be recycled, or the product lifecycle can be extended through modernization. Each stage of the product lifecycle has its own impact on the environment, but the major spoiler is the energy consumption from the manufacturing process of raw materials and components. Therefore, innovative energy sources are developed and used such as hybrid technology.

4.5. Transportation

During the interviews, it was found that the biggest factors affecting on transportation decisions are price, quality of the service and delivery accuracy. Company A mentioned the suitability of the vehicles is one of the main factors. Their products require specific vehicles because the heavy weight of their products. For example, in carrier evaluation and selection, the price and quality are the main components in decision making. However, when the importance of sustainable choices has increased, carrier's sustainable reputation is the final determinant when comparing two or more equally competitive and sufficient carriers.

Nowadays, it is common for companies to use outsourced transportation services. In these cases, organizations are as customers, purchasing transportation services, and here organizations can not affect thoroughly on carrier's way on operating. Organizations can effect by changing their buying behaviour and to favour sustainable transportation companies. Company B favours big, global operators, since they are found better in developing sustainable operations due bigger amount of resources, such as time and money,

in their hands. Big transport companies also compensate their CO emissions. When it comes to big operators' resources, they have better and newer vehicles such as trucks, which are efficient at energy and fuel consumption. With company B, carriers must report their CO₂ emissions, in order to be accepted as collaborator partner.

As the logistics services are often outsourced, also other factors such as shipment's utilization rate cannot be fully determined by a client organization. It is planned by transportation company's transportation planning where the routes are decided. However, company B has started systematically monitoring and reporting shipment's utilization rates since 2018.

4.6. Drivers for SSCM

All the three organizations interviewed stated, that today's high competitiveness and increased customer awareness of environmental issues are pushing organizations to aim towards more sustainable operations. It has been noted, that the most important pressure towards sustainability arises from stakeholders' expectations and demands. Company B has surveys to gather feedback from customers. Customers' expectations and demands are taken seriously, and the operations are formalized to meet with current customers' requirements - and to attract new potential customers.

As the technology and innovation leader of building material sector, the Company A is aware of its heavy responsibility for the improvement of living conditions on Planet Earth. The Sustainable Development Goals of the United Nations (17 SDGs) are the yardstick against which policymakers as well as global players like Company A has to measure their performance. The Sustainable Development Goals are: 1) No Poverty, 2) Zero Hunger, 3) Good Health and Well-being, 4) Quality Education, 5) Gender Equality, 6) Clean Water and Sanitation, 7) Affordable and Clean Energy, 8) Decent Work and Economic Growth, 9) Industry, Innovation, and Infrastructure, 10) Reducing Inequality, 11) Sustainable Cities and Communities, 12) Responsible Consumption and Production, 13) Climate Action, 14) Life Below Water, 15) Life On Land, 16) Peace, Justice, and Strong

Institutions, 17) Partnerships for the Goals. These goals are broad based and interdependent. The 17 Sustainable Development Goals each have a list of targets that are measured with indicators (United Nation the Sustainable Development Goals 2019).

In company B, United Nations' Global Compact's ten principles are followed to support the examination of impacts that company B might have into the environment. These principles are followed by several organizations, and these UN standards are shaping the minimum requirements on today's business. The first two principles are regarding human rights, following three regarding labour, yet following three regarding environment, and the last principle is about anti-corruption. The following table provides the reader an overview of UN Global Compact's ten principles:

Principle	Description
Human rights	
1.	Businesses should support and respect the protection of internationally and;
2.	make sure that they are not complicit in human rights abuses.
Labour	
3.	Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
4.	the elimination of all forms of forced and compulsory labour;
5.	the effective abolition of child labour; and
6.	the elimination of discrimination in respect of employment and occupation.
Environment	
7.	Businesses should support a precautionary approach to environmental challenges;
8.	undertake initiatives to promote greater environmental responsibility; and
9.	encourage the development and diffusion of environmentally friendly technologies.
Anti-Corruption	
10.	Businesses should work against corruption in all its forms, including extortion and bribery.

Table 7. United Nations' Global Compact's Ten Principles

Global standardization organizations such as ISO are also leading companies to more sustainable solutions. By utilizing global standards, organizations can use resources and raw materials more efficiently and to reduce energy consumption. All interviewed companies have adopted ISO 14001 and the goal is to have all manufacturing sites covered with the standard.

As the stakeholders such as customers are strongly shaping organizations strategy and way of operating, as are also economy, environment and society, organizations must carefully balance with these two forces. For interview companies, compliance, ethics and integrity was found the most important theme

for stakeholders, when it comes to corporate responsibility. Responsible supply chain and sustainable innovations were seen as very important themes from both sides, stakeholders and society. Surprisingly, people themes such as equal opportunities and diversity were seen as not-so-important, compared to sustainability topics or themes regarding safety culture and employee well-being. All interview companies are committed to mitigate their productions' effects on climate change and to provide environmentally friendly solutions for their customers by not compromising their responsibility on the surrounding environment and communities.

EU regulations and governmental regulations will be even tightening in the future. This drives companies to development new sustainable solutions on all their operations. Company A mentioned recycling obligations and use of recycled materials obligations.

There will be new regulations for production. It is not going to be enough to recycle our own waste and put obsolete products back to production. To meet targets, we need to incorporate other companies' recyclable products as well into our production to fulfil future obligations. (Plant Manager Company A)

4.7 KPIs

This chapter provides listed main sustainable supply chain KPIs. Interviewed companies are measuring, reporting and managing these KPIs in daily, weekly, monthly and yearly basis. KPIs are presented by TBL segments; economic, environmental and social.

Economic	Measures
Quality	Supply quality, supply lead-time, supplier reliability, delivery reliability, availability of products, customer satisfaction levels, quality rate, damage free shipments
Efficiency	inventory level, average inventory, inventory turnover rate, days to sell inventory, inventory cost, obsolete inventory, capacity utilization, transportation cost,
Responsiveness	Production flexibility, response time, demand forecast accuracy, order flexibility, order fulfilment lead time
Environmental	
Emissions	Total CO2 emission, % CO2 emission produced per ton produced, reduction % of CO2 emission
Natural resources utilisation	Total energy consumption, reduction of energy consumption, water consumption, water recycled/reused
Waste and recycling	Product recycling rate, material consumption rate, scrap rate, product life cycle, waste reduction rate, waste recycling rate
Social	
Responsibility	Social responsibility, percentage of supplier's subject to sustainability assessment, percentage of local suppliers,
Health and safety	Number of accidents, reduction % of accident
Employees	Employees training, number of employees, percentage of women

Table 8. KPIs structured by TBL

In conclusion, measuring sustainability KPIs is an essential business practices and will allow companies to track, manage and control the sustainability level of their businesses. The degree and amount of KPIs are measured entirely dependent on the individual business and the goals company is trying to achieve.

5. Analysis and Discussion

The following chapter presents the analysis of theory together with empirical findings uncovered through interviews and organizations' reports. The analysis is following the structure of literature review and empirical findings.

5.1 Sustainability in manufacturing organizations

As Lee et al. (2016) mentioned, sustainability issues are one of the most important business concerns in organizations SCs today. Environmental, social and ethical concerns have increased the pressure significantly for organizations to reach towards sustainability in their business operations. Finnish companies, which were under the scope in this research, have successfully established their position in front of the sustainable development, by receiving 2nd place in Robecosam country sustainability ranking in 2018 (Robecosam, 2018). In Finland, clean air and unspoilt nature are valued and therefore Finnish companies are doing their best to retain the unique nature as it is - without compromises.

All the three interviewed companies addressed the importance of sustainability in their operations and adopted sustainable business practices. Also, two out of three companies (namely A and B) mention it in their company mission. Even though, as Pathak et al. (2017) has pointed, manufacturing industries as their current state, have little potential to become leading forces of SD and therefore it is important to be aware of raw materials' origins and to focus on product development in order to find sustainable future solutions. All three companies have implemented sort of a "roadmap of goals" to continuously improve their ecological, social and environmental performance. Everyone's goals are related to TBL and company B is following the goals set by the UN. Also, company A and B, since they are big organizations, have standardized systems to follow their sustainability and quality such as ISO 9001 and ISO 14001.

The most obvious way for companies A and C to pursue these goals is through using primarily recycled raw materials in their production. Especially company A and B have heavily invested in innovation to develop sustainable products. When A and C are focusing in the usage of recycled raw materials, for company B due the nature of complex products, it is more about providing customers high quality products with expandable lifespan. By this way the economical footprint can be minimized even if the recycling has not been the main baseline.

5.2 Supplier selection and procurement

As mentioned by Tate et al. (2012), companies' environmental impact is considerably determined by its supplier's environmental behaviour. If an organization aims to succeed performing sustainably, it must require all its suppliers to do so. All the three companies researched are aware of their environmental impacts and are continuously improving their operations' sustainability. One of the companies (namely company B) was found availing strategic sourcing as part of their sourcing strategy. Seuring and Müller (2008) pointed out how intense the competition is in today's global business markets; organizations have developed such as evaluation schemes to evaluate their current and potential new suppliers. Especially company B, which has multiple different suppliers, supplier handbook is used to obey agreed organizational requirements with suppliers.

As Mendoza-Fong et al. (2017) stated, in the past, suppliers were mainly selected based on their financial measures such as material price, when sustainability and ethics were secondary and not seen important at all. From studied companies, two out of three (namely A and B) require their suppliers to follow Code of Conduct, in order to become collaborators. Here, suppliers respecting human rights and the principles of environmental production are seen more trustworthy than suppliers who are only competing with price-first principles.

All the three companies interviewed are all operating in totally different markets. Therefore, there are many differences in companies' procurement strategies. Local sourcing was found important procurement approach for all the three

companies. However, when companies A and C are mostly purchasing raw materials rather than finished companies, whereas company B is, it has found easier to favour local suppliers. Company A's main raw materials are natural materials such as soil, raw materials are found remarkably near. Also, for company C, raw materials used are such as recycled paper products, main criteria for supplier selection for these two companies' is material availability. Company B has also put effort in recycling, which is functioning for metal raw materials, still local sourcing is not too obvious due the nature of purchased materials, when they are mainly finished mechanical and electrical components. Comparing to the amount of companies A and C local sourcing, company B is lacking, even though here the importance of ethical purchasing is emphasised and compensated.

KPI	Metric	Mentioned
Supply quality	Product quality	A, B, C
Supply lead-time	Total time to fulfil an order	A, B, C
Supplier reliability	Percentage of purchasing orders that arrive on time.	A, B, C
Delivery reliability	On time delivery of goods	A, B, C
Availability of products	Capacity to respond to demand	A, B, C
Social Responsibility	Sustainability, diversity or community initiatives	A, B, C
Number of total suppliers	Level of dependency towards suppliers	A, B
Percentage of supplier's subject to sustainability assessment	% of supplier spend covered by our Supplier Code of Conduct or equally assessment	A, B
Percentage of local suppliers of organisation	% of local suppliers / all suppliers	A, B
Long-time relationship	Duration of cooperation	A, B

Table 9. Supplier selection and procurement KPIs

5.3. Warehousing and inventory management

As it was mentioned earlier by Amjed and Harrison (2013), by adopting sustainable principles in warehousing operations, organizations can achieve their SD goals as warehouses as facilities have great impact on the environment. Even though, there is not much scientific literature about warehousing and inventory management and their sustainability, still all the companies interviewed have switched to renewable energy sources used in their warehouses. None of the products companies are manufacturing, requires refrigerated warehouses, which would be greater energy consumer than warehouses which only require warming - or no heating at all. As Fichtinger et al. (2015) mentioned, warehouses and other sortation facilities cover 15% of total SC emissions. Since the majority of emissions are caused from heating, lighting and cooling systems, companies have decreased their carbon footprint by using electricity, which is produced sustainably and in lighting, efficient LED bulbs are used.

The production manager of company A stated, that it is cheaper to produce more in order to keep the production costs low. Hence, it increases the warehousing costs when there is more inventory than required at certain amount of time. On the other hand, due the nature of company A's products, they can be stored outside with sufficient packaging which compensates the inventory costs. Company C does not relate to this issue, since their finished products are "made from customers order", enabling to keep inventory levels minimum. Company B has similar approach with company C by keeping the inventory levels minimum. Also, both of the companies' (namely B and C) manufacturing is based on customers' orders, when company A has inventory for finished products based on sales forecasts.

For raw materials and components, companies A and B are following ABC inventory analysis, meaning of categorizing product into three categories. A means: 20% of the item's accounts for 70% of the annual consumption value of the items (monetary value), B items account for 25% of annual consumption value and items C account the remaining 5% of the annual consumption value. This indicates the items A being the most valuable for the company, and due their high price it is important to avoid excess inventory for those items. Especially for

company B having expensive inventory, it is essential to focus on proper packaging. It was also pondered by company B: “is it okay to use packing materials which are not classified as sustainable to keep products safe and minimize percent of obsolete product”. Depending on the value of the product for a company, some cases it is still necessary to “bargain” from sustainability in order to remain profitability. Aforementioned is a challenge especially in Finland, where weather conditions can change rapidly.

KPI	Metric	Mentioned
Inventory level	Inventory per square metric of storage space	A, B, C
Average inventory	$(\text{Beginning Inventory} + \text{Ending Inventory}) / 2$	A, B
Inventory turnover rate	$\text{Cost of Goods Sold} / \text{Average Inventory}$	A, B
Days to Sell Inventory	$(\text{Average Inventory} / \text{Cost of Sales}) \times 365$	A, B
Inventory cost	$\text{Carrying Costs} / \text{Overall Cost}$	A, B
Obsolete inventory	Obsolete inventory percentage	B
Demand Forecast Accuracy	How well company is predicting its upcoming demand	A,
Customer Satisfaction Levels	The percentage of the time that customers receive their orders on time	A, B, C

Table 10. Inventory and warehouse management KPIs

5.4. Waste management

According to Demartini et al. (2018) one of the main industrial issues in sustainability are currently related to waste from manufacturing. Also, as Smith and Ball (2012) states, companies must cope with the demand for products whilst using less material and energy and to keep the amount of waste as small as possible. This can be achieved by recycling, as all the three respondent companies are doing already in their operations. All these companies have mentioned efficient and ultimate waste management being one of their future goals. Since company B has high daily outbound and inbound flow, they require their suppliers to use standardized pallets which can be reused until they give out. After that, those wooden pallets can easily be recycled. Among standardized

pallets, company C requires suppliers to use packing materials which are recyclable as well compostable, such as plastics and cardboards. For company B, warehouse sustainability is not directly measured through inventory turnover, but the monetary value of spoiled and scrapped materials. All the companies are sharing the same ideology, to recycle everything that can be recycled. Especially for companies A and C, when A is using natural resources such as soil materials and company C recycled wood and paper products, the level of circulation is very high. For company B, when waste is originating mainly from steel and other metal products or broken electric or mechanic components, recycling is not so obvious. Even though, half of the steel used in company B's production is melted from recycled materials.

KPI	Metric	Mentioned
Product Recycling Rate	Percentage of existing product reused in new products	A, B
Material consumption	All material consumption within site boundaries	A, B, C
Water consumption	Total volume of water consumption	A, C
Water recycled/reused by an organization	Percentage of water recycled/reused by an organization	C
Total waste	Tons waste leaving site / Tons outgoing products	A, B, C
Waste Reduction Rate	Total waste of the year compared previous period or year	A, B, C
Waste Recycling Rate	% of product recyclable	A, B, C

Table 11. Waste management KPIs

5.5 Production

Like Alayon et al. (2016) discussed, manufacturers have become more aware of their operations' impacts on the TBL. So have the three respondent companies. They are all aware of their operation's environmental impacts, and it is emphasised with company A and B, since they have heavy production. All three companies are building their management systems around ISO 14001 (Environmental management system) standard, even company C which has smaller scale production always launched by customer orders. These ISO standards can be adopted by companies regardless their size, type of nature, therefore it is motivational to adopt by also smaller companies. Usually the

biggest barrier to adopt sustainability systems is money, and therefore it is advisable to provide management systems for free.

When companies are following ISO 14001 system, the same is expected from their suppliers as well. To achieve this, company B is using a supplier manual where all the minimum requirements for suppliers are listed. Company B has strict guidelines and code of conduct to evaluate who can become their collaborator.

Krajnc and Glavič (2003) stated that transformation towards greater sustainability requires changes in industrial processes, in the types and amounts of resources used, in waste management, in the control of emissions and in the final products produced. Company A has reached almost all its goals set years ahead of original schedule, which indicates the commitment and desire towards more sustainable operations and image. The energy consumption is measured and monitored by all companies interviewed. Year by year the amount of energy is reduced by using renewably produced energy. Plant manager of company A stated, that their possibility to use biogas in the future would effect on prices by increasing them due higher production costs. Switching to environmentally friendly energy is not decided only by manufacturer, but the customers and their behaviour. Are they willing to purchase products with higher price in order to have more sustainable products? Quality is also important to companies A, B and C. They all have installed quality management system ISO 9001. Company A is measuring and reporting product rejection rate monthly and annual basis.

As Krajnc and Glavič (2003) stated, current production systems are not sustainable in the long term relating on their demand of non-renewable natural resources such as oil. All the three companies agree with the statement and are therefore investing in innovative energy sources. Also, recycled materials are used in all companies' production, most for companies A and C because they consume natural raw materials. Company B's products are way more complex and by investing in high quality to expand product lifecycle, the waste of resources is minimized.

KPI	Metric	Mentioned
Total Energy Consumption	Energy consumption/ Tons of outgoing products	A, B, C
Total CO2 emission	Total CO2 emission in tons	A, B, C
	CO2 emission produced per ton produced	A, B, C
	Reduction of CO2 emission %	A, B, C
Material consumption	All material consumption within site boundaries	A, B, C
Quality rate	$((\text{Total Production} - \text{Defect amount}) / \text{Total production}) * 100$	A, B, C
Scrap Rate	Percentage of finish products	A, C
Capacity Utilization	Actual available capacity is used on production line.	A, B
Creativity and innovation	Share of innovative products in total revenues	A, B, C
Product life cycle	Product life in years	B
Flexibility	Ability to respond to changing environment	A, C

Table 12. Production KPIs

5.5. Transportation

Pathak et al. (2019) stated freight transportation being one of the SC's most significant and cost-intensive activity being the linking function of partners among SC. It covers one-fifth of total greenhouse gas emissions in EU and globally almost 20% of energy consumption. Therefore, organizations choosing sustainable transportation options can have huge positive impact on the environment. The three biggest factors affecting on transportation decisions, agreed by all three companies, are price, quality and delivery accuracy. Company A and B stated that when evaluating carriers, their sustainable reputation is the final determinant in cases where carriers are equally competitive by other manners, such as price and flexibility. By choosing carriers with sustainable principles, organizations gain also positive company reputation by favouring sustainable collaborators.

None of the companies interviewed has their own transportation equipment, namely trucks, therefore transportation services are outsourced and purchased

from logistics companies. Thus, companies can not directly effect on carrier's sustainable performance, but it can be steered by customer behaviour, preferring sustainable carriers. Company B cooperates with big, globally operating transportation companies since they are found better in developing their sustainability due bigger amount of resources available, such as money and time. Big operators which are competing globally and have greater media visibility are also more willing to invest in one's sustainable development. Sustainable options are also found more economical by company B, because energy and fuels produced renewably are usually cheaper. In order to become company B's collaborating carrier, logistic companies must report their CO2 emissions. Here, since company B is big and known manufacturing company, it has the leverage to demand sustainable action from their stakeholders.

KPI	Metric	Mentioned
Delivery reliability	% On time delivery of goods	A, B, C
Transportation cost per unit	Dividing total freight costs by number of units shipped per period.	A, B, C
Damage free shipments	Percentage of damage free shipments delivered	A, B
<i>CO2 emission</i>	% of carriers report their CO2 emission	B

Table 13. Transportation KPIs

5.6. Drivers for SSCM

All the three companies interviewed agreed that today's high competitiveness and increased customer awareness of environmental issues are pushing them to adopt sustainable attributes into their operations. Amjed and Harrison (2013) stated that firms see sustainability as an opportunity to gain competitive advantage via sustainable and responsible reputation, which was also noted by all three respondent companies. Since it is noticed, that the most important pressure arises from stakeholders' expectations and demands, company B uses surveys to get feedback from customers and other stakeholders. With these

surveys, company B can measure their performance through non-financial reputation measurement and to make necessary improvements if required. Amjed and Harrison (2013) also discussed how organizations receive mandates from governments and general public. All manufacturing companies must obey the legislations regarding production methods and all of the three companies are very aware of the code of conduct. As companies A and B are the innovation leaders in their markets, they are aware of their heavy responsibilities improving environment and living conditions. United Nations has set a list of goals for companies' guidelines to achieve sustainable statuses. These UN goals are pursued in a large scale by company A and B. Company A even stated their concerns regarding in future tightening regulations by EU and governments. Also, according to Cazeri et al. (2017), organizations which are global leaders in their market sector and aim for superior environmental performance are in the front line of adopting SSCM practises. This statement is particularly accurate for companies A and B which were pointed out being the market leaders.

5.7 KPIs

As presented in Table 9, supply quality, supply lead-time, suppliers' reliability, delivery reliability, availability of the products and social responsibility was found mutually important for all three companies interviewed. The sustainable attributes of TBL are respected by all companies, but however, the aforementioned KPIs are the most essential for companies' business performance. Suppliers product quality and total order fulfilment time are in key position for companies to be able to maintain their promises and delivery accuracy for customers. Two out of three company (namely A and B) monitor the number of total suppliers in order to find the most dependable suppliers.

KPIs measured by all three companies are inventory levels and customer satisfaction levels. Most of the KPIs to measure inventory levels and cost are not used by company C, since their strategy is not to have inventory, but to make products by customers' orders.

As all the companies aims to minimize their waste, total amount of waste, waste reduction rate and waste recycling rate are closely monitored in order to avoid making unnecessary waste. Overall material consumption is measured within site boundaries to make sure no raw materials or components are left over and the inventories are kept minimum in order to reduce inventory costs. This affects directly financially. Only companies A and C mentioned in their strategy water consumption and where the wastewater is ending up.

The biggest amount of KPIs was found regarding production. As in the literature was stated, significant amount of environmental pollution is caused by manufacturing companies production facilities. Majority of production performance measures were commonly used by all three companies interviewed. Some differentiation can be identified between industries, as company A and C as natural raw-material consumers can easier respond to changing business environment.

Transportation KPIs were few, this can be caused by logistics services purchased through outsourcing. Delivery reliability and transportation cost were important for all companies interviewed, but requiring CO2 reporting from carriers was unconditional only for company B.

6. Conclusion

In this chapter, the conclusion of the study is presented by summarising up the empirical findings and the analysis. In conclusion, the research question is answered as well as the sub-research questions. That is followed by implications, limitations and finally, suggestion for future research.

6.1 Research Questions

As it has been widely witnessed in literature, the emerge of sustainability issues is one of the main business concerns organizations are facing in their SCs (Lee et al. 2016). Environmental, social and ethical concerns have increased by putting great pressure on organizations to adopt sustainable way of thinking in their operations these days. This is challenging, having both direct and indirect impacts on managing SCs (Allaoui & Choudhary, 2015). TBL is one of the central definitions followed by organizations, also found fundamental among the companies interviewed. The purpose of this study was to examine how the crucial KPIs are determined by organizations and what are the actions to measure the performance. The study was conducted by abductive research approach, allowing to formalize the perception of current state of performance measurement in manufacturing industry. Empirical findings supported by literature review enabled to answer to following research question:

How organizations measure their sustainable supply chain performance with Key Performance Indicators?

The empirical findings of the study show that the sustainable SC performance is measured through numerous KPIs in each SC sectors focused in supplier selection and procurement, warehousing and inventory management, waste management, production and finally transportation. Research question was also divided into two sub-research questions, to gain clearer understanding of the types of KPIs used and lastly, what were the designated KPIs used in each particular company interviewed to assess sustainability in their individual SCs.

SQ1: What types of KPIs measure sustainable supply chain performance?

First sub-research question was answered by empirical data gathered from interviews, showing that both financial and non-financial KPI are measured. It was found, that the most measured SC sector was production, resulting from tighten global and local legislations and increased awareness among customers. It was also found that as stated in literature review, SC sectors are indeed measured as individual sectors, not as whole SC. All SC sectors investigated, procurement, warehousing, production and logistics have their own characteristic KPIs to measure the performance. Performance is measured through both financial and non-financial KPIs and the findings indicate financial KPIs are still being more important for companies. KPIs used were also obeying features of TBL, and KPIs used were possible to classified into four categories: economic, environmental and social KPIs.

SQ2: What key performance indicators do companies use to assess sustainability in their supply chains?

The findings show that all companies used the same KPIs to measure their sustainable SC performance. Although, there was variation among companies due their different sizes and the different fields they are operating in. In supplier evaluation and procurement, KPIs used by all responding companies were supply quality, lead-time, delivery reliability and the availability of products. Also, social responsibility was raised on top among all three companies. In warehousing, only order-fulfilment time to customers was measured among all three companies, other aspects being volatility important to one or another. In waste management companies followed similar procedures. Material consumption, total waste, waste reduction rate and recycling rate were highly measured, them affecting directly on companies' economics. In production, financial KPIs were also measuring majority of companies' performance. Such as Total Energy Consumption, total amount of CO2 emissions, material consumption and quality rate were measured by all companies. Also, share of innovative products in total revenues was measured since innovation is required in order to remain competitive. In transportation KPIs measured were little, since logistics services are outsourced.

Delivery reliability and cost were the main factors when evaluating logistics companies.

6.2 Implications

6.2.1 Theoretical Implications

As the chapter Literature Review shows, definitions of SC and SSC are not commonly agreed in already existing literature. The definitions vary between different points of views and in which context the topics are discussed in. Therefore, the authors must have determined the most suitable SSC definition for manufacturing context. Also, as found during the research and systematic article review, there were several shallow expressions for KPIs used for measuring SSC, yet not explicit literature what are the specific features of particular KPIs and how organizations perform the measuring in practice and what are the initiatives.

This paper provides future researchers a listing and definition of KPIs commonly used by manufacturing companies. Combined theory together with empirical findings provides guidelines for future research to examine the KPIs used also in other industries.

6.2.2 Practical Implications

As organizations have become increasingly aware of the actions, they must commit in order to increase their sustainable performance, the manufacturing industry is slowly but surely striving towards more environmentally friendly condition. As stated in analysis chapter, for big companies the investments to support sustainable development are greater than for SMEs, but the KPIs observed during the research are within to reach by all companies regardless the size, economical position or the market operating in.

6.3 Limitations

Some limitations occurred during the thesis process. Supply chain management itself is enormously wide topic with numerous sectors covering the whole supply network. The concept of sustainability including triple bottom line pillars covering environmental, economic and social issues is as well boundless field where new researches are continuously made. Therefore, it is difficult to find and analyze all the available data inside the limited time frame given to complete the thesis. Time, as the major limiting factor hampers to gather diverse empirical data and therefore research questions must remain rather narrow.

According on the amount of academic literature found about waste management, the topic is relatively new and not much researches have conducted in the field.

Since SSCM is a novel research topic, most of the articles used in this review were published later than year 2010, which resulted in that the articles had few citations, additionally the searches of SSCM had to be broadened to include relevant articles.

6.4 Future research suggestions

Even if this research focused on manufacturing companies in Finland, the companies chosen are however operating globally and having >0,5 million EUR revenue annually. High revenue and global operations enable big businesses to monitor and invest on their sustainability actions due higher capacity to do so. Big organizations are also more attractive to media and thus are more concerned about protecting their reputations. Therefore, big organizations are “forced” to be sustainable, when for small businesses it is more volunteer. One future research suggestion would be to investigate, how small- and medium sized enterprises (SMEs) adopt sustainable business practices and why? It would be interesting to investigate the reasons and pros and cons for SMEs to do so.

Second suggestion for future research is to focus on another industry. Now the scope was only to investigate sustainability in manufacturing industry, and there are numerous other industries which are not under such media pressure as manufacturing industry, because it is seen as the worst climate spoiler.

During this research it was noted that the sustainability of SC was not measured as a whole entity, but all different sectors within the SC were measured separately. Therefore, it was hard to determine the sustainability of the whole SC. In large organizations sustainability actions are usually tightly respected by all stakeholders within the SC which determines the overall sustainability of the SC. With SMEs the conditions might vary more.

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Appendices

Appendix 1: Interview questionnaire

Introduction
<ul style="list-style-type: none">- Presentation of interviewers- Presentation of the topic and goal
Opening questions
<ul style="list-style-type: none">- How sustainability is taken into account on your operations and what are your responsibility goals, aims, target?
Procurement
<ul style="list-style-type: none">- How is sustainability considered in procurement?- How has increased focus on sustainability affected on procurement strategies? <p>(Along price, quality and reliability, has the importance of ethics increased?) (How much supplier reputation and image matters?)</p> <ul style="list-style-type: none">- What are the factors influencing on supplier evaluation and selection? <p>(Are there local or global principles followed?)</p> <ul style="list-style-type: none">- How is sustainability measured and reported?- How frequently suppliers are changed and what is the most important factor influencing on selection?

Warehousing/materials
<ul style="list-style-type: none"> - How is sustainability considered in warehousing and materials management? - How has increased focus on sustainability affected on inventory management? - How important is recycling and usage of renewable energy sources? (Are there local or global principles followed?) - How is sustainability measured and reported?
Logistics/transportation
<ul style="list-style-type: none"> - How is sustainability considered in logistics? - How has increased focus on sustainability affected on logistics strategies? (Along price, quality and reliability, has the importance of ethics increased?) (How much carrier reputation and image matters?) - What are the factors influencing on carrier evaluation and selection? (Are there local or global principles followed?) - How is sustainability measured and reported? (Do you optimize shipments? How?) - How lightly carriers are changed and what is the most important factor influencing on selection?
Future views
<ul style="list-style-type: none"> - To what direction the development is heading? - What are the new innovations organization (...) is investing in?