



**REDUCING SUPPLY CHAIN CARBON DIOXIDE EMISSIONS THROUGH
SUPPLIER COLLABORATION: CASE MEHILÄINEN**

Lappeenranta–Lahti University of Technology LUT

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ABSTRACT

Lappeenranta–Lahti University of Technology LUT
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Reducing supply chain carbon dioxide emissions through supplier collaboration : case Mehiläinen

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Keywords: strategic supply management, supplier collaboration, carbon dioxide emissions, sustainability

This thesis was made for the domestic social and health company Mehiläinen, which is the case company for the study. The goal of the study was to find out what kind of opportunities supplier collaboration has to influence the company's carbon dioxide emissions. The goal was also to find out what kind of drivers and barriers there are in supplier collaboration to control emissions, as well as what concrete means are there to reduce emissions in the supply chain. The thesis progresses from the introduction to the theory part, which considers supplier collaboration and its elements. In theory there is also focus on green supply chain management and its drivers and barriers from the perspective of collaboration.

The empirical part of the study examines the research part and the results obtained from it. The research was carried out as qualitative research with interviews with suppliers and procurement professionals. The environmental survey conducted in the case company was also used as secondary data to support the research.

The results of the study showed that supplier collaboration is beneficial in emissions reduction work for both the supplier and the buyer company. The pressure from customers to reduce emissions pushes suppliers to make changes in their operations and to take the importance of environmental sustainability further into the supply chain. The results showed that collaboration can be done in many ways and by using them, concrete changes in sustainability can be achieved. The theory part of the study also supports the results obtained from the study.

TIIVISTELMÄ

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Päästöjen vähentäminen toimitusketjussa toimittajayhteistyön avulla : case Mehiläinen

Kauppätieteiden pro gradu -tutkielma

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Tämä Pro Gradu tutkielma tehtiin kotimaiselle sosiaali- ja terveysalan yritykselle Mehiläiselle, joka toimi tutkimuksen case-yrityksenä. Tutkimuksen tavoitteena oli selvittää, millaisia mahdollisuuksia toimittajayhteistyöllä on vaikuttaa yrityksen hiilidioksidipäästöihin. Tavoitteena oli myös selvittää millaisia edistäviä ja estäviä asioita toimittajayhteistyössä on päästöjen hallintaan, sekä millaisia konkreettisia keinoja on toimitusketjun päästöjen vähentämiseen. Tutkielma etenee johdannosta teoriaosuuteen, joka käsittelee toimittajayhteistyötä sekä sen elementtejä. Teoriassa paneudutaan myös vihreään toimitusketjun hallintaan ja sen edistäviin ja estäviin tekijöihin yhteistyön näkökulmasta.

Tutkimuksen empiirisessä osiossa tarkastellaan tutkimusosuutta ja siitä saatuja tuloksia. Tutkimus toteutettiin laadullisena eli kvalitatiivisena tutkimuksena haastatteluilla toimittajille sekä hankinnan ammattilaisille. Tutkimuksen tukena käytettiin myös case-yrityksessä tehtyä ympäristökyselyä sekundääridatana.

Tutkimuksen tulokset osoittivat toimittajayhteistyön olevan hyödyllistä päästöjen vähentämisessä sekä toimittajalle että ostajayritykselle. Asiakkailta tuleva paine päästöjen vähentämiseen ajaa toimittajia tekemään muutoksia toimintaansa ja viemään ympäristö vastuullisuuden merkityksellisyyttä myös pidemmälle toimitusketjuun. Tulokset osoittivat, että yhteistyötä voidaan tehdä monilla eri tavoilla ja niitä käyttämällä saada konkreettisia muutoksia vastuullisuuteen. Tutkimuksen teoriaosuus tukee myös tutkimuksesta saatuja tuloksia.

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"You can't climb the ladder of success with your hands in your pockets."

-Arnold Schwarzenegger

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1. Introduction

In recent decades, concern about the environment has grown rapidly in the whole world (Hsu, Kuo, Chen, & Hu, 2013), and more than 3 billion people are defenseless about climate change (Lintukangas, Arminen, Kähkönen & Karttunen, 2022). Human-caused greenhouse emissions (GHG emissions) contribute to the progression of climate change and thus affect the whole world. To stop the temperature rise to two degrees Celsius, carbon dioxide emissions should be reduced globally to approximately 85% below the level of 2000 by 2050. If the temperature rises above this, it causes dangerous effects on the environment and people. (Greenhouse gas protocol.) According to the UN, carbon neutrality is the most urgent mission to achieve by 2050 (Zhang, Gong & Wang, 2022). CO₂ emissions travel long distances and penetrate the environment. This makes them the most dangerous pollutant and causes worldwide environmental damage. (Asif, Lau, Nakandala, Fan, & Hurriyet, 2020.)

Consumers' awareness of environmental issues has increased as the climate deteriorates, and thus, the reduction of carbon dioxide emissions in companies' operations. Companies strive to meet consumers' demands for greener production, as about 30% of consumers in OECD countries are considered as "green consumers". (Zu, Deng, & Chen, 2021.) Reducing greenhouse emissions in operations offers an excellent opportunity for companies (Jira & Toffel, 2013). To hold back climate change and to keep up with consumer demands for environmentally friendly products and services, companies would have to adopt practices that facilitate the management of carbon dioxide, which would be practical and feasible. When stakeholders such as suppliers and customers are committed to managing carbon dioxide emissions, the burden on the climate can be reduced together. At the same time, the ability of the supply chain to adapt and be flexible can also be enhanced. (Lintukangas et al. 2022.) Increasing the management of the green supply chain is at the forefront of promoting sustainable development, as it allows companies to decide what kind of environmental goals are required from suppliers. (Meixell & Luoma, 2015.) Therefore, there has been a consensus that green supply chain management must be increased, and pollution issues must also be managed in supply chain management (Hsu et al., 2013).

In 2009, World Business Council reported that at least 80% of CO₂ emissions were produced in the supply chains (Hsu et al. 2013), which makes indirect emissions more significant than the company's own carbon footprint (Dahlmann & Roehrich, 2019). For this reason, working on reducing carbon dioxide emissions in collaboration with suppliers is particularly important to the fight against climate change. While it is possible for companies to work alone to develop their sustainability to achieve better results, they must also consider their supplier network (Danese, Lion, & Vinelli, 2019). Collaboration between parts of the supply chain is a prerequisite for environmental friendliness, thus reducing carbon dioxide emissions. In addition, collaboration has many other beneficial effects, such as creating value, minimizing costs, and improving financial performance. As the company's competitive advantage improves, environmental and financial performance can also be balanced. (Andalib Ardakani et al., 2022.) Collaboration in the supply chain has been seen to have much better results in combating climate change than only one-way monitoring of emissions (Dahlmann & Roehrich, 2019).

1.1. Background of the study

Previously procurement was considered a strategically insignificant and separate support function in companies. For this reason, it was also not considered a source of competitive advantage. The perception of procurement has become an essential part of companies' strategy, and it is also seen to be a vital part of achieving competitive advantage and performance. From an earlier point of view, procurement tasks were reactive filling of other functions such as product development. In recent decades, however, the strategic importance has grown significantly. To this extent, the relationships between buyers and suppliers have moved from a transaction-oriented perspective to a more relational perspective. Typically, supplier relationships have been kept at arm's length, i.e., by playing against another player and getting the best benefits from the supplier relationship. In this model, the buyer can get benefits such as cost savings in the short term. However, arm's length prevents suppliers from providing quality and good service in the long term. Therefore, collaboration instead of an arm's-length relationship with suppliers can bring better benefits to companies in the

long term and generate added value for both the buyer and the supplier. (Moeller, Fassnacht, & Klose, 2006.)

Companies must look for resources and opportunities from resources outside their own organization (Cao, & Zhang, 2011). Business relationships can offer exceptional value in the market, and therefore, relationships between companies have been studied extensively in academic literature in the last two decades (Wagner, Eggert, & Lindemann, 2010). The aim for companies nowadays is to focus more on the core competence, which requires close collaboration from their supply chain partners. Collaboration in the supply chain increases efficiency and the dynamic adaptability to changes the current market requires. Therefore, resources outside the organization are also needed, and collaboration with suppliers is an excellent enabler. (Cao, & Zhang, 2011.)

As mentioned in the introduction, the growing trend of greenhouse gas control continues to spread all the time, and it continues to grow globally (Olson, 2010). Carbon dioxide emissions transparency used to be a niche market, but it has become common practice. In addition to their own emissions, companies must report the emissions of their suppliers. (Villena, & Dhanorkar, 2020.) A directive entered into force in the EU in 2023, according to which stakeholders such as suppliers must report information companies need to assess their environmental impact. The first reporting year for companies is 2024 (EU Commission.), so this research subject is also current. Increased regulation and consumer-supplier activism have forced companies to include environmental considerations in their strategies and supply chain planning (Andalib Ardakani et al., 2022.). In addition to this, companies strive to convey their own environmental friendliness in their marketing, among other things, to differentiate themselves from their competitors on the market (Olson, 2010.) and increase the transparency of their operations (Marttinen & Kähkönen 2022). For companies, developing the management of carbon dioxide emissions and more environmentally friendly operations can be challenging. Attention must be paid to both direct and indirect emissions so that carbon dioxide management can be developed. (Lee, 2012.)

Risks affecting the operations of organizations have been identified from carbon dioxide emissions and climate change. There are both indirect and direct risks. Indirect risks include

the threat of regulation due to increased regulation and reputational risks, and direct risks can be classified, for example, the costs caused by the supply chain related to carbon dioxide emissions. (Yunus, Elijido-Ten, & Abhayawansa, 2016.) Also, because of these risks, it would be necessary for companies to pay more and more attention to managing their carbon dioxide emissions.

Research has shown that supplier collaboration has great importance in promoting the sustainable development of the supply chain. When making a purchasing decision, the buying company must consider the entire supply chain, not just the first supplier in the chain, as it is vital from environmental aspects. (Marttinen & Kähkönen 2022.) For example, carbon dioxide emissions accumulate from the entire supply chain's journey to scope 3 emissions of the buyer company. Buyer companies can influence their suppliers if they have power over them (Marttinen & Kähkönen 2022).

Very little research has been done on sustainable supply chains in the service sector. And especially in healthcare, it is almost impossible to find it. Social and healthcare emissions are estimated to produce 6.5% of Finland's carbon dioxide emissions (Terveyden ja hyvinvoinninlaitos, 2023). Issues related to patient safety and the quality of care slow down the sustainable development of healthcare. In order to promote sustainable development in health care, correct practices are required from operators. (Tseng, Ha, Lim, Wu, & Iranmanesh, 2022.) Due to the lack of research on the topic, it is interesting to study it more. There have been studies on social sustainability in the healthcare sector, such as the study by Hussain, AJmal, Gunasekaran & Khan (2018), which also found that there is almost no research on social sustainability in the service sector. However, the study by Elabed, Shamayleh, & Daghfous (2021) mentions that the demand for sustainable development in healthcare is increasing, as it produces adverse environmental effects. However, the products and services purchased in the healthcare sector are broader and include, for example, much more in nursing homes, such as food, household appliances, cleaning, etc. In this case, sustainable development can be developed in other product categories than only healthcare equipment and supplies, which have precise regulations on their quality and safety.

Typically, in healthcare, 15–30 percent of the budget is allocated to purchased products and services (Abdulsalam, Gopalakrishnan, Maltz & Schneller, 2015). The cost increase poses a challenge for healthcare, as the costs are not passed on to the patients. This is why supply chain management and supplier collaborations are essential in healthcare. (Chakraborty, Bhattacharya, & Dobrzykowski, 2014.) Based on trends, however, it has been predicted that more investments will have to be made in developing supply chains in the future, and supply chain management has therefore increased its importance (Mandal, 2017). Healthcare differs significantly from other industries typically discussed in the supply chain management literature, such as consumer goods. In health care, the center of activity is promoting or even saving patients' health for example, most hospitals in the United States are non-profit. In addition, the products are specific and often require special handling. (Abdulsalam, et al. 2015.)

According to Mandal's (2017) research, supply chain collaboration and its development in a hospital environment is supported by supply chain transparency. According to the study, hospital supply chains must also consider environmental changes to keep up with the dynamically changing environment. So, in supply chains, suppliers must be helpful and ready to learn new things. Especially in healthcare supply chains, it is vital to exchange information between actors so that it can be beneficial to both sides. (Mandal, 2017.) Healthcare has the potential to utilize supply chain collaboration and thereby increase shared value in the supply chain, which in turn also impacts the company's performance (Chakraborty et al., 2014). According to the study, the collaboration of the hospitals' supply chains has positively affected their performance (Mandal, 2017).

For all the previously mentioned reasons, managing and reducing carbon dioxide emissions is an important and current topic for many small and large companies that strive to change their operations in a more environmentally friendly direction and reduce their indirect emissions in supply chains. Particularly for the healthcare sector, this topic is current, because many healthcare companies spend forms from purchased items. Research on similar topics can be found in other fields, such as food and electronics (Cloutier, Oktaei, & Lehoux, 2020), but not in healthcare, where there are many different suppliers from several industries.

1.2. Research questions and limitations

This study examines the impact possibilities of supplier collaboration on reducing carbon dioxide emissions in supply chains. The research takes a stand on various supplier collaboration tools and practices that can strategically influence reducing carbon dioxide emissions in supply chains. In addition, the study examines what kinds of things in collaboration drive the emission reduction work forward and which things hold it back.

One main research question has been set for this study, supported by three related sub-research questions. The purpose of the main research question is to be the primary question that reflects the aim of the research. In addition, it aims to cover the topic comprehensively.

Research questions

Main: How can buyer-supplier collaboration reduce the company's carbon dioxide emissions?

Sub: What are the elements of supplier collaboration?

Sub: What kind of functions in supplier collaboration are the drivers and the barriers to reducing carbon dioxide emissions?

Sub: What concrete practices are for reducing carbon dioxide emissions through collaboration?

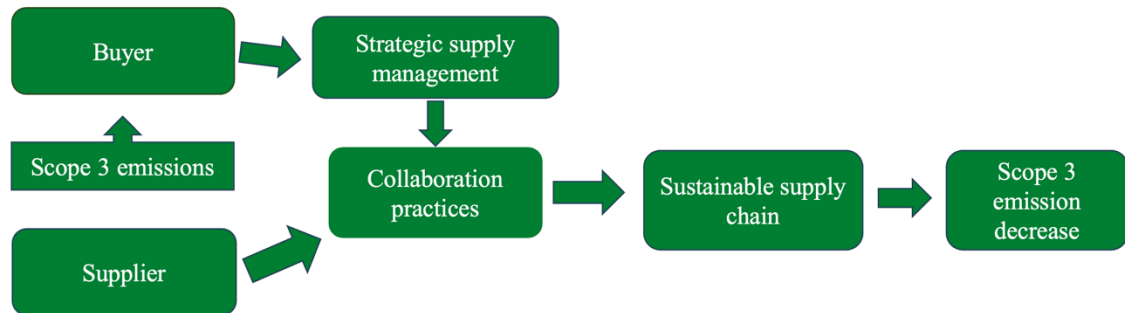
In this study, we delve into the possibilities of collaboration between supplier and buyer to reduce carbon dioxide emissions in the supply chain. The research discusses ways supply chain collaboration can drive the management of carbon dioxide emissions and what barriers exist in collaboration. The progressive factors discuss concrete ways to evaluate suppliers and deepen environmental management with suppliers. The research does not study other

parts of sustainable development, such as social and financial responsibility, but focuses only on the environmental aspect. Also, this study does not examine carbon dioxide emissions or their calculation in more detail, which would deepen the study away from supply chain management. The research also does not take a position on supply chain models other than collaboration because collaboration has been seen to have the best effect in promoting sustainable development in managing supply chains. The research is limited to dealing with strategic supply chain management in the healthcare sector and related emissions management. The result of the study does not seek concrete numerical results on how much carbon dioxide emissions can be reduced through buyer-supplier collaboration. The purpose is only to study collaboration methods and their effectiveness in managing the company's emissions.

1.3. Theoretical framework

This chapter presents the theoretical framework of the study. The theoretical framework provides a perspective on how the concepts used in the research are related. The picture below shows the reference framework of the study in the form of a diagram. On the left side of the figure are the supply chain partners, i.e., the supplier and the buyer. When the buyer buys products and services from the supplier, indirect scope 3 emissions are transferred to the buyer's carbon footprint. When the purchasing company strategically plans its supply management, it creates ways to collaborate with its key suppliers. In this way, both parties can improve the sustainable development of their supply chain and thereby also reduce carbon dioxide emissions.

Figure 1. Research framework



1.4. Research structure and key concepts of the study

There are five chapters in the study. The study is divided into two sections, one covering theory and the other with empirics. The research begins with an introduction, which presents the research questions and the purpose of the study, the research framework, and key concepts. After the introduction, the research proceeds so that the theory relevant to the research is discussed first. The theory includes the concept of supply chain collaboration and its elements and application in sustainable supply management. Chapter three considers drivers and barriers to environmental collaboration in the supply chain and concrete actions to reduce carbon dioxide emissions with supplier collaboration. The fourth chapter presents the research methodology, analysis tools, and data collection methods. The following paragraph discusses the case company and the study's empirical findings. The last paragraph of the study covers the conclusions and summarizes the main findings and suggestions for the case company.

Next, the essential concepts from the point of view of the research will be defined, which will be used during the research. The essential concepts of the research are supply chain management, supply chain collaboration, carbon management systems, and scope 3 emissions. The concepts will be specified later in the theory section.

Supply chain management (SCM)

Stock & Boyer, in their journal in 2009, define supply chain management as relationship network management with other companies and within the company. Relationship network management consists of several things, such as procurement, suppliers, marketing, and logistics. With the help of these business units, it is possible to facilitate the forward and backward movement of information, material, and services from suppliers at the beginning of the supply chain to end customers. Supply chain management maximizes efficiency, and added value is produced for customers, thereby achieving customer satisfaction.

Supply chain collaboration (SCC)

According to the article by Cao & Zhang (2011), supply chain collaboration is defined as a partnership process between two or more companies. Companies work closely to achieve common goals and mutual benefits.

Sustainability

In 1987, the World Commission on Environment and Development defined sustainable development as activities that meet current needs without compromising the ability of the needs of future generations. The concept focuses mainly on the earth's biophysical and biological resource adequacy. (Portney, 2015.)

Green supply management (GSM)

Supply chain management measures aimed at improving the environmental efficiency of suppliers or the production inputs they supply. The activities may include, among other things, the collection of environmental information and the development of environmental processes and products. (Bowen, Cousins, Lamming & Farukt, 2001.)

Scope 3 emissions

Scope 3 emissions are emissions from sources outside the direct company's control. These emissions are controlled and owned by other value chains. Scope 3 emissions can be caused for example, by suppliers, logistics, passenger suppliers, and other similar sources. Scope 3 emissions are also part of the purchasing company's climate impact. (Radonjić & Tompa, 2018.)

2 Collaboration in the supply chains

2.1. Concept of collaboration

Collaboration is a concept that is very broad and comprehensive (Barratt, 2004). There is not only one specific definition for supply chain collaboration, but it has been defined in the literature in several slightly different ways. However, these concepts fall into two different categories. The first is process-focused, and according to this definition, supply chain collaboration is *"a business process in which two or more supply chain partners work together to achieve common goals"*. The second definition focuses on the supply chain relationship. According to it, supply chain collaboration is *"the formation of long-term partnerships where supply chain members work together and share information, resources, and risks to achieve common goals."* When the definitions are combined, the definition is a partnership process where two or more actors in the supply chain work together to achieve common goals and share resources, knowledge, and risks to achieve these goals. (Cao & Zhang, 2011.) Although collaboration is seen as mutually beneficial, companies still strive to benefit from collaboration for their own benefit. Examples of the desired benefits are the elimination of transaction costs and the improvement of responsiveness. However, the result of the collaboration should be a common goal and a benefit for the end customer. (Simatupang & Sridharan, 2002.)

In supply chain management, long-term supplier relationships are currently being aimed at. There are fewer relationships, and suppliers are then more reliable. (Hsu et al. 2013.)

Collaboration is considered the most strategic structure in supply chain management, and it includes, for example, supporting suppliers and training them (Yen, 2018). By working together, supply chain parties can achieve many benefits for all supply chain members (Simatupang & Sridharan, 2005). Supply chain collaboration is considered one of the most effective ways to achieve competitiveness. Due to the current fierce competition, partnerships in the supply chain are even required to achieve and maintain competitiveness. (Baah, Opoku Agyeman, Acquah, Agyabeng-Mensah, Afum, Issau, Ofori & Faibil, 2022.)

When well implemented, supply chain collaboration also impacts the company's performance because, with it, the company can share risks, reduce transaction costs, and improve productivity and availability. For example, financial performance has been seen to improve in a study that utilized supply chain cooperation in the long term. (Cao & Zhang, 2011.) According to research, collaborations significantly impact the performance of the supply chain if they share information and resources, communicate cooperation, and coordinate goals. (Baah, et al. 2022.) Companies have benefited from collaboration in the supply chain in the form of, for example, improved inventory levels and reduced inventories, shorter delivery times, improved sales, and more consistent orders (Simatupang & Sridharan, 2005).

However, despite its many benefits, conflicts cannot necessarily be avoided before and during collaboration (Simatupang & Sridharan, 2002). Miscommunication (Cao, & Zhang, 2011) or unsynchronized decision making (Simatupang & Sridharan, 2005) can cause such conflicts between partners. Close cooperation can, however, facilitate the meeting of supply and demand. Identified conflicts in supply chain cooperation include, for example, conflicts arising from goals, disagreement over domain, or decision-making power. It is also possible that one party benefits more from the collaboration. (Simatupang & Sridharan, 2002.)

So which suppliers should buying companies collaborate with? To map the need for collaboration, suppliers can be segmented. Segmentation similarly takes place to the segmentation of customers, where customers are segmented based on, for example, their service needs or their purchasing behaviour. With suppliers, the segments can be, for

example, collaboration, arm's length, and market-based. Even if suppliers are segmented, all supply chains must create their own management style, culture, and strategy. Suppliers can also belong to several segments at the same time. Collaboration with strategically essential suppliers makes the most sense, and this kind of differentiation has been linked to successful collaboration. Collaboration with everyone is not profitable, and companies should focus on collaborating with a few close partnerships instead of focusing on all of them with the same intensity. With some suppliers, an arm's-length relationship is enough, where no additional benefits are created through collaboration, but the relationship is based on costs. (Barratt, 2004.)

Supply chain collaboration is often divided into three terms based on its structure. These three terms are horizontal, vertical, and lateral supply chain. (Simatupang & Sridharan, 2002.) Collaboration is horizontal when two or more competing or unrelated companies collaborate and share private information and resources (Simatupang & Sridharan, 2002). In horizontal collaboration, the parties are either both buyers or suppliers (Berlin, Feldmann, & Nuur, 2022). Vertical collaboration in the supply chain means collaboration where two or more companies share their resources and responsibilities and share information to benefit the end customer. In vertical collaboration, companies can be, for example, wholesalers, distributors, or manufacturers. (Simatupang & Sridharan, 2002.) In vertical collaboration, the parties are the supplier and the buyer (Berlin et al. 2022). Vertical supplier collaboration involves sharing information at the operational level. Collaboration can be done in supply chains on both a tactical and a strategic level. If strategic collaboration is not carried out, performance may remain at a limited level in the supply chain development. (Barratt, 2004.) In lateral collaboration, there are both ways of vertical and horizontal collaboration. Lateral collaboration can be used to achieve flexibility through both methods of collaboration. (Simatupang & Sridharan, 2002.) Vertical collaboration has had great success in many fields of application (Raweewan, & Ferrell, 2018). This research focuses on vertical collaboration.

2.2 Elements of collaboration

In the study of Cao & Zhang (2011), several elements essential to collaboration were identified, which can be used to form practical collaboration in supply chains. Cao & Zhang (2011) divided supply chain collaboration into seven parts in their journal. These elements are information sharing, target congruence, decision synchronization, incentive alignment, resource divide, collaborative communication, and joint knowledge creation. Elements are also assumed to change with each other and correlate. They bring added value to the collaboration because by utilizing their resources and innovation, costs and response time can be reduced. (Cao, & Zhang, 2011.) This chapter explores the elements of collaboration in more detail so that they can be utilized in research.

Information sharing

Different supplier-buyer relationships are based on information sharing. Sharing information is a necessary element in many studies to improve performance. High-quality information and transparency play an important and almost mandatory role in supply chains. (Barratt, 2004.) Information sharing describes the extent to which the company shares a variety of information in a timely manner that is relevant, complete, and confidential. (Cao, Vonderembse, Zhang, & Ragu-Nathan, 2010). The possibility of the two companies is either to collaborate or to be in a competitive position. The information shared between collaborating companies causes the information to no longer be protected, but on the other hand, it makes it possible to benefit from the collaboration. (Barratt, 2004.)

Decision synchronization

Simatupang & Sridharan (2005) define decision synchronization as "*the extent to which the chain members are able to orchestrate critical decisions at planning and execution levels for optimizing supply chain profitability*". Planning decisions are important in the supply chain because it allows firms to carry out operations in an optimal way. According to Lambert, Emmelhainz, & Gardner, (1999), poor advance planning is one of the reasons for the failure of partnerships. There are a total of seven planning categories, and they include, for example, operational strategy planning, scheduling and distribution management. (Cao

& Zhang, 2011.) Synchronization of decisions can, for example, be implemented through face-to-face meetings. What makes the synchronization of decisions essential for the functionality of supply chain cooperation is that it can be used to identify and share information and transfer it to the correct party. This enables efficient operations that are beneficial to the parties in the supply chain. (Simatupang & Sridharan, 2005.) The problem, however, is that the partners may have different expertise and decision-making rights. For example, sales and order forecasts may differ and goals between operators are different, in which case decision-making may be suboptimal. For this reason, decisions must be coordinated and, with the help of the right kind of coordination, affect performance. (Cao et al. 2010.)

Goal congruence

The goal congruence refers to how the parties in the supply chain experience the realization of their own goals at the same time as the goals of the supply chain are realized. If the goals are compatible, the partners feel that the goals are in line with the goals of the supply chain. If the goals differ, however, one's own goals can be achieved as a direct result of achieving the goals of the supply chain. (Cao & Zhang, 2011.) Expectations must therefore be clear for the parties to the cooperation. In their article, Lambert et al. (1999) also mention that business processes and management should be agreed upon as the basis of the visions.

Resource sharing

Resource sharing is an element of collaboration in the supplier-buyer relationship, a process of utilizing and investing in physical assets and capabilities. Physical assets mean technology and facilities. Both are needed in the distribution of resources. (Cao et al. 2010.) According to the resource-based view or RBV, companies get complementary resources from cooperation if their own are limited. According to RBV, operational performance and environmental cooperation can also be improved through supplier collaboration. (Yu & Feng, 2017.) In partnerships, financial investments are often reciprocal between actors (Cao et al. 2010).

Incentive alignment

According to the definition of supply chain collaboration, the parties' goal is to mutually benefit from the cooperation (Cao & Zhang, 2011). Incentive alignment refers to the benefits and risks shared among the members in collaboration. With it, the parties are motivated to act in accordance with the strategy they have created together. The collaborating parties thus share the load to achieve the planned goals and aim to improve the profit. The profit and benefit will be shared equally between the buyer and the supplier. (Simatupang & Sridharan, 2005.) Incentives must be defined carefully in collaborative relationships so that the profits are correctly proportionate to the risks invested (Cao & Zhang, 2011).

Joint knowledge creation

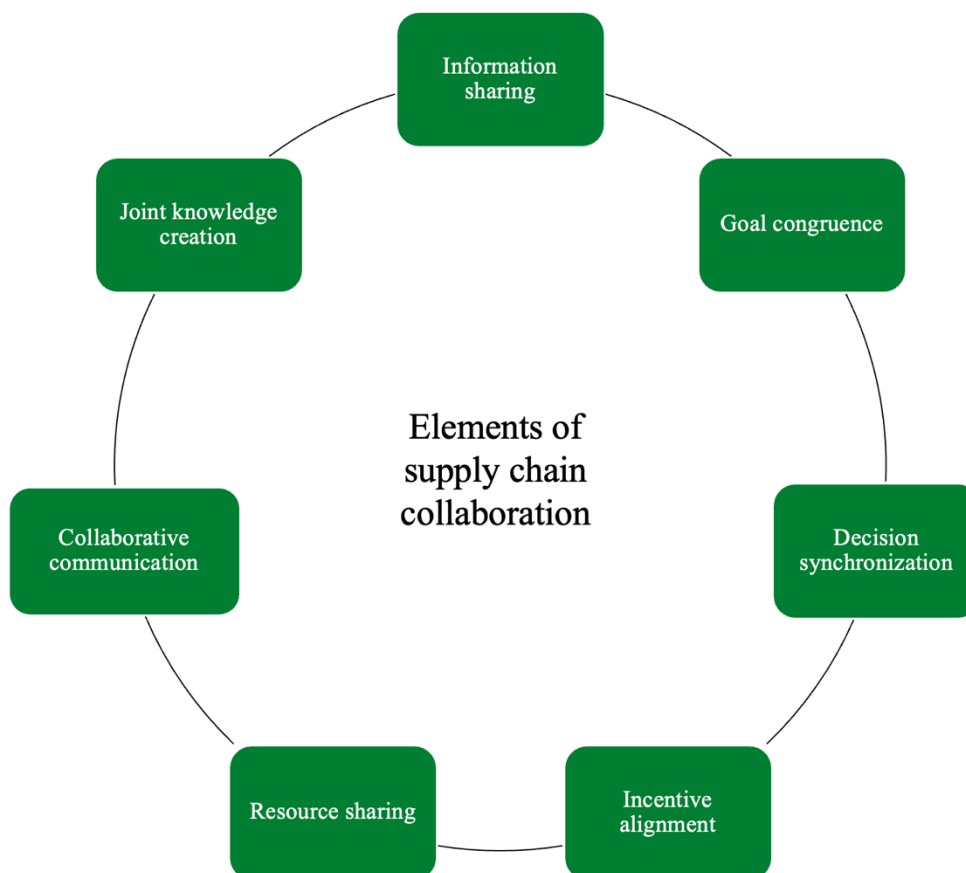
In the collaboration of the supply chain, research has been focused mainly on the previously mentioned compatibility of goals and the sharing of resources, which are elements for integrating SCC processes. (Cao, et al 2010.) Joint knowledge creation is defined by Cao et al. (2010) in the article "*The extent to which supply chain partners develop a better understanding of and response to the market and competitive environment by working together*" There are two different types of information creation: researching information and utilizing information. Researching information, in this case, means looking for new information and utilizing information, assimilating it, and applying it. Recording and exchanging information between parties enables competitiveness and the birth of inventions in supply chains. (Cao & Zhang, 2011.)

Collaborative communication

Like joint knowledge creation, communication has taken a back seat in research. Poor communication is often the cause of cooperation failure. Incorrect communication can cause misunderstandings or even conflicts in the supply chain. For example, ignorance of demand can lead to extensive inventories and poor service. (Cao, et al. 2010.) Collaborative communication is defined by Cao et al. (2010) as "*The contact and message transmission process among supply chain partners in terms of frequency, direction, mode, and influence strategy*". When communication is open, mutual, and repeated, it often refers to close

company relationships. (Cao et al. 2010.) In their study, Prahinski, & Benton (2004) also found that collaborative communication has a positive effect on the relationship between supply chain partners. For example, the indirect influencing strategy and giving feedback was seen as a positive development for the relationship between supplier and buyer. (Prahinski, & Benton, 2004.)

Figure 2. Elements of supply chain collaboration (referring to Cao, & Zhang, 2011)



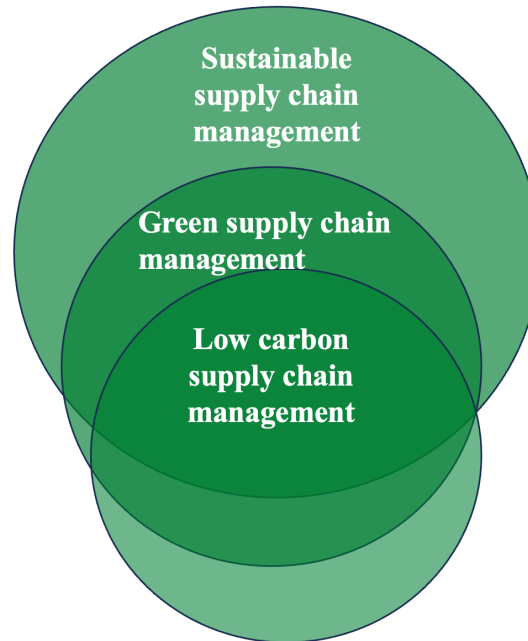
3. Supply chain collaboration in environmental sustainability

3.1 Concept of green supply management and collaboration

Green supply chain management (GSM) has become a widely used theme in the field of supply chain research and in companies (Asif, Lau, Nakandala, Fan, & Hurriyet, 2020). The research has been increased by pressure on the supply chains from customers, competitors, changes in legislation, and social obligations (Hong & Guo, 2019). Back in 2017, in an article by Chen, Zhao, Tang, Price, Zhang, & Zhu, it was reported that supply chain collaboration and sustainable development literature is still in its early stages, but by this day, the issue will have been extensively discussed in the literature from the perspective of each area of sustainability, i.e., economic, social, and environmental perspective (Cloutier et al., 2020). However, about 70–80% of studies discuss the environmental and economic dimensions, and the remaining 20–30% include the social dimension (Chen et al. 2017). Green supply management is defined in literature as complex, aimed at improving suppliers' environmental performance at the corporate level (Yu, Chavez, & Feng, 2017).

From the point of view of this research, it is essential to look at the collaboration between the supplier and the buyer in terms of sustainability because sustainable supply chain management includes the environment as one subcategory, which also includes emission management that is the topic of this research. According to Correia, Howard, Hawkins, Pye, & Lamming, (2013), the figure below illustrates the relationship between sustainable supply management, green supply management, and low carbon supply management. According to the article, these do not completely overlap, as procurement is widely affected by many challenges.

Figure 3: Relation between sustainable supply chain management, green supply management and low carbon supply management (referring to Correia et al., 2013)



Pressure for a greener supply chain comes from stakeholders, such as customers, companies, and government environmental regulation (Asif, et al. 2020). In companies, the most significant pressure often comes from stakeholders. According to stakeholder theory, companies achieve success by considering stakeholders' interests. It refers to relationships that are reciprocal with stakeholders. (Zhang, Tay, Alvi, Wang, & Gong, 2023.) Pressure from the government affects the implementation of environmental strategies (Ramathan et al. 2014). The authorities' regulation aims to promote environmentally friendly practices in the operations of organizations and improve their awareness. Emphasis on regulations helps organizations to be motivated in environmental matters and to enhance their production process in a more environmentally friendly direction. Participating in green trade can be an enabler of a low-carbon economy. (Andalib Ardakani, Soltanmohammadi & Seuring, 2022.) Stakeholder pressure can affect companies' sustainable strategic procurement and improve the company's competition and performance in addition to sustainable development (Yen, 2018). At the tactical and strategic levels, the low-carbon supply chain has become part of a strategic aspect of supply chain management (Laosirihongthong, Samaranayake & Nagalingam, 2019).

GSM contains many environmental functions, which makes it a multidimensional construct. Research on the topic has divided green supply chain management into dimensions, which include supplier selection, evaluation, collaboration, and monitoring. (Yu, et al. 2017.) For green supply chain management to be done, it requires different actions to ensure sustainability. These include, for example, the accurate selection of suppliers, the removal of suppliers, the improvement of performance with weak suppliers, and the allocation of resources to develop suppliers. (Kumar, Shrivastav, Adlakha, & Vishwakarma, 2022.)

Environmental collaboration in the supply chain means cooperation between companies aiming to achieve environmental goals (Yen, 2018). Collaboration between the supplier and the buyer in supply chains is seen as one of the prerequisites for environmental friendliness (Emberson & Storey, 2006), and according to researches, collaboration with suppliers is a critical success factor to companies' total environmental impact (Yu et al. 2017). According to studies, the benefits created by cooperation are the joint utilization of internal and external resources. In addition, benefits for a greener supply chain can be obtained from product design, product recycling, and marketing of green products. (Hong & Guo, 2019.) For this reason, the collaboration between the buyer and the supplier has become a strategic approach to achieving organizations' economic, social, and environmental sustainability goals (Chen, et al. 2017).

In concrete terms, supply chain collaboration can achieve benefits such as reducing supply chain waste and using more environmentally friendly raw materials (Yu, et al. 2017). In the literature, the environmental sustainability performance of the supply chain is measured by the increase in energy savings due to efficiency improvements and the reduction of carbon dioxide emissions, hazardous waste, environmental accidents, and hazardous consumption (Arora, Arora, Sivakumar, & Burke, 2020). Lee (2011) mentioned in the journal, that when the emission sources are identified, they can be controlled, and efforts can be made to minimize the emissions. Considering the carbon footprint in supply chain management helps improve awareness of serious emission sources. (Lee, 2011.)

In the GSM literature, the central role of procurement personnel has yet to be considered. According to RBV, purchasing personnel are crucial in building a green supply chain. Research has suggested that purchasing personnel be adequately rewarded and trained, as they have a significant impact on the greenness of the supply chain. The knowledge and qualifications of the procurement staff therefore have a critical impact. According to RBV, a procurement person with experience and knowledge can help companies implement environmental practices. According to the research, a sophisticated purchasing function with skills in green purchasing can increase the sustainability of suppliers and the introduction of innovations through supplier collaboration. (Yu, et al. 2017.) According to Bhardwaj's (2016) study, managers must plan a mission and a strategy to control emissions and motivate procurement professionals to promote activities in this direction.

Reducing the supply chain's carbon footprint is challenging, especially when several parties are involved (Ramanathan, Bentley & Pang, 2014) and because it is often in conflict with more traditional supply goals, such as quality and costs (Adesanya, Yang, Bin Iqdara, & Yang, 2020). It is indeed a long-term project, and it makes sense to continue, as it usually rewards both parties involved in the collaboration (Ramanathan et al 2014). The size of the supply base is of great importance in how the goals of sustainable development are achieved in collaboration because the organization is no more sustainable than the suppliers it chooses and with whom it cooperates. Effective supplier base management has a connection to better partnerships and, in addition to this, also to environmental management. (Arora et al., 2020.) Ramathan et al. (2014) defined cooperation within three years as short-term collaboration, between three and six years as medium-term, and long-term collaboration between six and ten years.

According to a study by Ramatha et al. (2014), inter-organizational and internal collaboration is essential in reducing carbon dioxide emissions. According to the study, supply chain partners should improve their strategies and initiatives to reduce emissions and plan how information on the level of CO₂ emissions is shared in the supply chain. In addition, defining the level of collaboration in reducing emissions is important. For example, at the preparatory level, short-term goals differ significantly from futuristic, long-term goals. In the short term, the concrete actions of the supply chain cooperation can be mapping carbon

dioxide emissions, searching for alternative materials, and planning. In the long term, the goal can be, for example, a 20% reduction in carbon dioxide emissions and new technological innovations. (Ramathan et al. 2014.)

Dahlmann, & Roehrich's (2019) study emphasizes that companies that have not yet committed their suppliers to climate change management should start by collecting basic data on greenhouse emissions. In addition, this information should be evaluated internally before reducing emissions. (Dahlmann, & Roehrich, 2019.) Carbon dioxide emissions can also be calculated by product or storage unit. When the emissions for a particular storage unit are known, finding opportunities to reduce emissions and financial benefits from the products is easier. It is typical for companies that they do not find any surprises in their carbon footprint, but usually, the measurements are not done at low enough levels, such as per storage unit. Opportunities can be found in product groups that have similar characteristics, such as physical characteristics or similar logistics. These may be important things to consider in the company's supply chains. Awareness and understanding of the formation of carbon dioxide emissions in the supply chain can increase; thus, the prioritization of reducing emissions becomes easier. Products with high emissions can also be eliminated, and products with low carbon dioxide emissions per yield are preferred. (McKinnon, 2010.)

3.2 Drivers and barriers

As mentioned earlier, companies need ways to mitigate climate change. Environmental regulation and stakeholder pressure force companies to think about their operations for more environmentally friendly supply chains (Eggert, & Hartmann, 2021). Companies should adopt effective practices that promote supply chain collaboration to combat climate change (Lintukangas et al., 2022). Since there is little literature related to reducing carbon dioxide emissions in the supply chain, this study examines the topic from the point of view of improving environmental sustainability, which essentially includes emissions control. In this chapter, we learn which practices in collaboration drive environmental sustainability and, through that, carbon dioxide management in the supply chain and which are a barrier to it.

3.2.1. Drivers

According to the literature review by Cloutier et al (2020), seven collaboration mechanisms promoting sustainable development have been found in literature and studies. Collaboration mechanisms are divided in the article into; “*relationship management, joint practices, technological and information sharing practices, contractual and economic practices, governance practices, assessment practices, and supply chain design*”.

Relationship management

Relationship management in the supply chain can be of great importance to how sustainability goals are realized in the supply chain. The behavior of suppliers and the sustainable development of organizations can be influenced by relationship management. (Adesanya et al 2020.) According to Cloutier, et al. (2020) study, the most crucial factor promoting collaboration in the studies to promote the sustainability of the supply chain is relationship management. Relationship management was mentioned in 83% of the articles related to collaboration practices. An essential part of managing collaboration is finding the right partner and committing them to promoting a sustainable supply chain. Transparency, trust, proactive behavior, and goodwill in cooperation are required from the partner. (Cloutier, et al. 2020.) Companies build relationships based on trust, so trust plays an important role when getting suppliers involved in carbon dioxide management. When suppliers are included in planning and evaluating carbon dioxide management, it increases transparency between actors (Lintukangas et al. 2022.), which has been seen in studies as an essential part of collaboration (Cloutier et al. 2020).

According to Ki Fiona Cheung and Rowlinson's (2011) research, a sustainable supply chain requires proactive relationship management, trust, and an appropriate organizational culture. The parties in the supply chain must, therefore, commit to the concept and recognize the benefits and principles of the relationship. Relationship management increases people's helpfulness, and work is enjoyed more. According to Ki Fiona Cheung and Rowlinson's (2011) study, these things can be used to promote a sustainable supply chain. Meetings,

communication, and networking are concrete ways of relationship management that improve sustainability (Cloutier, et al. 2020).

Joint practices

Joint practices mean the mutual practices of the collaboration parties and their actions. With the help of joint practices, the supplier and the buyer can trust each other's expectations and knowledge. In this case, both have information about each other's commitment to, for example, the production forecast. (Cloutier, et al. 2020.) Activities are carried out together in a coordinated manner. It starts with planning and ends with joint evaluation, and this process lasts for several years. (Mentzer, DeWitt, Keebler, Min, Nix, Smith, & Zacharia, 2001.)

Concretely, joint practices can mean, for example, shared goals and planning, finding solutions, and planning transportation. (Cloutier, et al. 2020.) In their article, Lintukangas et al. (2022) mentioned that flexible and efficient operating methods are needed to reduce emissions and combat climate change. The right kind of strategy in collaboration is seen to be useful in improving the performance of sustainability (Kumar, Subramanian & Maria Arputham, 2018). Very little is known about the carbon dioxide emission control strategies used to combat climate change, their implementation, and their effects. (Yunus, et al. 2016) However, a few studies have been done on them, emphasizing that organizational commitment and management tools can reduce the supply chain's carbon footprint. (Wang, & Zhao, 2023) Carbon management is usually divided into six different activities, which include, from the perspective of supplier collaboration, a commitment to reducing emissions, improving procurement and processes, improving products, engaging the organization, and developing external relations. Companies can have different attitudes towards carbon dioxide management. Attitudes can vary from reactive, such as emission compensation, to more proactive management, such as strategies, innovations, and process improvement. (Yunus, et al. 2016)

Carbon strategies, on the other hand, are divided into three different types: carbon compensation, reduction, and carbon dioxide independence. Compensation aims to offset emissions by buying carbon dioxide credits, while reduction and independence are preventive measures. Reducing emissions can be done in companies by changing products and production processes. Companies achieve independence through actions that make the business completely independent of fossil fuels. (Yunus, et al. 2016.)

Technological and information-sharing practices

Technology plays a critical role in supply chains as it plays a significant role in improving performance. Technology has been found to facilitate the development of partnerships in supply chains. For relationships to progress to collaboration, they require easy technological means of information sharing, where information moves quickly. This may require technological integrations between companies. (Salam, 2017.)

However, it is also possible that the technology does not add value to the partnership or improve its success rate. Namely, technology can remove goal setting and information sharing from collaboration, as communication can decrease. (Salam, 2017.) The Schniederjans & Hales (2016) study had a contradictory result, as they found that collaboration had a great connection with the environmental friendliness of operations, and cloud services promoted supply chain collaboration. Cloud services had an even more positive impact on the environment than financial performance. The study emphasized that choosing the proper cooperation platform is important in terms of environmental friendliness. (Schniederjans & Hales, 2016)

Governance practices

Governance practices are activities that determine rules, laws, and practices that guide organizations. There are external and internal administrative practices. External means, for example, the government or environmental organizations. Mutual governance of internal partners may include standards defined by the parties themselves. Collaboration is facilitated if there is an external administration, as it helps define the parties' responsibilities. On the

other hand, the consistency of processes, transparency, responsiveness, and coordination of costs can be improved with good internal management practices. Regulation has been seen to have a practical effect on the environment in the long term. (Cloutier, et al. 2020.)

External governance is increasing in the EU. In 2023, on January 5, the CRSD directive entered into force in the European Union. The purpose of the directive is to modernize the regulation of environmental reporting. The regulation applies to small and medium-sized listed companies as well as large companies. This means around 50,000 companies in the EU. The first reporting year for companies is in 2024, which means that the first regulatory reports will be published in 2025. (European Commission.) As mentioned in the article by Klaaßen & Stoll (2021), the first step to reducing emissions is their calculation, and therefore this regulation is essential. The EU CRSD directive mentions that previously there was no obligation to report emissions and to ensure the reliability of the data, it is important to standardize and report the calculation. In this way, it is possible to avoid, among other things, greenwashing, and double counting. Regarding Scope 3 emissions, primarily is good to know in the reports which categories are the largest and most significant for the company. (EUR lex.)

According to the United Nations Global Compact, reporting is claimed to promote the transparency and sustainability of the supply chain (Okongwu, Morimoto, & Lauras, 2013). The first step in reducing emissions is calculating the current emissions situation (Klaaßen & Stoll, 2021). Companies prepare more and more reports on their sustainability, and through legislation, the need to calculate carbon dioxide emissions is increasing. It increases the standardization of carbon dioxide calculation in reporting. (Olson, 2010.) The GHD protocol, which separates the types of emissions into three parts, scope 1, scope 2, and scope 3, has been used the most in reporting emissions.

The current reporting and calculation companies use is unsystematic, especially regarding scope 3 emissions, which are incomparable between different companies. According to studies, companies can communicate their emissions inconsistently using smaller numbers in their reports. In addition, the calculations are incomplete, as they are done in different

ways. These methods are process-based and economic output-input systems and their mixture. About a third of suppliers deliver their own scope 3 emissions. Companies are, therefore, unable to utilize primary information about their supply chain's emissions. This leads to the incompleteness of the data when they must be corrected with secondary data. The third reason for the incomparability is the complete neglect of scope 3 emissions. (Klaaßen & Stoll, 2021.)

As the regulation of reporting increases, companies' awareness of their own indirect emissions can also increase and thus improve emissions management. Larger companies may have to demand calculations from smaller companies so that they can carry out their own calculations as accurately as possible. This may indirectly increase the need for reporting by smaller companies as well.

Contractual and economic practices

Contracts are legal documents, written or oral, between any stakeholders. The parties to the agreements must accept their obligations and act in accordance with them. Clauses can be included in the contracts, with which, for example, can oblige the design of eco-products or the distribution of incentives for long-term cooperation. (Cloutier, et al. 2020.) According to the research of Hong & Guo (2019), cooperation agreements are valuable now that consumers have become more environmentally conscious. According to Li, Zhang, Zhao, & Liu, (2019) article, contracts for low-carbon supply chain management are cost-sharing contracts and revenue-sharing contracts. According to the study, these agreements are helpful in coordinating the low-carbon supply chain, as they act as incentive systems. (Li et al., 2019.)

Assessment practices

Assessment practices are activities in the supply chain that can be used to improve performance by monitoring and evaluating it. Evaluation practices include supplier audits, supplier evaluations, performance evaluations, and certifications. (Cloutier, et al. 2020.) According to Klassen & Vachon (2003), customer evaluations such as audits and feedback

positively affect how suppliers see environmental issues. When the customer performs these controls at suppliers, management is most likely encouraged to make environmental investments (Klassen & Vachon, 2003). One of the advantages of measurement and evaluations is a common understanding of the environmental sustainability of the supply chain (Cloutier, et al. 2020).

Supplier evaluation has become an important part of companies' operations, as it affects their performance. A reliable evaluation of suppliers is a challenge because the supply chain is affected by several things such as the economy and sustainability. Laosirihongthong et al. (2019) research found that suppliers should be classified according to the importance of different criteria. Assessments can act as driving factors as well as in pollution control. Evaluations can also be used to benchmark other companies. (Laosirihongthong, et al. 2019.) According to a study by Winter & Lasch (2016), environmental criteria are often used in supplier evaluation, but they function more as a removal criterion, and not as a determining factor for supplier selection.

Auditing suppliers can be classified as an assessment practice for supply chain collaboration (Cloutier, et al. 2020). The need for standardized audits increases as carbon dioxide emissions are calculated more accurately in sustainability reports (Olson, 2010). However, at the product level, there are many challenges with product-level carbon dioxide emissions auditing. At the product level, audits are costly for companies, and it is very challenging to audit a wide range of products in their entirety. The carbon footprints of individual products can vary as the supply chain changes when, for example, the raw materials vary. This also challenges product-level auditing. In addition, challenges arise from, for example, the allocation of storage costs and the delimitation of the audit, for example, by scope. The resources that would be used for such an emissions audit could be used much more productively. All the time and effort would not necessarily affect consumption behavior either, but if this were the case, measuring carbon dioxide emissions could be justified on the other hand. (McKinnon, 2010.)

Supply chain design

Supply chain design was according to the literature review the least mentioned collaboration mechanism to promote a more sustainable supply chain and it was only mentioned in 30% of the articles. Supply chain planning considers the environment in the supply chain's structure. Concrete planning measures include environmentally friendly logistics, the selection of suppliers, and the location of the units. (Cloutier, et al. 2020).

Even though the selection of suppliers is not an actual cooperation between the supplier and the buyer, the selection of the supplier is usually a matter that precedes the cooperation. Therefore, it is crucial to consider it in the emissions management process. According to studies, the selection of suppliers has indeed been found to be one of the most important tasks of supply chain management, and it can include various conditions regarding environmental issues such as emissions (Yu, Yang, & Chang, 2018). Logistics is a significant source of emissions in supply chains, and globalization has accelerated supply chain logistics traffic. Switching to more energy-efficient forms of transport will reduce emissions a lot. According to a study by Jin, Granda-Marulanda & Down (2014), this would be promoted by higher taxation of the carbon dioxide level, in which case retail stores would have to redesign their supply chain. (Jin et al. 2014.)

Table 1: Drivers and collaboration mechanisms promoting sustainable development (referring to Cloutier et al, 2020)

Drivers	Concrete practices
Relationship management	Meetings, training, communication
Joint practices	Planning and execution to achieve common goal
Tehnological and information-sharing practices	Platforms, information sharing
Governance practices	Regulations, laws, guidelines, common methods
Contractual and economic practices	Cost-profit sharing, contracts, rewards
Assessment practices	Auditing, supplier monitoring, certifications
Supply chain desing	Locations, logistics, supplier selection

3.2.2 Barriers

Although the literature identifies more drivers than barriers in green supply chain collaboration (Walker, et al., 2008), it is also worth looking at barriers. Barriers can be divided into internal and external (Walker, et al., 2008). This paragraph takes a closer look at these barriers.

Costs

In a well-functioning supply chain, the goal is to maintain the flow of information, goods, and funds, and to maintain good availability of products. In addition to this, an essential part is keeping costs down. (Chopra, 2018, 20.) Internal factors are even seen as the biggest obstacle to reducing carbon emissions. Companies focus on the financial side and for this reason, they do not have the necessary resources. (Zhang et al. 2022.) According to research, rising costs are an obstacle in making better environmental choices (Walker, et al., 2008). The purchase price of environmentally friendly products can increase when more ecological manufacturing, materials and raw materials are used (Lintukangas, Kähkönen & Ritala, 2016). Costs are significant for small and medium-sized companies when making a purchase decision, as they can be vulnerable due to limited resources. Customers must weigh whether to emphasize environmental friendliness or costs in their purchase. This is also challenging for buyers, and they may not know how to include environmental issues in their purchases. (Walker et al, 2008.) Costs can therefore be an obstacle or a slow-down for companies when they try to reduce CO₂ emissions in the supply chain.

However, overall costs can be reduced when more sustainable decisions are made. This arises from the fact that, for example, the amount of waste can be reduced and the need for energy reduced. (Lintukangas et al. 2016.) According to research, sustainable operation is economically profitable, as it improves companies' competitiveness, legality, and ecological responsiveness (Giunipero, Hooker, & Denslow, 2012). The company should choose the optimal compromise between economic costs and environmental considerations. (Hong & Guo, 2019.) Yu et al. (2020), the cost learning effect leads to reduced costs but does not necessarily compensate for the costs spent on investments. For this reason, suppliers

cooperate with, for example, retailers, in which case the costs of reducing emissions are shared between them. (Yu et al., 2020.)

Poor supplier engagement

Poor commitment from suppliers can become an obstacle to reducing emissions in the supply chain. (Walker, et al., 2008) Supplier commitment to carbon management is defined as activities that manage carbon dioxide emissions and involve upstream and downstream members of the supply chain. The goal of commitment is to minimize the generation of emissions and curb the progress of climate change. Studies found engagement to be an important part of companies' sustainable development progress. (Lintukangas et al. 2022.) Three institutional reasons drive supplier companies to transparency of carbon dioxide emissions: coercive, normative, and mimetic. Coercive pressure drives suppliers to participate in disclosure programs to which buyer companies invite them. Normative pressure arises when the industry has certain norms, such as standards or emissions reporting. The mimetic pressure, on the other hand, comes from competitors and their success, and because of this, suppliers mimitate the actions of their competitors. Studies have shown that incentives are essential in openly reporting carbon dioxide emissions. (Villena & Dhanorkar, 2020.) According to Zhang et al. (2023) research, carbon neutrality in the supply chain was most promoted by customer enforcement and normative pressure. For this reason, management's commitment to carbon neutrality plays a huge role.

There are three types of supplier engagement models for managing climate change and reducing emissions: basic, transactional, and collaborative. At the basic level of supplier engagement, scope 3 emissions are asked from suppliers. Still, they are not used to develop operations, but more so that information on scope 3 emissions can be collected. The data is thus only processed at a minimal level. At the basic level, engagement is only reactive and short-lived. (Dahlmann, & Roehrich, 2019.) However, the apparent engagement does not guarantee an improvement in the transparency of carbon dioxide emissions. Suppliers may participate in, for example, communication programs symbolically, but fail to answer important questions. This is why it is important to know about suppliers' commitment to carbon transparency (Villena & Dhanorkar, 2020.)

The second model is the transaction model. The attitude is more proactive in the transaction model than in the basic model. Emissions data is processed a little more deeply and can be used internally for productive purposes, and companies can identify improvement opportunities through this. In the transaction type, the purpose is to achieve better risk- and cost management and improve performance. (Dahlmann, & Roehrich, 2019.)

Collaborative engagement is the third and most profound supplier engagement model for emissions management. In this case, the cooperation is strategic and aims to create value, and innovations and promote competitive advantage. Cooperation between operators is long-term and proactive. The essential thing about cooperation is that it includes customers and possibly consumers in the data collection. Companies must try to convince that new innovations have added value for the customer. The intensity is affected by the customer's responsiveness and the degree to which the customer is in control of climate change (Dahlmann, & Roehrich, 2019.)

Lintukangas et al. (2022) study concluded that buyer companies that considered emissions management in their strategy had higher supplier engagement than those companies that did not consider emissions. Public policy also positively affected suppliers' commitment, as suppliers saw carbon management as a moral act. (Lintukangas et al. 2022.) In the Dahlmann, & Roehrich (2019) study, it was noticed that companies' commitment to with suppliers they engage with has not changed over time. The study emphasizes that companies that have not yet committed their suppliers to climate change management should start by collecting basic data on greenhouse emissions (Dahlmann, & Roehrich, 2019.), so that they can use information in their own operations and give product carbon labels (Villena & Dhanorkar, 2020). In addition, this information should be evaluated internally before reducing emissions (Dahlmann, & Roehrich, 2019).

Barriers within the industry

Walker et al. (2008), in the literature review, it was found that there are different obstacles within the industries to achieve a greener supply chain. For example, in healthcare, the

products preferred by healthcare professionals became an obstacle to product changes. Doctors may have wanted to use certain products in their work, and patient safety is the most important in healthcare. In this case, environmental issues are secondary in the purchase decision. In the healthcare sector, it is also possible that the supplier pool consists of many small suppliers, which makes it more difficult to focus on cooperating with large suppliers. (Walker et al., 2008.)

Chan (2018) studied the difficulty of reducing carbon dioxide emissions in hotels, and the result was that stakeholders have insufficient interest in reducing emissions. The incomplete standardization system for auditing carbon dioxide emissions and the difficulty of collecting emission data affect the hotel operators' interest in improving things. The study also mentioned that hoteliers have more important tasks like business and quality service. (Chan, 2018.) This may indicate that in specific industries, emission reduction measures are seen as problematic and unattainable, and therefore do not want to spend time and resources on them.

A shortage of suppliers or an oligopoly situation can also lead to a situation where suppliers do not improve their environmental friendliness, because customers cannot demand it by changing suppliers. (Walker et al., 2008.)

4. Methodology

After the theory part of the research, it proceeds to the empirical part. The purpose is to delve deeper into the case company's current situation from the research topic's perspective and thus answer the research questions. The empirical part of the research consists of qualitative research. This chapter describes the research methodology and the collection and analysis of the data used in the research. First, the research method and the factors are discussed influencing its choice. After this, more is discussed about the data collection, selection, and analysis method used in the study. The chapter also discusses the validity and reliability of the study.

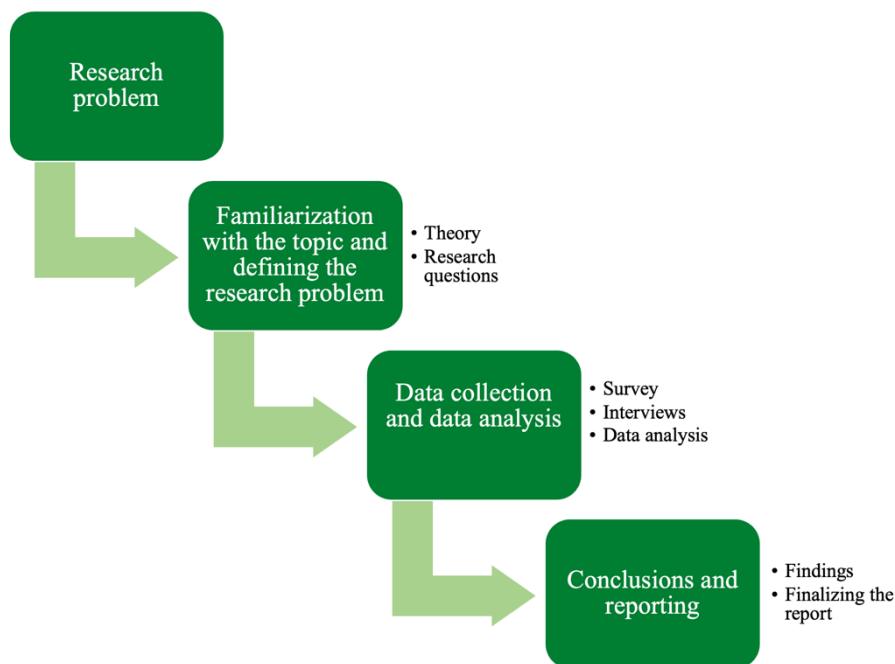
4.1 Research methodology

As the first methodological decision of the research, the researcher has to decide whether it is a qualitative, quantitative study or a combination of them (Saunders et al. 2016, 164). This research is carried out as a qualitative case study investigating one company. Case studies have an extensive history and have been used in many different disciplines. They are especially popular in business, as they can be used to ask difficult-to-understand questions in the form of real life. On the other hand, this real-life use has also caused criticism against case studies. (Eriksson & Kovalainen, 2008.)

Qualitative research is, by nature, understanding research (Tuomi & Sarajärvi, 2018). This is because the researcher needs to understand the subject's social constructions (Eriksson & Kovalainen, 2008). The figure below shows a diagram from Hirsijärvi and Hurme's book (2001) that explains the empirical research process. The process in question is also followed in the implementation of this study. The most critical research stage is the first, i.e., defining the research problem. With its help, for example, decisions are made about acquiring research data and its collection methods. Empirical research has several stages from which a whole emerges. The phases have a dependency relationship with each other. It is also easier

for the researcher to do the research when the critical stages of the research are known. (Hirsijärvi & Hurme, 2001.)

Figure 4: Research process (referring to Hirsijärvi & Hurme, 2001)



4.2 Case company and background

This study examines the reduction of carbon dioxide emissions in the supply chain of a large domestic healthcare provider Mehiläinen. Mehiläinen is an exciting company to investigate, as it produces many different healthcare services, and its purchased products comprise most of its carbon dioxide emissions. Due to its size, Mehiläinen is also obliged to report in 2025 in accordance with the CSRD directive, so this study is essential to do now because of that perspective.

Mehiläinen is a company founded in 1909. It operates in Finland, Sweden, Estonia, and Germany. However, Finland is the company's current primary market area. Mehiläinen has

acted as a pioneer in the healthcare sector, benefiting society simultaneously. According to the sustainability report, 33,000 professionals worked in Mehiläinen in over 800 units in 2022. According to the 2021 figures, the company was the fourth largest private employer. Mehiläinen produces several different health services in the public and private sector and operates as a producer of social services. (Mehiläinen, 2022.)

According to the sustainability report, Mehiläinen promotes the UN's sustainable development goals in its operations, and the most essential for the company are goals 3, 8, 9, and 17. UN's sustainable development goal 17 is to support sustainable development and global partnership implementation. (Mehiläinen, 2022.) The sustainability report shows that Mehiläinen strives to strengthen its partnership with its stakeholders further. This goal is also linked to the topic of this study, as suppliers are one of the stakeholders with whom sustainable development can be further promoted.

Mehiläinen has already done much work to reduce the emissions of its operations, for example, by using renewable energy and optimizing energy consumption. It strives to reduce its emissions continuously. The interest margin of Mehiläinen's loan is tied to its success in its three sustainability goals. This financing agreement was concluded for the company in 2021, and according to it, Mehiläinen commits to improving the quality index of care for the elderly, offering non-urgent access to treatment at public health stations, and reducing its carbon dioxide emissions. The goal of carbon dioxide emissions is to reduce them relative to turnover by three percent per year compared to the previous year. This goal is valid until at least the year 2025. (Mehiläinen, 2022.)

Since scope 1 and scope 2 emissions are at an advanced level, Mehiläinen needs to reduce its scope 3 emissions to reduce its emissions in the larger picture. Although scope 3 does not yet belong to this 3% goal, it can be included in the calculation later when there are more precise frames for calculating emissions. Mehiläinen is also committed to the SBT initiative. This means that Mehiläinen has set targets for reducing its emissions. The table below shows the figures for the carbon footprint in its 2022 sustainability report. Scope 1 emissions in 2022 were 2,522 tCO₂, scope 2 0 tCO₂, and scope 3 82,200 tCO₂, which means that scope 3

emissions make up 97 % of Mehiläinen's carbon footprint. This research aims to find ways to reduce this carbon footprint by taking advantage of strategic supplier collaboration. The picture below shows Mehiläinen's emissions from 2021 and 2022 divided by scope. Scope 3 has grown along with the business.

Table 2: Mehiläinen's carbon footprint (Mehiläinen, 2022)

Mehiläinen's carbon footprint

tonnes (tCO ₂)	2021*	2022
Scope 1	2,281	2,522
Scope 2	1,449	0
Scope 3	77,088	82,200

The research takes a stand on various supplier collaboration models and methods that could strategically influence reducing carbon dioxide emissions in supply chains. The goal is to study how Mehiläinen's collaborative suppliers can reduce their carbon dioxide emissions with close cooperation with Mehiläinen and, at the same time, positively affect Mehiläinen's scope 3 emissions.

4.3 Data collection

The most common data collection methods for qualitative research are interviews, surveys, information collected from documents, and observation (Tuomi, Sarajärvi 2018). The empirical part of this study uses two of these, i.e., interviews and information collected through surveys. The research uses both numerical and written data.

At the end of 2022, an environmental survey was carried out in the case company to map the calculation of carbon dioxide emissions of the largest suppliers and the reporting and goals related to them. This survey data is used as supporting data in the research to discuss the general situation regarding the state and management of carbon dioxide emissions for the more extensive supplier base. Still, it does not mention collaboration-related issues in more detail. For this reason, the interviews are the primary data of the study.

According to Tuomi & Sarajärvi (2018), the basic principle of the interview is to ask the interviewees what they think and why they act the way they act. Its benefit is flexibility, as questions can be corrected if necessary, and a discussion can be held. In the interview, the questions can also be asked in the order the interviewer wants. Since the interview aims to get as much information as possible, the interview questions are sent to the interviewees in advance. (Tuomi & Sarajärvi, 2018.) The interview questions were sent to the suppliers well before the interview so that they could be prepared for them as much as possible. The company being interviewed was allowed to decide who attended the interview in the company based on the questions so that they could tell the relevant information. For example, suppose the interviewee is a key account manager. In that case, he or she may not be as aware of emission reduction measures as the company's climate manager. In contrast, a key account manager may know much more about cooperation and its practices with the customer.

The research uses a semi-structured interview as an interview method. In a semi-structured interview, the aim is to proceed according to predetermined themes and related questions, and if necessary, the questions can be defined. (Tuomi & Sarajärvi, 2018). Interviews were conducted with six of Mehiläinen's suppliers from different industries to obtain industry-specific differences in practices and considerations, as with three procurement specialists from Mehiläinen. All the suppliers used for the research are in a financially significant position in Mehiläinen's operations and thus also significantly impact emissions. The interviews were conducted via Microsoft Teams, so that the interviews could also be analyzed afterwards.

Table 3: Interviewed companies and the durations

Company	Size of the company	The duration of the interview
Supplier A	Medium	53 min
Supplier B	Large	27 min
Supplier C	Large	1h 9min
Supplier D	Large	51 min
Supplier E	Large	43 min
Supplier F	Medium	42 min
Mehiläinen		11 min
Mehiläinen		36 min
Mehiläinen		26 min

4.4 Data analysis

The research material is analyzed using the content analysis method. Data-driven analysis is one of the qualitative analysis methods, and it aims to analyze research data systematically and objectively. The material for content analysis can be many different sources, such as conversations, letters, speeches, or reports. (Tuomi & Sarajärvi, 2018.) This study uses an interview and data from an environmental survey created by Mehiläinen's procurement team for suppliers to deepen the understanding of the collaboration between buyer and supplier to control carbon dioxide emissions.

Content analysis aims to get a condensed and general picture of the phenomenon under study, and it is suitable for analyzing the semi-structured interview used in this study. The analysis can be done deductively or alternatively inductively. (Tuomi & Sarajärvi, 2018.) In this study, however, the material is analyzed inductively. Inductive analysis means that reasoning is done from a single case to a general one (Tuomi & Sarajärvi, 2018).

4.5 Reliability and validity

In implementing the study, its reliability and validity have been considered. Reliability tells the extent to which the procedure ends with the same result in repeated situations. So, it

relates to how another researcher would get the same results if they repeated the study. Validity tells about how accurately the conclusions of the study describe what happened. When the research results are valid, they are inevitable and proper. In qualitative research, the term is used so that the research aims to give a guarantee that the description or report is correct. However, researchers have disagreed about whether, for example, interviews can be evaluated using these reliability and validity measures. (Eriksson & Kovalainen, 2008.)

Triangulation has been used in the research. The term refers to a process in which several perspectives are used to refine the research, and with the help of it, the reliability of the research is increased (Eriksson & Kovalainen, 2008). There are several triangulation methods, but the ones used in the study are data triangulation and methodology triangulation. Data triangulation was used in the study in such a way that research material was collected from several different groups of informants, such as different suppliers and Mehiläinen's procurement. Triangulation of the methodology was used in the research in such a way that the data also included a previously conducted survey in Mehiläinen, which contained numerical data on suppliers' emission management.

Efforts have been made to influence the reliability of the research in many ways. First, the theory presents the information relevant to the research logically. The theory is collected from peer-reviewed journals and research literature related to the subject area. The questions for the primary data, i.e., the interviews, are formulated according to the theory related to the topic. The number of interviewees is reported in the study to ensure validity. People and companies are kept anonymous in the research, which limits the information that can be shared. On the other hand, when the interviewees are unknown, they may answer the interview questions more openly and truthfully. The answers to interview questions were based on the knowledge and experience of the interviewees. In addition, the study's inspectors read the study to ensure its validity before it was published.

5. Findings

5.1 The results of the environmental survey

This chapter presents the research materials and the findings made from them. The first of the research materials is the results of the Mehiläinen environmental survey as background information to get an overall picture of how the most significant suppliers are committed to reducing emissions and reporting on them. The environmental survey serves as the research's secondary data. The survey contains both numerical and written information.

In December 2022, Mehiläinen's procurement team conducted an environmental survey for the most significant suppliers according to Mehiläinen's spend report. The survey supports Mehiläinen's goal of sourcing products and services from suppliers committed to sustainable and responsible operations. Its goal was to gather information about suppliers' environmental sustainability and reporting. The survey was sent using the Microsoft Forms tool and was sent to a total of 115 suppliers. 89 of the suppliers responded, making the survey's response rate 77%. 23 suppliers did not answer the survey at all. There were 18 questions in the survey, divided into three sections; questions related to the carbon footprint, the CO₂ emissions of the products and services sold, and questions about climate-related goals.

Questions 1-2 of the survey dealt with the respondents' information, such as the company and the respondent's position in the company. This information was requested so the answers could be linked to the company and the person who answered them. Question three asked if the supplier does sustainability reporting regularly. 50% of respondents answered that they regularly report on sustainability. Some suppliers responded that sustainability was reported as part of the annual report or that the reporting was done at the group level. Not all suppliers have reports publicly available. 63% answered that the reports are available, and some suppliers only report internal sustainability issues. Some of the reports will also be available in the future, but they have yet to be made available. The reason is that the suppliers who do not report sustainability regularly said they are not yet obliged to do so or that the report is

coming in the future. The supervision of the authorities in the industries was also one of the reasons why there was no need for the report yet.

Figure 5: Preparation of the sustainability report

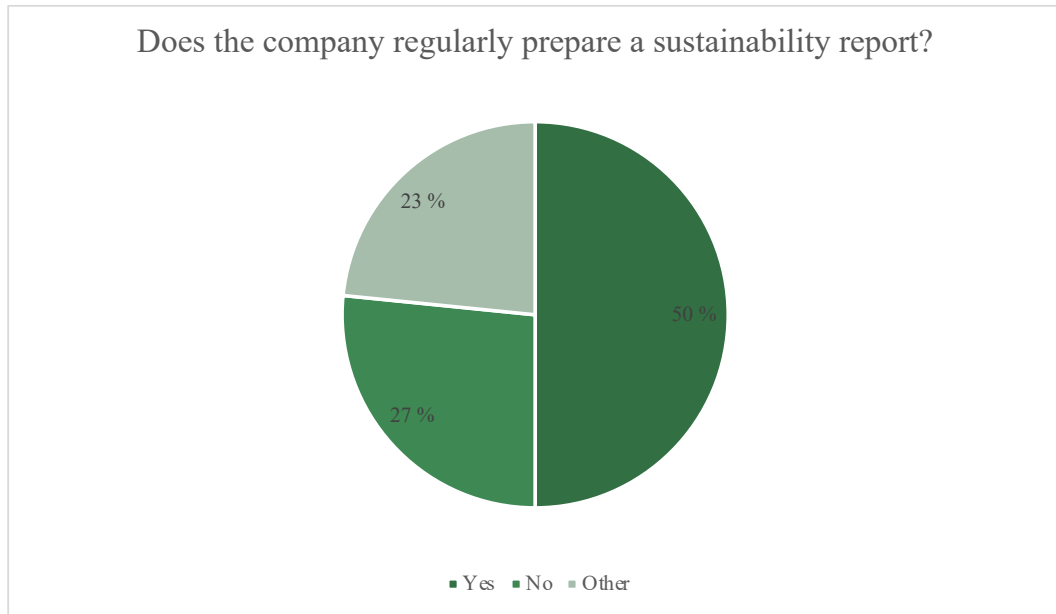
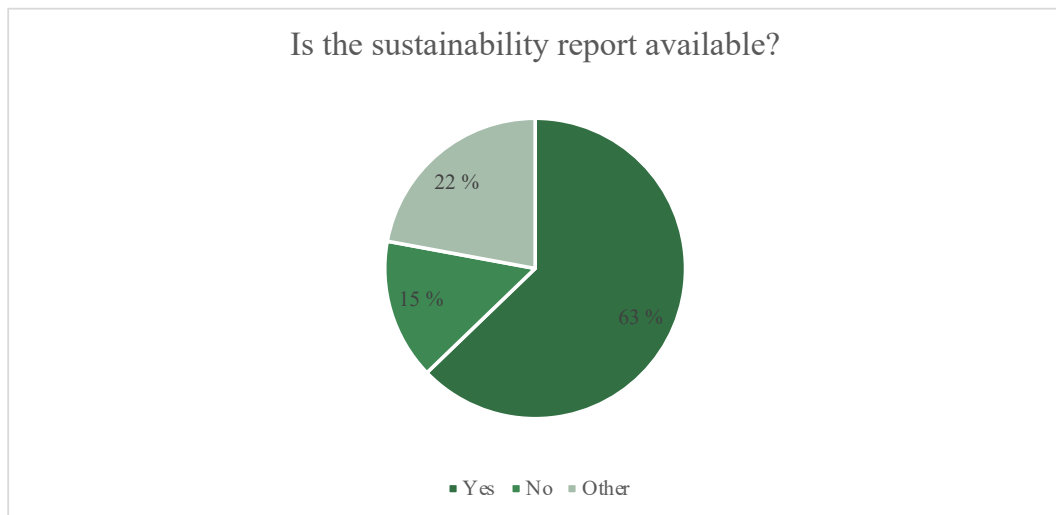


Figure 6: Availability of the sustainability report



Question five asked if suppliers have goals and plans to reduce carbon dioxide emissions. The answers to the question were asked in an open-ended manner, and very varied answers

were received. One supplier replied that according to the plans, the operation should be carbon-negative by the end of 2025. Another supplier's operations have already been carbon neutral since 2020. The goal of carbon neutrality came up in many answers, and this was planned for, for example, 2025, 2030, 2035, 2040, or 2050. The answers show that the date of realization of the carbon neutrality goal is significantly closer for some than others.

It was seen from the suppliers' answers that the management of carbon dioxide emissions is also considered by scope. For example, one company said it was already carbon neutral at the scope 2 level, and another said that the goal for scope 3 was to be carbon neutral by 2035. This means that the companies have explored their emission sources in detail and separated from them the factors that they can influence on a faster schedule. Most of the suppliers' answers said they aimed to reduce emissions and reach carbon neutrality. However, in the survey, it was reported that not all suppliers have targets or plans in terms of emissions. Although not everyone had goals for reducing carbon dioxide emissions, there were also answers about, for example, reducing the use of waste and energy and using alternative packaging materials. Almost all the answers showed that the respondents were familiar with emissions management and that suppliers have the will to improve their operations in this area.

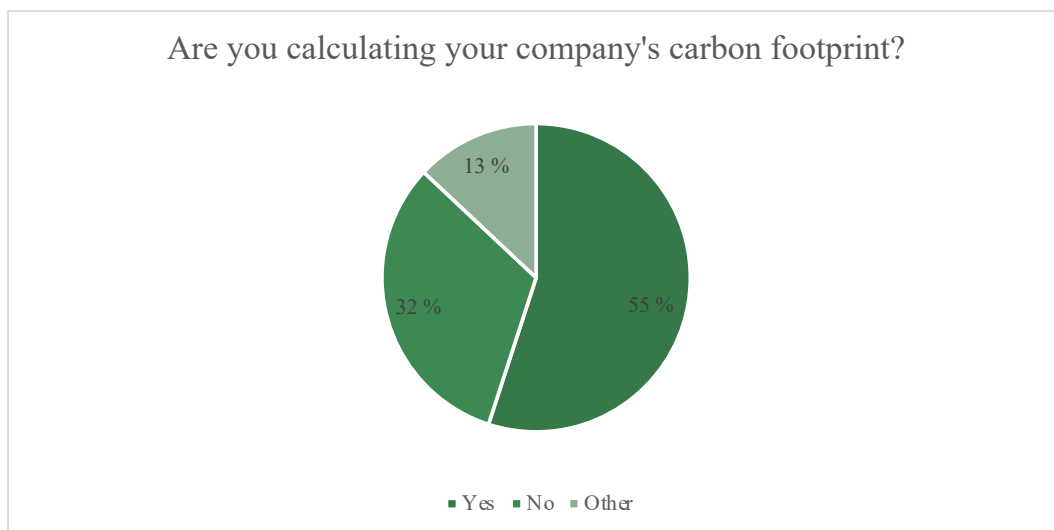
Question six asked about suppliers' most significant emission sources and their identification of them. Due to the differences in the industries of the suppliers, the answers were very different, but a few can be identified that are repeated in many answers. Emissions were said to come from energy, heating, real estate, transport, cars, travel, production, and scope 3 emission sources. The answers to this question also indicated that the largest emission sources had been identified in many companies and that most of them were emissions belonging to the scope 1 and scope 2 categories.

The seventh question asked whether stakeholders, such as suppliers and subcontractors, are required to set emission reduction targets. This question divided the suppliers into two categories: about half answered that they do not require reduction targets, and half answered that they require, or it is planned. Some suppliers mentioned that the targets are a selection

basis in supplier tenders, and some, for example, work closely with subcontractors to minimize emissions. Suppliers are also presented with requirements for reducing emissions in the supplier evaluations.

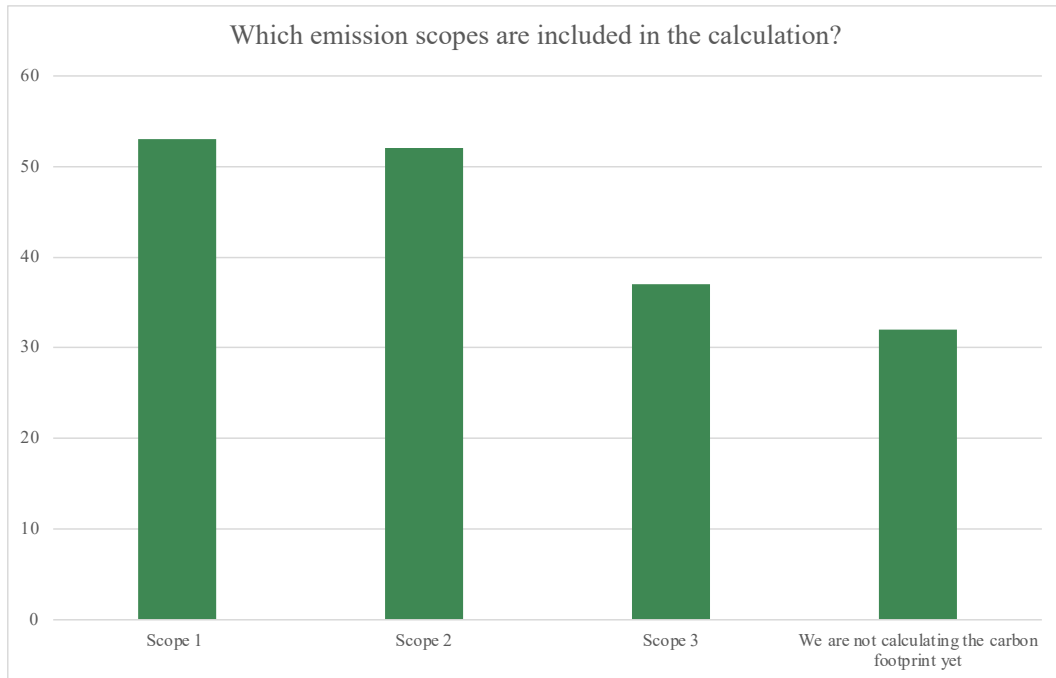
The eighth question asked if the supplier does a carbon dioxide emission calculation. As an answer, the respondent could choose yes, no, or other options. The figure below shows that a little more than half of the suppliers who answered are calculating their carbon footprint. The other option was chosen, for example, by suppliers where the calculation is done at the group level, is in progress, or is coming in the following year.

Figure 7: carbon footprint calculation



Question nine asked in more detail which emission categories are included in the carbon footprint calculation. Based on the survey, suppliers have calculated more scope 1 and 2 emissions and less scope 3 emissions, as shown below. The reason for this may be that accurate emission data is not yet available for the entire supply chain or the calculation method has not yet been decided.

Figure 8: Which emission scopes are included in the calculation.



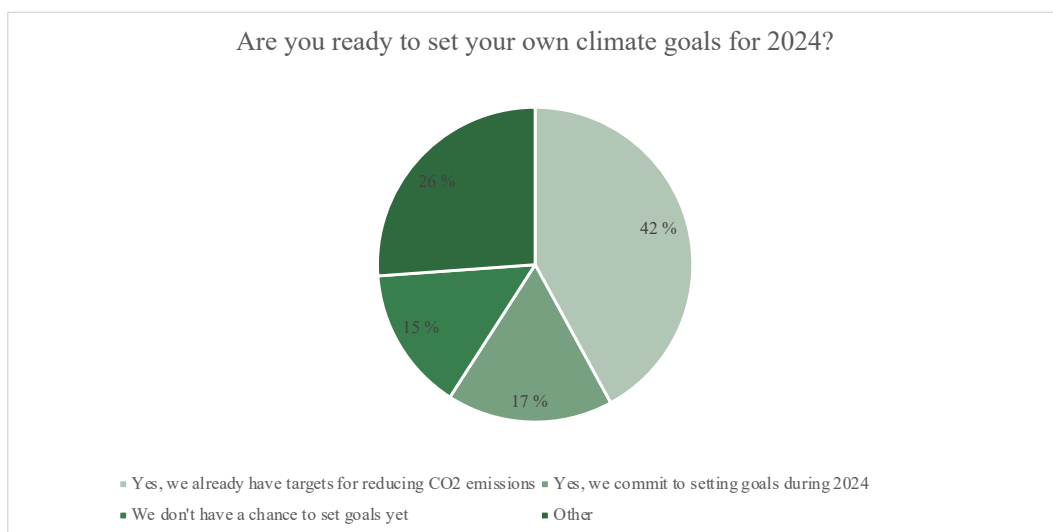
In the survey, suppliers were asked whether they also report these emissions to stakeholders. Some of the suppliers who calculate emissions also report them to stakeholders. Some said they would report the information when requested. Here, there were differences in activity between the companies. Suppliers either generally report emissions in their reports or actively communicate with their stakeholders about emissions and how they have been reduced. However, from the customer's point of view, the reporting of emission data would be helpful, as it would then be possible for the customer to monitor the development of emissions and compare suppliers' emissions with each other.

36% of the suppliers who responded to the survey calculated carbon dioxide emissions per product, and 41% did not. This calculation was only available for some suppliers who did the calculation (55%). This means that Mehiläinen cannot accurately calculate its scope 3 emissions using these numbers but must use estimates from the numbers. According to the survey, fewer suppliers had completely carbon-neutral products. In some industries, for example, travel is entirely carbon neutral. At this stage, the carbon-neutral products are

compensated according to the answers to the survey. Compensations can also be purchased from suppliers to add a certain percentage to the price for emission compensation. Several suppliers had plans for carbon-neutral products. Few suppliers were committed to the SBTi, and emission compensation is not allowed according to it.

The suppliers were asked in question 16 whether they are ready to set climate goals during 2024 to support Mehiläinen's scope 3 emission reduction work. Only 15% of the suppliers expressed that they could not set climate goals for next year, and the rest either already had climate goals or committed to 2024. The reasons for this of the suppliers who answered negatively varied. The small companies justified their operations as so small that there is no possibility for such goals due to a lack of resources and know-how. Retailers also have challenges reducing emissions, as their products come from the manufacturers and the share of scope 3 emissions is high. In such cases, however, their suppliers and logistics partners can be asked to consider the climate and pay particular attention to their own supply chain. According to the responses, the high price of electric cars still affects the reduction of logistics emissions.

Figure 9: Setting climate goals for the year 2024



The environmental survey provided superficial information on how Mehiläinen's most significant suppliers are committed to reducing emissions. The survey showed that most suppliers are environmentally aware and that the work to reduce carbon dioxide emissions is still beginning for many. Based on the answers, many suppliers have goals for better emission management in the near future. Not everyone is yet familiar with the emissions calculation because it has not been required, but as the legislation tightens, the situation will undoubtedly change for these suppliers as well. The interviews delve deeper into what kind of collaboration Mehiläinen has with its suppliers to reduce emissions and how it can be further developed.

5.2 Interviews

This paragraph presents the results obtained from the interviews. All findings described in the paragraph are based on conducted interviews. The interviews provide a real-life description of how to reduce carbon dioxide emissions in supplier communities from both the supplier's and Mehiläinen's perspectives. The findings are presented in the paragraphs in the order of the interview themes presented to the suppliers. The exact questions of the interviews are attached.

5.2.1 Collaboration

Initially, the interviews aimed to understand the suppliers' current cooperation with Mehiläinen and how they experienced it. The levels of depth of collaboration and its length varied between the suppliers, but all cooperated actively with Mehiläinen's procurement. The interviewed suppliers deliver very different products and services to Mehiläinen; because of this, the amount and style of collaboration differ. The interviewed companies supply, for example, laundry services, work clothes, food, IT supplies, medical supplies, office supplies, and logistics services.

The collaboration length is one essential factor in the depth of cooperation between the supplier and Mehiläinen because, after a long experience, the suppliers have a broader

knowledge of Mehiläinen's operations and needs. Supplier A has, among other things, cooperated with Mehiläinen for almost 20 years and supplier C throughout the 2000s. Supplier E has just started cooperation with Mehiläinen after being chosen in the request for quotation, but as the procurement category is relevant, it requires deep cooperation from both parties. The other interviewed suppliers had several years of experience working with Mehiläinen. The cooperation may also have been interrupted and continued later with the same partner. From the long cooperation relationships, it can be concluded that Mehiläinen strives for long-term cooperation with its suppliers. With the suppliers in question, the operation has been able to work for both parties and for this reason has continued for a long time.

The suppliers were asked in the interview to identify the benefits they achieved from the collaboration. The interviewees' perception of the collaboration was positive, even though not everyone who participated in the interview actively participated in the daily cooperation. The business benefits were mentioned in several interviews, as Mehiläinen, as a significant customer, increases the suppliers' turnover and operations. In the benefits, it was also mentioned that Mehiläinen benefits from joint work, as it can be offered competitive prices for products and services. Supplier C, with whom there has been close collaboration throughout the 2000s, mentioned that it has been helpful for them in the cooperation that they have been able to predict their production according to Mehiläinen's growth. It has therefore been possible to improve the predictability of production through close cooperation and communication about growth. Supplier D expressed that Mehiläinen is a demanding customer, and the requirements set by Mehiläinen have promoted their processes and operations. Supplier E said they can hardly identify the benefits due to the short collaboration. However, they would like Mehiläinen to increase their customer understanding, i.e., understanding of what customers want, expect, and need, for example, from an environmental sustainability perspective. Supplier F said that the cooperation was instructive for both parties.

The collaboration has also been found to be beneficial from the point of view of sustainability. Mehiläinen does a lot of evaluations of suppliers and tries to discuss with

suppliers about sustainability, which according to interviews, has put pressure on operations. The message that environmental issues are important to the customer pushes suppliers to take more action. Suppliers who are very advanced in sustainability also find these evaluations necessary because, with them, they can verify their sustainability and focus on what customers expect. Deep cooperation has, for example, increased the use of more environmentally friendly logistics and the production of emission data at supplier A. Suppliers D and F said in interviews that Mehiläinen has had a very positive effect on their sustainability because it has pushed them to demand the same from their own suppliers.

"The message we get from you now which things are important, we will pass them on to the manufacturers."

According to Mehiläinen's procurement team, Mehiläinen has a defined meeting agenda for meetings, where sustainability issues are a key part. The suppliers mentioned in the interviews that the sustainability themes often come up in meetings. In general, there are meetings with the most prominent suppliers at least quarterly, with some it can be more often. For example, supplier D meets with Mehiläinen's procurement specialist monthly, and supplier C about 4–5 times a year. Meetings are also held directly related to sustainability. However, supplier D expressed in the interview that they could also organize meetings related to sustainability more often and reflect on development targets in more depth. Supplier B occasionally meets with Mehiläinen regarding sustainability, but there are no regular meetings. Supplier F meets with Mehiläinen's support function every week, but a meeting with environmental issues on the agenda has not been held. Environmental issues are discussed in the weekly meetings, and according to the interviewee, they aim to optimize transportation, among other things. From this, it can be concluded that those suppliers who do not cooperate continuously with the procurement team do not necessarily regularly discuss the progress of supply chain responsibility in their follow-up meetings. Suppliers with follow-up meetings, specifically with procurement, are constantly going through sustainability.

The procurement professionals of Mehiläinen were interviewed to get a view of the cooperation from another aspect. All interviewees are responsible for supplier cooperation for their own categories, and their job description includes, for example, strategic category management, tendering categories, negotiating contracts, and updating product catalogs. From Mehiläinen's side, the cooperation is generally seen as good, as the suppliers are helpful, knowledgeable, and active. Answers from the suppliers are often good regarding the products, and they are also happy to answer sustainability issues.

According to procurement professionals, the level of cooperation varies greatly depending on the supplier's size and the procurement contract's value. The most important suppliers are met more often and can even be in daily contact with them. Development meetings are held with suppliers so that cooperation and processes serve Mehiläinen's needs as well as possible. Positive and negative issues, such as complaints, are discussed in the development meetings. There is not so much strategic cooperation with smaller suppliers, but we work with them on a case-by-case basis. With all suppliers, this is unnecessary and depends a little on the procurement category and the category manager. Mehiläinen has many suppliers; for this reason, there are many suppliers in some of the categories with whom procurement professionals would also like to cooperate more closely. There are not necessarily resources for this. However, most of the interviewed suppliers were met by Mehiläinen's procurement team several times per year. There were also significant suppliers whom other support functions meet more often. However, attention has already been paid to this in procurement team.

According to Mehiläinen, the good aspects of the collaboration were the self-direction of the suppliers and the fact that it usually does not require a lot of investigative work from the procurement professional. Suppliers actively communicate with the procurement team about issues and often suggest process improvements. In one interview, it became clear that openness has been fruitful in suppliers' associations, and it has been possible to discuss even tricky issues. This is how things have been fixed. Service providers are often service-oriented and respond quickly to inquiries. According to the interviewees, the positive thing about small suppliers is that they act quickly and can, for example, do urgent things with a phone

call. All these aspects are essential for Mehiläinen. From the answers, it can be concluded that cooperation with suppliers is very beneficial both on an operational and a strategic level. The conversation with them is open, making it easier to solve challenges. The positive aspects of collaboration vary by supplier and are affected by, for example, the company's size, industry, and contact person.

Challenges were also identified in supplier collaborations. For example, cooperation with multinational, remotely controlled companies can be challenging, and they do not respond to the need in a sufficient time frame. One interviewee said there are challenges here if, for example, price errors occur. Customer service and its speed have also been a challenge for some companies, although, in general, these are no problem with suppliers. In addition, in challenging times such as during the COVID-19 pandemic, Mehiläinen would have desired a more partner-style approach from its suppliers. In challenging situations, the hope would be to meet and solve the situations together as partners, not just as a customer and a supplier. On the other hand, during COVID-19 some suppliers operated in a partner style. A collaborative procedure would be necessary, especially in challenging times. Suppliers should also pay attention to the speed of the service and respond to their customers in problem situations.

5.3.2 State of sustainability

In this paragraph, the results obtained from the interviews, which were related to the general sustainability of suppliers, are analyzed. In addition, it will be explained how sustainability in Mehiläinen's procurement is reflected in procurement operations.

It was evident in the interviews with all the companies that sustainability plays an important role and that they are ready to make efforts to advance. Supplier A said that in the wholesale industry, they want to increase transparent sustainability activities across the company by producing verified data on sustainability for customers. Supplier C said that sustainability is one of their values and has been part of their strategy for a long time, as their operations are based on the circular economy. Supplier D said that sustainability is fundamental to them

and that it has its own strategy. The answers were very close to each other, highlighting that sustainability is an increasingly popular theme in companies' operations. Many of the companies strive to be pioneers in their industry with the help of their sustainability. For example, supplier B said they are pioneers in the Nordic countries and have the most ambitious goals in their industry.

Almost every supplier has different working groups at different organizational levels for sustainability. Supplier E has an existing sustainability unit and, in addition, a sustainability team, and their goal is also to introduce sustainability issues to the rest of the organization. This way, everyone has their own sustainability goals on their desks. Supplier A has a working group for sustainability, including an external consultant. Supplier B also has local and organizational sustainability working groups. The sustainability of the supply chain is considered particularly important, as there is a lot of outsourcing in the industry in Finland. Supplier F was the only one who did not have an actual working group to promote sustainability. Still, sustainability issues are discussed in the executive team several times a year. The size of the interviewed companies influenced whether working groups have been established and how extensively they deal with sustainability. In larger companies with operations in many countries, there were broader sustainability working groups at the group and local levels. There were no working groups in smaller companies, such as supplier F, and supplier A has one working group for sustainability.

The sustainability of the supply chain plays a central role in the sustainability of the interviewed companies. Suppliers demand sustainability requirements from their suppliers before being selected for the supplier base. Supplier C said they have a precise sieve to become a supplier. The Supplier Code of Conduct is an essential tool that suppliers and Mehiläinen use to ensure that suppliers follow their ethical practices. Supplier C said sustainability emphasized the importance of creating long-term, confidential relationships that promote development activities in supplier collaboration. They meet with suppliers regularly at different organizational levels and think strategically about their operations from now on. For example, where the suppliers see themselves in five years.

"We firmly believe that it is much easier to develop a supplier's activities with familiar suppliers with whom a relationship of trust has been created. In general, in this kind of development activity, it is essential to speak openly."

Supplier E also said that they require suppliers to sign the Supplier Code of Conduct and, in addition, specific certificates from risky countries to verify their sustainability. However, the sustainability of the supply chain was a challenging topic, as a few suppliers felt that they could not influence their suppliers' activities. Through the sustainability of logistics and order cycles, smaller suppliers tried to influence the supply chain's sustainability, but the products' emissions were more challenging.

Signing the supplier Code of Conduct often came up in interviews as a measure of supply chain sustainability. Only two interviews did not mention the Supplier Code of Conduct as a measure of supply chain sustainability. In addition, a few interviewed suppliers conduct audits for their suppliers. Suppliers who have their brands and those in the range of others did audits only for their factories. Other metrics mentioned in the interviews were supplier evaluations, scoring of suppliers according to sustainability in the tendering process and the number of suppliers who joined SBTi. There were significant differences between the suppliers in measuring the supply chain, which suppliers with working groups for sustainability better handled. However, attention was paid to the sustainability of the supply chain of all companies and its various parts, and efforts were made to measure and monitor it. Only supplier F did not say in the interview that they audit or measure the sustainability of their suppliers. However, they have a strict supplier selection process.

According to Mehiläinen, consideration of sustainability in procurement work has grown tremendously in recent years. It plays a significant role in daily work. For example, in the ESG audits performed for suppliers, suppliers' sustainability is carefully reviewed for different topics. In addition, supplier evaluations and the tendering process also extensively ask questions related to sustainability. The team has its own person responsible for the quality and sustainability of procurement, but everyone's job description also includes considering sustainability issues in collaboration with the supplier.

Even before the collaboration with the supplier begins, the fundamental sustainability issues are asked in product category requests of quotations, such as how sustainability is comprehensively ensured in the supplier's operations. Sustainability is emphasized when choosing a supplier, but in addition to that, other things, such as total costs, also affect the whole. According to the interviewees, it is not the main criterion for supplier selection, but it still plays a significant role in tendering and supplier selection. The interviews showed that, so far, no clear limit has been set in the selection process as to how much sustainability is emphasized. A supplier whose sustainability issues are not in order cannot be chosen because of this. Those suppliers whose sustainability is at an advanced level do not necessarily get added value if the price is high compared to others. This can impact what kind of opportunity suppliers have, for example, to make an accurate calculation of emissions or measures to reduce them.

In connection with the conclusion of the procurement contract, the suppliers sign the Supplier Code of Conduct prepared by Mehiläinen, which contains the operating conditions. Signing the Code of Conduct is mandatory for every supplier. The percentage of how many suppliers have signed it is one of Mehiläinen's measures of procurement sustainability. Implementation of the Code of Conduct is monitored at a general level.

Sustainability issues often come up in supplier meetings. According to procurement team members, sustainability is discussed with suppliers every time in meetings, although for some suppliers, this is still "in the shoes of a child." According to all interviewed procurement professionals, the importance of sustainability in cooperation meetings has increased. Environmental issues are considered in collaboration by discussing and improving, for example, order cycles and centralizing purchases to suppliers, in which logistics causes fewer emissions. The resources of the smallest suppliers are often focused on concrete activities instead of sustainability.

"Not all suppliers have opportunities for the kind of sustainability that Mehiläinen might expect at the moment. Together with them, we are trying to build sustainability on the supplier side."

As can be seen from the interviewee's comment above, suppliers are not necessarily rejected due to lack of sustainability, but certain sustainability requirements must be met in order to become a selected supplier. Mehiläinen strives to increase suppliers' awareness through, for example, climate surveys and audits, which also creates pressure for suppliers to meet Mehiläinen's sustainability requirements.

5.3.3 Carbon dioxide emissions in the supply chain

In order to get to the main topic of the research, i.e., reducing emissions in collaboration with suppliers, it is necessary to examine the suppliers' current management of emissions. In the interview, the suppliers were asked about their current emissions calculation and what data is currently available. It would be to Mehiläinen's advantage if suppliers could produce accurate emission data on purchased products, but almost all suppliers still have it in the initial stages. This paragraph focuses on interview questions related to carbon dioxide emissions in the supply chain.

According to interviews, many suppliers' primary motive for emissions is that they want the earth to continue to be a habitable place for future generations and slow global warming. The motives for reducing emissions are, therefore, not only business-related. Supplier A added that they strive to produce added value for customers when they recognize their position in reducing emissions and then start taking measures for it. Supplier E says that their activities can influence their customers' solutions as a significant player, reducing emissions. In addition, they want to be at the forefront of environmental issues in their industry, in which case customers also commit to a service provider who can find more information on environmental issues.

The sources of emissions have been mapped in the companies, but the most excellent knowledge was about the emissions resulting from their own operations, i.e., scope 1 and scope 2. As already seen from the environmental survey results, most suppliers have mapped

more scope 1 and 2 emissions than scope 3. This may be influenced by the fact that they do not still get emission data from their supply chain. Supplier A mentioned that the harsh fact is that emission data is not yet available from everyone, and the suppliers cannot yet be judged simply because of their sustainability. They have calculated scope 1 and scope 2, and scope 3 is next on the agenda. The emissions of the supply chain have, therefore, not been mapped. Supplier F said that they have not yet mapped the emissions of their supply chain but aim to work towards this issue in 2024. Supplier C has started mapping the emissions of his supply chain after joining the SBTi and noticed that a significant part of their suppliers does not know their own carbon dioxide emissions. Supplier B has calculated its supply chain emissions and publishes public reports on these. Supplier D has also mapped its supply chain emissions and joined the SBTi.

The company's size correlates to the emissions calculation, as smaller companies had not yet mapped the supply chain emissions. Still, the largest ones had more detailed knowledge of the emissions for example, they may know about the scope 3 emissions in more detail. In addition, larger companies had more precise goals and means to manage the emissions of their supply chains because there are more resources for procurement as the number of personnel is greater. In addition, the calculation of emissions can already be more advanced at larger companies, as the EU's stricter legislation requires large companies to calculate emissions in the future.

The operating methods for reducing emissions in the supply chain vary by industry, as wholesalers and, for example, service providers and logistics have very different sources of emissions. Supplier D said they aim to have two-thirds of their suppliers join the SBTi. Supplier C had also considered something similar and started discussions with their suppliers over the past year. Supplier A mentioned that using compensation as a method and with tender requirements affects its supplier base. Supplier F actively talks with its suppliers and tries to use them to communicate the need for its customers to reduce emissions. Supplier E strives to reduce, among other things, the amount of wastage and influence their customers' choices so that they are as low-emission as possible. However, scope 1 and 2 measures were also mentioned in the interviews, even though the question was about supply chain

emissions. This may indicate suppliers still primarily focus on their emissions instead of the supply chain.

When suppliers were asked what kind of goals, they have for reducing emissions in the supply chain, i.e. scope 3, the answers partly went to scope 1 and 2. Their own transport equipment is being replaced with electric vehicles and those that use biofuel, and efforts are being made to save energy with LED lamps. Although these actions reduce the company's own emissions, these answers did not answer the question about the supply chain. Supplier F said that they try to influence the emissions of their supply chain by choosing as many sustainable partners as possible in the competition. However, they expressed that they cannot require suppliers to commit to emissions reduction requirements, as their suppliers are large multinational companies. Supplier D mentioned that their goal is to change the product range so that by 2026, 90% of the products will be sustainable. To achieve this, partners who consider emissions and the recyclability of products and packaging in their operations are selected. In addition, sustainability goals have been set for procurement for operational activities such as optimizing orders and which countries products are ordered from. Supplier C approaches the reduction of emissions from the perspective of supplier collaboration. Together with their suppliers, they strive to find solutions. According to them, emissions arise from many small streams from which a large entity is created, and the aim is to find solutions for these in logistics, materials, and energy use. Supplier A aims to produce data for its customers and, through this, control emissions management in the supply chain.

There was also a clear dispersion in the production of emissions data by suppliers. The most advanced emission data was obtained in wholesale operations by evaluating emissions. For example, supplier D considers, among other things, the product's manufacturing material and the country where the product is manufactured in the calculation. Although a completely accurate number cannot yet be provided, according to them, this is a reasonable estimate of the product's emissions during its life cycle. By 2026, the supplier aims to have the emissions of its brand products, and suppliers are seeking to join this development. Supplier F also produces emission data for its customers in the customer portal, where the emissions of all products are calculated by product category. This can help customers choose ingredients

with lower emissions. Supplier C calculates emission data for the products and services sold according to the average. The calculation is based on the value of the purchased products. However, in the future, the supplier's purpose is also to get more detailed data on product-specific emissions.

Regarding logistics operations, the emissions assessment is the furthest along. Supplier B is already able to produce emissions calculations for Mehiläinen, which are published on the customer portal. Emissions are obtained from how the vehicle has been on the road and its entire life cycle. In this way, Mehiläinen can monitor exactly how the emissions have developed.

Emission data from product changes is not yet available from any supplier interviewed. However, companies are heading in this direction. Supplier C said that he can produce emission data on changes in product quantities. Supplier B can also see these changes from the customer portal if they are made. Supplier E cannot obtain data on product changes within the same category, as emissions are calculated by product category. For example, if the brand to another is changed, the product emissions will not change. With wholesalers, the calculation is obtained from a marginal batch of products, which is impossible on a large scale. The product-specific calculation is still at an undeveloped level at this point. However, for Mehiläinen, this kind of data would be excellent because it would allow it to make small changes within product categories that, in the big picture, would reduce its carbon footprint.

Suppliers had varying attitudes towards emission compensation. Some were vehemently opposed to compensation; one supplier compensated all their services automatically with no additional cost, and two offered compensations for an additional fee. One supplier considered the possibility of compensation but said that not enough is known about it yet and said they were monitoring the situation. Suppliers against compensation justified this by saying there is insufficient information or certainty about the compensation model. These suppliers also perceived the compensation as greenwashing.

"We are not committed to any specific emission compensation model, because we do not yet know the best possible model. On the other hand, we don't want that when we hate greenwashing, and we don't want it to seem like we're doing something that isn't real."

"We approach compensation quite critically, or in fact very critically, because in a certain way I see it as greenwashing."

Supplier B compensates its service automatically, so it is not an additional customer service. Supplier A compensates its scope 1 and 2 emissions and offers compensation for specific products for a fee. They strive to get rid of compensation because they are also aware that compensation is not a sustainable way to reduce emissions. Ultimately carbon-neutral products that would not have been compensated are not yet available from any supplier who participated in the interview. According to supplier C, they are possible in their industry, but they do not exist yet. However, emission compensations are not a sustainable way to reduce emissions in the long term because they do not make fundamental changes to the supply chain. For this reason, suppliers who take concrete actions in addition to emission compensation can progress in reducing emissions in their operations, and those who compensate for everything without making actual changes may not develop.

Emissions reduction measures were generally perceived as an expense item. New operating models, investments, and renewal of transport equipment cause additional costs. Not all customers are yet ready to pay more for more sustainable products and services, but suppliers hope that customers will be more ready to pay some of these costs in the future. Supplier F said that emission measures have not been a significant expenditure item for them, and the economic aspect of reducing emissions has not guided their activities. Although, at this stage, the measures cause costs, the change was also seen as a positive side. Supplier E thought these measures may be required in the future, and taxation may be increased if emissions management is not in order. Supplier C also looked at the actions critically and said that sustainability cannot be seen only as an expense item. They said they need to balance additional costs and reduce emissions and think where the line is that it makes sense to take on additional costs. Supplier C believes that customer demands are increasing, and investing in sustainability is worthwhile.

"Sustainability cannot be seen only as an expense item. Because if you looked at it like that, no one would do anything, and we would be heading straight for the destruction of the Earth. But of course, we also have to be able to discuss it with customers, where is the limit of what customers and end customers are willing to pay."

The EU emissions regulation was a familiar topic to the interviewees. Tightening regulation is seen to add more work, but on the other hand, it is a positive thing in increasing transparency. The interviewee of supplier C said in the interview that the regulation gives a sense of excitement and the feeling that rational decisions are finally being made regarding the future. Although regulation poses its challenges, it is seen as an excellent opportunity. The European Union's emissions regulation will legally affect supplier C in 2025, but the supplier already does them before they become mandatory. Supplier D expressed that regulation affects their customers the most. For this reason, they will have more reporting requirements, which creates pressure. Large suppliers had already reacted to this regulation change more than smaller ones.

Reducing emissions in the supply chain has been challenging for suppliers. However, apparent differences could be seen between the industries in the challenges. Supplier E said that the challenge has been costs and investment payback times because there are no unlimited resources. Supplier C said there have been challenges in reducing emissions because the supplier has a vast network of suppliers in the supply chain. The interviewee says that large operators in Finland and the EU are generally aware of reducing greenhouse emissions, but outside the EU, small operators may not understand the issue. Since the supply base is enormous, supplier C has decided to start with the biggest emitters. According to them, ABC thinking works in emissions, i.e., 80% of emissions are caused by 20% of suppliers. They would hope that the understanding of emissions in the entire supply chain would increase yearly. Supplier D said in the interview that the biggest challenge in terms of emissions is scope 3 emissions, which is caused by suppliers' pressure to reduce emissions. Supplier B said the global challenges that have occurred in recent years, such as COVID-19 and the war in Ukraine, because the price of diesel has risen sharply. This has partly affected investment opportunities as well. The state has supported companies to invest

in electric delivery vans, which has, on the other hand, made things easier. Only supplier F expressed that there have been no challenges in reducing emissions. Suppliers have tried to approach the challenges positively and to think that the changes made will be rewarded in the future and are meaningful for customers and environment.

5.3.4 Reducing emissions with collaboration

As in the quantity and quality of the collaboration between the suppliers and Mehiläinen, there are also differences between the suppliers in the collaboration aimed at reducing emissions. Not all the companies that participated in the interview cooperated with Mehiläinen to promote emissions reduction, even if the cooperation was otherwise close. For example, supplier F meets Mehiläinen weekly, but these issues have not been considered. This is because the supplier cooperates more deeply with Mehiläinen's other support function than procurement. The hope would be that the issues would be included in the discussion in these meetings. The interviews also included suppliers with whom reducing emissions is part of ongoing collaboration. Due to the short cooperation, supplier E has not yet had time to collaborate on this topic. Still, the purpose would be to also discuss with Mehiläinen product choices, transport optimization, and the development of reporting. Supplier D said that they do not collaborate to reduce emissions with Mehiläinen much and said that they could do much more. The interviewee said that they could influence ordering behavior and total emissions. They saw this as a good development target for cooperation because such projects have been implemented with other customers, and those projects have been fruitful. Supplier C said that collaboration to reduce emissions is done in regular meetings, with ESG audits, delivery of emission data, and minimizing excess products. According to them, this does not differ from the activities carried out with other important partners. Supplier A also actively cooperates and, in addition to these other issues, has organized customer events to increase awareness of emissions.

"Environmental issues are at the center of our company's operations so the matter will be discussed at every meeting. During the past year, we have organized two client events with an environmental theme, in both of which Mehiläinen was represented."

"The cornerstones of our strategic partnership are the development of operations on both sides in a more environmentally friendly direction, e.g., by measuring the order frequency of branches."

Collaboration between supplier and customer that reduces emissions is generally seen as beneficial. The suppliers expressed that collaboration with customers has in many ways brought perspectives and ways to reduce emissions. For example, audits can raise development ideas in operations or alternatively validate companies' sustainability. Supplier B saw the collaboration as beneficial with customers, as it allows costs to be shared and positive marketing communication about these activities for both parties. On the other hand, supplier E said that the changes they offer, such as logistics, do not have a big impact, because the share of logistics in the product's emissions is so small. For suppliers, the answers depend on what kind of collaboration they have with Mehiläinen, and how they can identify the benefits it generates. Those whose sustainability is more advanced may not benefit as much from, for example, benchmarking as those companies whose sustainability is not so advanced yet.

In terms of collaboration, the suppliers would like to increase the reciprocity. Communication helps suppliers understand their customers better and thus meet their wishes. In addition, the interviews included pilot models of new projects in which Mehiläinen could be involved. Supplier D would like to develop collaboration specifically in terms of environmental sustainability and reducing emissions and sees the healthcare industry as interesting, as the requirements are higher than the average industry. One concrete development point of cooperation came up in the interview with supplier B when they suggested that Mehiläinen could promote the use of electric vehicles by adding fast charging points for transport vans. These charging points could be in big units like hospitals where vehicles could be charged between drives. For Mehiläinen, these could be positive developments in increasing marketing communication and general sustainability. If suppliers have upcoming pilot projects, Mehiläinen could be at the forefront as a significant customer, helping the development of sustainability in its partner companies.

The interviewed companies had widely different concrete collaboration methods for their suppliers, and they varied. What they all had in common, however, were collaboration meetings and a general discussion with suppliers about emissions. Supplier B is doing projects with its suppliers, the purpose of which is to reduce emissions. Among other things, they are about to start an electrical grid project, possibly in the near future. In addition to that, clauses mentioning measures to reduce emissions are changed in the contracts. In addition, joint communication is carried out with partners and partner days are held on the subject. Supplier C is creating a reward system for its suppliers and a working group that will concretely consider what further actions could be taken. Supplier D evaluates operational activities with its suppliers continuously and meets with all its suppliers regularly.

Table 3: Collaboration methods to reduce carbon dioxide emissions

Practices	Example
Supplier auditing	ESG audits, where the focus is also on the environment and emissions
Supplier evaluations	Annual assessment of suppliers in order to clarify the situation of the emission management and address challenges
Meetings	Regular meetings with suppliers to discuss about emission management and benchmark operations
Training	Training of customers and suppliers in emissions management. For example, partner days where sustainability is on the agenda
Joint projects	Pilot projects with suppliers or customers that test new methods to reduce emissions.
Contract clauses	A clause is added to the contracts that obligates the supplier to reduce its emissions during the contract period
Open communication	Discussion of the topic daily also in operational activities, discussion of challenges
Reward systems	Rewarding suppliers for reducing emissions. For example, the supplier of the year award.
Joint planning	Order optimization, long-term plans and their concrete implementation

The role of the customer is important for suppliers because as mentioned earlier, large customers can cause pressure to reduce emissions in the supply chain. In this case, the customer can be used as a lever for own suppliers. Ordering the right number of products and avoiding wastage are also good ways. Supplier C mentioned that although usually the conversations are between sales and procurement, in her experience, the conversation

between procurements is very fruitful and gives a massive amount of power to continue development. Sharing information is important because this way partners can benchmark their activities and develop them further.

"In my opinion, this kind of "just keep these things to yourself" is no longer any sensible strategy. In other words, the more transparent we can be, the better."

Mehiläinen's supplier evaluations have had tangible benefits for suppliers. With the logistics reform implemented with supplier A, considerable changes were achieved quickly. Within the comparison period of the month, emissions from logistics had dropped by 90.78%. Mehiläinen's audit played a significant role in this, as it helped the supplier speed up the introduction of biofuel. Suppliers B and C have responded to several supplier evaluations and environmental surveys prepared by the company's customers, and they see evaluations as interesting from the point of view of seeing a trend in what customers demand. Supplier D also gets a lot of tips for their own evaluations from Mehiläinen and learns from evaluations and surveys. In 2022, supplier D was audited, and, in this context, they received tips from Mehiläinen to improve, among other things, the traceability of their supply chain. Supplier F answered the 2022 Mehiläinen environmental survey, and it caused them to commit to reducing their emissions during 2024. So, the push for this improvement came from Mehiläinen. The suppliers' answers showed that Mehiläinen has greatly influenced their operations to be more sustainable.

Collaborative meetings have the same benefits as evaluations. They often deal with sustainability issues, and questions and wishes may come to light, which the supplier can then take forward. Supplier E feels that meetings have not yet played a role in reducing emissions at this stage of the collaboration because the cooperation has only been done for a short time. In the future, however, reporting can be done in meetings, and its development is favorable in reducing emissions. Supplier B has not attended many cooperation meetings where emission reduction was the topic but thinks that discussing this aspect in cooperation meetings is also helpful if the customer is interested. The fact that the interviewee has not participated in cooperation meetings where emissions reduction has been discussed may be

influenced by the fact that he has not been a contact person from the supplier's side in the meetings. The job description of all the interviewees did not necessarily include customer meetings with Mehiläinen. This may have impacted the answers because they do not necessarily have information about which topics have been discussed in the meetings.

According to Mehiläinen's procurement professionals, emissions reduction efforts with suppliers have increased within about a year. Mehiläinen has considerably increased its environmental sustainability in procurement, and, for example, clauses regarding emissions have been added to tenders and procurement contracts. The team's investigation tasks regarding emissions have also increased recently, and now each person in the procurement team goes through emission matters and possible product changes with their own suppliers. During the last two years, Mehiläinen has conducted ESG audits for its suppliers. Through this, it has tried to increase the awareness of its suppliers and show that sustainability is important to Mehiläinen.

In Mehiläinen's interviews, procurement professionals were asked whether they had noticed a difference in suppliers' emissions reduction work by industry. According to one interviewee, she has not seen significant differences between suppliers in different industries, except that in some industries, it is easier to identify emissions and develop measures for them. For example, she took maintenance services, which do not necessarily identify sources of emissions other than transportation. Transportation is often seen as a significant source of emissions for suppliers. She also said that she notices more supplier-specific differences than industry-specific differences. According to another interviewee, reducing emissions is greatly influenced by the supplier's industry because, for example, it is not yet possible to offer carbon-free compensated products for medical supplies, while logistics is more advanced. As for medical supplies, the price is also significantly higher for carbon-free products. This category is essentially affected by the single-use nature of the products and the more precise legislation of the products due to patient safety. The third interviewee said she doesn't notice much difference between industries in her procurement categories. However, she said that she knows these exist in other industries.

"The internal goals of the procurements are, among other things, reducing the carbon footprint. If there are alternative carbon-neutral products, we try to prefer them, if possible, in terms of costs, quality, and product safety."

The suppliers' own desire and active cooperation have a positive effect on reducing emissions. For example, suppliers may contact procurement when they have new carbon-free products, because they know that Mehiläinen is interested in it. According to the interviewees, the costs prevent the reduction of emissions for the time being, because we are still living in a transition period. However, this situation is seen to change in the future, as more and more people buy and demand carbon neutral products from suppliers.

Mehiläinen's actions to reduce emissions were very close to what was revealed in interviews with its suppliers. Mehiläinen conducts audits in which it scores suppliers according to their sustainability in each area. In addition, it evaluates its most important suppliers annually. Mehiläinen has added a clause to its contracts with which it ensures the control of suppliers' emissions. The company actively tries to discuss emissions with its suppliers in strategic and operational activities. However, it did not appear in the interviews that Mehiläinen would do pilot projects with its suppliers or reward its suppliers.

In the interviews conducted for Mehiläinen's procurement, they were asked what drivers and barriers they see in reducing suppliers' emissions. The size of the Mehiläinen was seen as a big contributing factor. Mehiläinen is such a significant player in Finland that it has power over suppliers. If Mehiläinen gives a request related to sustainability, the suppliers take it seriously. Another contributing factor is that Mehiläinen has a sustainability policy and sustainability goals. Emissions have been studied carefully, and because of that, they know which procurement categories should be invested in. Mehiläinen's cars were mentioned as an example of this. On the personal level, the promoting factor is that the team has clear instructions, and everyone knows what emission reduction measures are required. According to the interviewees, surveys related to emissions calculation and interest in managing suppliers' affairs also promote emissions reduction.

"In the request of quotations, already when choosing a supplier, you can influence emissions when you choose suppliers for the supplier network who are interested and have the resources to promote these issues."

A few barriers were also mentioned. Calculating and reducing emissions is a new topic for suppliers that they do not necessarily have the resources or expertise to calculate and reduce them. According to the interviewees, it is easier in some categories, such as logistics, but at the product level it is still challenging at the moment. However, the interviewees believe the situation may be completely different in a few years. In addition, the challenge of reducing comes with higher costs in responsible products. To this end, they would like an orientation on how much sustainability can be emphasized over prices.

Table 4: Drivers and barriers for reducing emissions from the customer's point of view

DRIVERS	BARRIERS
Big size of the company, power	Suppliers' resources and expertise
Clear sustainability policy and goals	Industry
Evaluation of suppliers with e.g. audits	Costs
Supplier engagement	
Knowledge about own scope 3 emission sources	

Certain suppliers are very committed to reducing emissions. Smaller ones don't have the resources for this, even if they want to. In addition, there are still a few suppliers who do not want to do this. According to the interviewees, suppliers' commitment to reducing emissions also varies from supplier to supplier. It is not a priority for smaller suppliers, while larger suppliers have the opportunity to invest more. Many suppliers have good sustainability reports highlighting ESG goals and work well in sustainability. On the other hand, many have room for improvement. One interviewee said the most significant contract suppliers are committed to reducing emissions. She says their promotion of such things is good business for them. If the cooperation goes well, there are better conditions for continuing the cooperation, for example, in tendering situations. The partners have understood that

investing in these things is worth it. Engagement with other than large suppliers varies, but as a rule, they are committed or plan to do something about things in the near future.

6. Discussion and conclusions

This research aimed to discover what opportunities supply chain collaboration has to reduce carbon dioxide emissions in the supply chain. In addition, the research strived to discuss different concrete collaboration methods that can be used to reduce emissions. This chapter presents the findings of the empirical part of the study and compares them to the theory presented at the beginning of the study. This chapter aims to answer the research questions and present proposals to the case company Mehiläinen based on the research and give suggestions for future research. The research questions are reviewed so that the study's main research question is the last.

6.1 Answers to the research questions

Sub: What are the elements of supplier collaboration?

In the theory part of the study, it was mentioned that according to Cao and Zhang (2011), the elements of supplier collaboration are information sharing, goal congruence, decision synchronization, incentive alignment, resource sharing, collaborative communication, and joint knowledge creation. According to the article, these correlate with each other and change. The results of the interviews also support this theory, as elements were mentioned indirectly in the responses related to collaboration, even though these were not directly asked of the interviewees.

This study's interviews showed that these elements also connect to reducing CO₂ emissions in the supply chain. When the elements of collaboration are effectively included in the cooperation between supplier and buyer aimed at the sustainable development of companies,

they can also effectively reduce their emissions. When the customer aims to reduce its emissions, it also must demand this from its suppliers. In this way, the supplier and the customer have a common goal, for which they must, for example, share information, communicate, share resources, and possibly apply incentives to achieve this goal. In this way, the elements of collaboration are also visible in promoting the green supply chain and are closely connected. This chain of events also happened at Mehiläinen and the interviewed suppliers. Not all elements of the collaboration are equally visible in the partnership but differ from supplier to supplier. For example, physical resources are not necessarily shared in all partnerships. The elements can therefore be said to depend on the level and nature of the business between supplier and customer. However, by properly utilizing the elements of collaboration, the company can have positive effects on its environmental sustainability and emissions management.

Sub: What kind of functions in supplier collaboration are the drivers and the barriers to reducing carbon dioxide emissions?

According to Cloutier et al. (2020), seven factors drive forward green supply management. According to the article, the promoting factors are relationship management, joint practices, technological and information-sharing practices, contractual and economic practices, governance practices, assessment practices, and supply chain design. Interviewed procurement professionals said that for Mehiläinen, the drivers are its clear sustainability policies, the power of a large customer, evaluation of suppliers, engagement of suppliers, and knowledge of its own emission sources. Only one of these, the assessment of suppliers, was the same collaborative method as in the article. However, all of these drivers came up in the interviews, although they were not directly in response as a driver for greener supply chain management. This was the customer's point of view about the drivers to reducing emissions in general, not just from a collaboration point of view. In addition to this, the procurement professionals interviewed identified several concrete means that promote emissions management. However, the suppliers' interviews also indirectly mentioned these drivers in the theory, which aimed to promote emission control.

The suppliers and Mehiläinen are doing actively relationship management, such as meetings where emissions management is discussed. Sustainability is discussed in every meeting, but the depth of this can vary depending on the level of the suppliers. In this way, Mehiläinen also gets information about the suppliers' sustainability level and can include possible development targets in the discussion. In addition, the suppliers said that some of them train their own suppliers and hold partner days where environmental sustainability is on the agenda. This is not what Mehiläinen said it does, but training suppliers could also be effective for smaller suppliers whose knowledge of emissions is still at a rudimentary level. Training is not necessarily required with larger suppliers, but benchmarking and discussion between purchases could drive operations forward. In addition, an active discussion on the topic can bring up-to-date information from different fields.

As Lee (2011) mentioned in the journal, when the emission sources are identified, they can be controlled, and efforts can be made to minimize the emissions. Considering the carbon footprint in supply chain management helps improve awareness of serious emission sources. Mehiläinen therefore benefits from the data shared about emissions because it gets concrete information on what it should focus on. For this reason, technological and information-sharing processes are good drivers for promoting sustainability as Cloutier et al. (2020) article mentioned. Some suppliers utilized technological and information-sharing platforms in the form of customer portals. Customer portals received data on purchases and the carbon dioxide emissions they produced. Some suppliers were ahead in this, i.e., for logistics, for example, data was already obtained from individual transports. For some suppliers, this data was estimated by product category or with another similar calculation system. From the customer's point of view, it would be most optimal if the suppliers received accurate emission data for each product or service, so Mehiläinen could make choices by considering the product's emissions in addition to the price. However, as the emissions calculation is in the initial phase, this is not possible, but the issue could be developed as the calculation progresses. Not all suppliers have this model available yet, but the most advanced emission counters produce this data. According to the environmental survey, only 45% of the suppliers who did a calculation had one available. As a customer, Mehiläinen could request this calculation from those suppliers who have not yet provided it to their customers. In addition,

customer portals could be developed with strategic suppliers, where emissions could be monitored more closely.

The EU's new CRSD directive is seen as a contributing factor both in the literature and in this study. The directive that will come into effect for companies next has a wide impact on the calculation of companies' emissions. The directive is seen to have a particular effect on harmonizing sustainability and emission reporting between companies. According to this study, companies consider it a particularly good thing that they will have concrete requirements for reporting emissions. This is also seen as a factor promoting supplier collaboration, as companies must obtain emissions information from their value chain. The directive's enforcement can push companies to discuss and cooperate more closely to create information. In the following years, legislation changes can be a special promoting factor for deepening green supply chain collaboration.

Contractual and financial collaboration methods are Li et al. (2019) are practical, as they act as incentive systems for reducing emissions. The article mentioned cost-sharing contracts and revenue-sharing contracts. The suppliers wished share-out of costs because reducing emissions substantially increases their expenses. This could, therefore, also contribute to strategic suppliers' progress in the emissions management case of Mehiläinen. Revenue-sharing agreements were not mentioned in any of the interviews, so such agreements are not necessarily that common yet, as emission control currently causes even more costs than profit. According to Cao & Zhang's (2011) definition of collaboration, partners should share risks and resources, so according to this definition, the customer should also meet financially to reduce emissions in cooperation with the supplier.

In this study, assessment practices emerged as a special contributing factor, evaluation methods, because they had brought about concrete changes that could be identified. For example, the supplier audit resulted in greener logistics for the supplier and significantly reduced logistics emissions. The environmental survey had influenced the supplier, so it had decided to commit to setting climate goals for the year 2024. The evaluation practices are therefore effective in promoting the reduction of emissions. The advantage comes from for

example, surveys can be sent to many suppliers at once. Also in this way, the customer shows an interest in sustainability and creates pressure to improve the questions asked. In addition, as a customer, Mehiläinen receives up-to-date information from suppliers and knows how to address potential challenges related to supply chain sustainability and emissions management.

Supply chain planning was mentioned as a final driver by Cloutier et al. (2020). Although, according to the research, it was the least mentioned driver in the journals, it has a decisive effect on the control of emissions. Namely, when the customer competes for a product category, it can set requirements for its partner. The supplier can, for example, be obliged to carry out environmental actions in the tendering process and thus demand a reduction of emissions in a possible partnership when choosing a partner. Mehiläinen already ensures sustainability from its suppliers when competing in product categories. For it to get its scope 3 emissions lower, it could already be in the category tendering phase to ensure that the partner has made progress in emissions management and is ready to cooperate in this regard in the future. The location of suppliers is also important, as product transport increases the amount of emissions. That is, when choosing partners who produce the products nearby, it is possible to reduce the product's emissions. However, Mehiläinen has units all over Finland, so delivery distances can be long. In addition, with operations in other countries as well, Mehiläinen strives to purchase its products from local countries instead of the entire group having, for example, the same supplier in a product category.

Common practices, i.e., planning, for example, were less identified in the interviews, so Mehiläinen could develop them in cooperation with its suppliers. The suppliers are indeed guided to make changes to reduce emissions, but according to the interviews, there was very little planning to implement these changes and achieve the goals. Planning was done for, among other things, production volumes, but this was not mentioned in terms of emissions management. Planning could be a good way to show interest in the direction of strategic partners that cause major emissions. However, it can be very time-consuming, so for this reason, Mehiläinen should also focus on the ABC model mentioned in the interview, i.e., focus on the biggest suppliers. The evaluation methods, on the other hand, are also suitable for smaller suppliers as they don't take as much time. This activity is also supported by the

correct segmentation of suppliers mentioned in theory, which Barratt (2004) presented in his article.

Therefore, this study can also be supported by the drivers according to Cloutier et al (2020). Mehiläinen has made extensive use of the drivers mentioned in the theory, but it could also consider the mentioned development targets to promote the environmental sustainability of its supply chains even further. Although it effectively contributes to the reduction of emissions right now, it is necessary to keep up with the development in the future as well.

In theory, the barriers were costs, barriers within the industry, and poor engagement from suppliers. Similar issues were also mentioned by Mehiläinen procurement professionals. The costs were the first thing that came up in the interviews. Currently, it costs more to produce products with lower emissions, as the production needs, among other things, ecological manufacturing, and more ecological raw materials. Although, according to the theory, cost minimization is one of the most essential issues in procurement (Chopra, 2018, 20), at this stage companies must also think about the future and support suppliers in reducing emissions. The suppliers' wish would be that the customers would be willing to share these costs. In terms of costs, the customer must weigh how much it is willing to pay for more sustainable products and whether it wants to support its suppliers in more sustainable operations. Compensations are also included in the interviews, as some suppliers can offer emission-compensated products at an additional price. This is up to the customer to decide on what basis they want to make purchasing decisions. As Mehiläinen commits to the SBT initiative, the possibility of utilizing its compensations is limited. This is why companies collaborate to reduce emissions instead of compensating them.

In the interviews, the obstacles within the industry were practically formed by the fact that the suppliers' own suppliers were not yet able to produce emission data, or, for example, the technology was not yet developed enough in terms of transport equipment. Some of the suppliers have very long supply chains, which makes it challenging to map all emissions from the entire chain, and therefore also challenging to reduce them. Therefore, not all suppliers have equal opportunities to take reduction measures. Mehiläinen could map these

obstacles by industry with its suppliers and think about the opportunities to influence them. This could also be connected to the category strategy of the product categories.

The poor engagement of suppliers was named as the third barrier in reducing emissions both in theory and in interviews. According to the environmental survey, 15% of the suppliers who answered were not ready to set environmental goals for 2024. For some suppliers, this is due to a lack of resources and expertise. Mehiläinen could already consider when tendering the product categories that it chooses suppliers who have the will and know-how to manage emissions. If there are no suppliers in the industry whose sustainability and emission management is advanced, it could be to support these suppliers to act. Poor commitment may still be common at this stage, as the legislation on calculating emissions does not yet apply to everyone, but at some point, the situation may change.

Since collaboration is also significantly affected by the buyer company's knowledge of sustainability, it is necessary to invest in the sustainability knowledge of the procurement staff. According to Yu et al. (2017) article, it plays a significant role in the greenness of the supply chain, and for this reason, according to the article, it has been proposed to reward and train procurement staff about the sustainability. If the procurement staff is not competent in matters of green supply chain management, it can also act as an obstacle to reducing emissions. Mehiläinen has actively trained its procurement staff. It also has to keep up with trend, as knowledge about sustainability and emissions is constantly evolving as requirements increase. Mehiläinen could develop various incentives for its procurement personnel and encourage them to study the matter more. In this way, the staff's knowledge of sustainability and emissions management is also transferred to the suppliers and thus reduces the emissions of the entire supply chain.

Although there are barriers to reducing emissions, the drivers drive past them numerically. So, companies have many ways to promote emissions management in collaboration, and it is possible to overcome obstacles. For example, according to interviewed companies, costs will certainly decrease as technology develops, and according to Lintukangas et al. (2016) costs can also be reduced when more sustainable decisions are made. In addition, there are

many good ways to engage suppliers, and the customer can also choose a supplier who is committed to active emissions management.

What concrete practices are for reducing carbon dioxide emissions through collaboration?

According to the theory part, the concrete practices of the collaboration were based on Cloutier et al. (2020) mentioned drivers. There were many practices, and companies used them in different ways to manage emissions in their supply chain. As summarized in Table 3, the suppliers mentioned many practices that can concretely influence emissions reduction. Some could use multiple table practices for their suppliers, and some used only discussions and meetings.

In this research companies ' practices aimed at reducing emissions were: ESG audits, supplier evaluation, meetings, training, joint projects, contract clauses, open communication, rewarding suppliers, and joint planning. According to the interviews, Mehiläinen used audits, evaluations, meetings, contract clauses, and communication. According to the interviews, few suppliers did all of these, but the practices differed to the company's resources. It is not necessarily appropriate to use all methods for every supplier, but they must be evaluated on a case-by-case basis. For example, it is not necessarily necessary to audit smaller suppliers, but an assessment may be sufficient. However, the practices mentioned by the suppliers could also contain methods that Mehiläinen could include in its own supply chain management. For example, joint planning with suppliers could be useful in the long run.

The difference to the theory is that in interviews the suppliers mention that they also use the Supplier code of conduct to oblige suppliers to reduce emissions. On the other hand, the code of conduct can also be a part of the contract, in which case it could be read in the factors promoting the contract and economic practices. The supplier code of conduct can also be a good practice in reducing emissions if it mentions that the supplier must commit to reducing emissions. However, practice must also be considered in this case, and one should not rely

on this happening. The case company and most interviewed suppliers use the Supplier Code of Conduct to verify their sustainability. When the suppliers sign it, they assure that they are acting sustainably.

In addition, sustainability clauses have been added to the contracts. This concrete method was used in a minor part of the interviews and may not be used so much in the contracts yet. However, this could also be used in the case company. The same factors promoting environmental sustainability included financial practices such as cost, profit sharing, and rewards. The interviews revealed that the suppliers' wish would be to pass on the costs to the customers as well, and a lot must be balanced with whether it makes sense financially to do something sustainable. Mehiläinen's interviews also revealed that no explicit limit exists on how much more can be paid for sustainability. This can be an inhibiting factor, even if you want to increase environmental sustainability in the product range. In the interviews, there was also no discussion about rewarding suppliers; only one company had considered doing this in the future.

Main: How can buyer-supplier collaboration reduce the company's carbon dioxide emissions?

This study also supports the theory that collaboration between the supplier and the buyer can influence the company's scope 3 carbon dioxide emissions. The business relationship between the buyer and the supplier is affected by several things and thus also their emissions management. With effective emissions management together with its suppliers, the sustainability of the entire supply chain can be improved and thus have a positive effect on the carrying capacity of the environment.

However, by committing suppliers to emissions management, the purchasing company can have its own emissions reduced. Studies found engagement a vital part of companies' sustainable development progress (Lintukangas et al. 2022). Large customers have more power to influence the activities of their suppliers (Marttinen & Kähkönen 2022) and for this

reason, they can also demand better emissions management. This was also stated in this study, as suppliers appreciate Mehiläinen's wishes for sustainability and implement them when large customers demand. However, in case of Mehiläinen, industry presents a challenge, because as Walker et al. (2008) research stated, in healthcare, the products preferred by healthcare professionals became an obstacle to product changes and patient safety plays a big role in the industry. Also, because of the small suppliers, it can be more difficult to focus on the large suppliers. As a major supplier, Mehiläinen has the opportunity to comprehensively influence the sustainability of its industry by requiring suppliers to reduce emissions.

With long-term cooperation, where many elements of collaboration have been utilized, companies can learn from each other about emissions management and develop their operations together. In the next few years, the tightening legislation will pressure companies to reduce their emissions, allowing concrete changes to be made to their operations. However, the work to reduce emissions in the supply chain is only at the beginning. Now, the most important thing is to make suppliers aware of emissions in the supply chain, discuss measurement and cooperation practices, and develop collaboration with strategic suppliers. Concrete plans to reduce emissions can already be made with the most advanced suppliers. Still, since suppliers are at a different level, it is important to approach them according to their level.

6.2 Suggestions for further research

Although this study went through the management of emissions in the supply chain with the help of supplier collaboration quite in-depth, there was still a need for further research. This study dealt with supply chain emissions management only from the healthcare perspective, which can limit other possible means of influence outside of it. Therefore, not all the results of the study would necessarily be the same in other industries. In addition, many large companies, whose sustainability is advanced, participated in the study. It would be interesting to study how the emissions of a smaller company could be influenced with similar means. For example, could it be the case that it would not be possible for the buyer company

to demand similar actions from its suppliers as in this study. Or how it is possible to influence smaller suppliers who do not have expertise in terms of sustainability with the collaboration methods in question.

In addition, the research was conducted at a time when emissions management is in the initial stages in many companies. In the future study how the situation has developed as legislation and know-how have changed could be done. How would the current collaboration methods have affected the amount of emissions in the supply chains. Would it even then be possible to influence the situation just as effectively with these means or will there perhaps be some new opportunities to influence emissions in supply chains in the future.

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APPENDICES

Appendix 1. Interview questions for suppliers:

General questions:

1. Which company do you work for, and what is your role?
2. What things are you responsible for?
3. Company size and turnover?

Collaboration with Mehiläinen

1. How do you collaborate and perceive the cooperation with Mehiläinen procurement?
2. How long has the cooperation been?
3. What kind of benefits have you achieved from the cooperation?
4. How often do you and Mehiläinen meet regarding environmental issues?
5. Do you believe that cooperation has a positive effect on your responsibility?

Sustainability

1. What role does sustainability play in your company?
2. Is there a working group for the promotion of sustainability?
3. How important is the promotion of sustainability in your supply chain?
4. How is sustainability reflected in your supplier selection and how is it measured?

Carbon dioxide emissions in the supply chain in general

5. Have you mapped the emissions in your supply chain and if you have, how do you work to reduce them?
6. Have you calculated the carbon footprint of the products you sell? Any plans for this?
7. Can you produce an analysis/calculation for Mehiläinen about the effect of product changes on the carbon footprint?
8. Do you offer an emission compensation option for your products?
9. Can you produce carbon-neutral products/services in your industry? Any plans for this?
10. What are your main motivations for reducing carbon dioxide emissions in supply chains?
11. What kind of goals do you have for reducing the emissions of your supply chains and what measures have you planned to implement them?
12. How do you feel about reducing the carbon footprint from a business perspective? Is it, for example, an expense item? How do you think things will change in the future?
13. How does the tightening regulation of emissions calculation affect you?
14. Have you had any challenges in reducing carbon dioxide emissions in your supply chain or in your own operations?

Reducing emissions in collaboration

15. What kind of cooperation do you currently have with Mehiläinen to promote the reduction of carbon dioxide emissions? Does it differ from cooperation with other customers/suppliers?
16. Do you see cooperation methods as applicable in emission reduction measures?
17. Would you like to develop cooperation in some way?
18. What kind of cooperation methods do you use with your own suppliers to reduce emissions?
19. How do you feel that Mehiläinen, as a customer, could promote emissions reduction in your supply chains through collaboration?
20. Has any of Mehiläinen's supplier evaluations, such as audits, annual supplier evaluations, or environmental surveys, developed your carbon dioxide emission reduction work? If so, in what way?
21. Have the cooperation meetings developed your work to reduce carbon dioxide emissions?
22. What did you think of the interview? Additional comments?

Appendix 2: Interviews for Mehiläinen's procurement team:

General

1. What is your position in the company?
2. What things are you responsible for?

Sustainability

3. What role does sustainability play in your job?
4. How is sustainability reflected in supplier selection?

5. How is sustainability reflected in supplier collaboration?
6. Do you have sustainability procurement strategy? If so, how does it consider the reduction of emissions?

Collaboration

7. How do you feel about collaboration with suppliers?
8. How close do you think the collaboration is?
9. What are the good things, and what are the targets for development in the collaboration?
10. How are environmental issues considered in supplier collaboration?

Reducing carbon dioxide emissions in supplier collaboration

11. Have supplier collaboration activities related to reducing carbon dioxide emissions increased? If they are, how?
12. Do you notice industry-specific differences in reducing emissions with different suppliers? If you notice, what kind?
13. Which issues in your supplier associations promote the reduction of emissions?
14. What things prevent it?
15. What kind of collaboration practices do you have with suppliers to ensure emissions reduction?
16. How well do you think suppliers are committed to reducing emissions?
17. Comments about the interview?