Implementing sustainability in the supply chain for Small and Medium-Sized Enterprises: Green supply chain challenges in the German assembly industry

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Abstract

Private individuals and the government have long since ceased to be the sole focus for ensuring a more responsible and sustainable society. Large companies are increasingly being held accountable to contribute and those who want to evade this can expect tremendous social pressure and consequently, there is an expanding body of research. However, there are still significant gaps regarding implementation for SMEs. Using a qualitative research method with eight semi-structured expert interviews from the German assembly industry and including existing literature, this research investigated the barriers SMEs face when implementing sustainability in their supply chain and the opportunities SMEs have to promote sustainability through their suppliers. In light of barriers to implementing sustainability, the thesis revealed that too high costs, too much effort, a lack of quality, and a lack of knowledge are the main internal barriers for SMEs, and regulations, social pressure, and dependencies on other companies as external barriers. In order to have an impact on other suppliers through the SMEs' supply chain, SMEs are mainly limited in their size and associated purchase volumes. They can only have a limited impact through knowledge sharing and explicit selection of sustainable suppliers.

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Resumo

Pessoas individuais e o governo há muito que deixaram de ser os únicos responsáveis por uma sociedade mais responsável e sustentável. As grandes empresas são cada vez mais obrigadas a contribuir e, consequentemente, existe um corpo de investigação em expansão.

No entanto, existem ainda grandes lacunas no que respeita à implementação nas PME. Utilizando um método de investigação qualitativo com 8 entrevistas semi-estruturadas a peritos da indústria de montagem alemã e com a inclusão da literatura existente, esta investigação investigou as barreiras que as PME enfrentam quando implementam iniciativas de sustentabilidade na sua cadeia de fornecimento e as oportunidades que as PME têm para promover a sustentabilidade através dos seus fornecedores. À luz das barreiras à implementação da sustentabilidade, a tese revelou que os custos demasiado elevados, o esforço excessivo, a falta de qualidade e a falta de conhecimento são as principais barreiras internas para as PME, e a regulamentação, a pressão social e as dependências de outras empresas são as barreiras externas. A fim de ter um impacto sobre outros fornecedores através da cadeia de abastecimento das PME, estas estão principalmente limitadas pela sua dimensão e apenassó podem ter um impacto limitado através da partilha de conhecimentos e da selecção explícita de fornecedores sustentáveis.

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Título: Implementação da sustentabilidade na cadeia de abastecimento das Pequenas e Médias Empresas: Desafios da cadeia de abastecimento verde na indústria de montagem alemã

Palavras-chave: cadeia de abastecimento verde, indústria de montagem alemã, PME, barreiras, estratégia sustentável, implementação da sustentabilidade, consciencialização ambiental

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Glossary

SMEs	small and medium-sized enterprises
ENGOs	environmental non-governmental organization
PV	photovoltaic
GSCM	green supply chain management

1. Introduction

"There is no company whose business model won't be profoundly affected by the transition to a net zero economy" (Fink, BlackRock, 2021).

Companies can no longer ignore the issue of sustainability. The significance of climate change and the related need to protect the environment and resources have grown over the past few decades. Almost no company has not yet come into contact with this topic. In general, corporate social responsibility is now a strategic endeavour for businesses' long-term future rather than just a choice (Balsalobre-Lorente et al., 2018; Amaladoss & Manohar, 2011). Corporate social responsibility should no longer be seen as a separate link to the company, but the company must be linked to ethics and the associated sustainable responsibility (Freeman & Velamuri, 2006).

There is currently plenty of research on drivers and why corporate responsibility is becoming more critical (Lozano & Haartman, 2017; Tello & Yoon, 2008), as well as the barriers that prevent companies from doing so (Bux et al., 2020; Gupta et al., 2020). However, the literature often refers to large multinational corporations, and SMEs are only occasionally included in this context. Nevertheless, they play a decisive role, as they are responsible for almost 70% of industrial pollution in the environment (Purwandani & Michaud, 2021; Hillary, 2004). Even though there is a considerable body of research on SMEs and sustainability, more research should focus on the unique problems and situations that SMEs have to deal with. SMEs can be highly driven and committed. They can address many areas of CSR and sustainability in a different way than major corporations. Despite this, more research is necessary to fully understand the various techniques and strategies SMEs need to be able to implement them (Morsing & Perrini, 2009). Particularly in Germany, more research is needed on how SMEs in the assembly industry can implement sustainability into practice.

Regarding the German assembly industry, only the car manufacturers, which are typically quite large corporations, have conducted any research at all (Beske et al., 2008; Koplin et al., 2007). As a result, this research intends to shed more light on this, as SMEs can significantly impact metal and wood producers due to their extensive supply chains (Wagner et al., 2017). When discussing sustainability, it is almost inevitable to talk about the supply chain sooner or later. Since this area is particularly important for the assembly industry, the focus of this work will also be placed mainly on this. If the scope of sustainability for a company is considered, i.e., in which areas and how a company can work sustainably, then the value chain is a massive factor in this (Schulman et al., 2021; Huang et al., 2009), and due to the unique characteristics of the assembly industry, the gaping research should be filled there.

This paper will follow up on these aspects and explain the key barriers to implement sustainability into the supply chain of SMEs in the German assembly industry. Additionally, it will present how these companies can impact the suppliers within the supply chain themselves.

2. Literature Review

This chapter provides an overview of existing research in the field of sustainability in the German assembly industry. The literature review is divided into four sections: Sustainability for Small and Medium-Sized Enterprises, the German Assembly Industry, Green Supply Chain Management and external impacts on the implementation of sustainability of SMEs and presents the current status to provide a solid basis for understanding.

2.1. Sustainability for Small and Medium-Sized Enterprises

In the following section, sustainability for SMEs is explained and special features in Germany, as well as general characteristics, barriers and advantages, are mentioned.

2.1.1. SMEs in Germany

Small and Medium-Sized Enterprises make up the largest share of companies in Germany. More than 99% of all German companies belong to this group. Accordingly, they also provide a large part of the economic output and more than half of all jobs in Germany (Federal Ministry for Economic Affairs and Climate Action, 2023). Both family-owned and non-family-owned enterprises make up SMEs in Germany. Compared to other nations, German-based SMEs are renowned for having outstanding levels of innovation (Werner et al., 2018).

The definition varies between countries and international organisations. Basically, companies are classified according to two different criteria: amount of employees and annual turnover. Since 2005, the EU has classified companies according to various factors. In addition to small, medium, and large enterprises, it has also introduced the term micro-enterprises. Small enterprises are all companies that have between 10 and 49 employees, an annual turnover between € 2 million and € 10 million, or the same amount of the total annual balance sheet. If these amounts are exceeded, they are medium-sized enterprises. This applies to companies with up to 250 employees and an annual turnover of up to € 50 million or a total annual balance sheet of up to € 43 million (European Commission, 2008).

In Germany, the term "Mittelstand" is used for small and medium-sized enterprises. In addition to numerical factors, this also includes quantitative and qualitative factors (Günterberg &

Kayser, 2004). When individual managers or family-owned management actively participate in strategic decision-making processes and assume risk, Mittelstand firms can be viewed as independent and owned. Private wealth and business success are inextricably linked. This means that legal and sociocultural characteristics, rather than only the number of employees and the annual turnover, can characterise Mittelstand firms (Pahnke & Welter, 2019).
In the following work, the term and the associated criteria of the European Commission are used to classify the companies, as it is recognised throughout Europe and the legal aspects should be separate from the focus of this work.

2.1.2. Characteristics and barriers to promote sustainability

It is already known that large companies have to be more and more sustainable. However, whether SMEs already have a similar stand is questionable. Among other things, it can be assumed that these are particularly committed to responsible business at the local level to serve the community (Spence et al., 2003). SMEs need to be resilient to local crises and dynamic to take advantage of opportunities. Therefore, the well-being of the local environment is also essential for the companies. Accordingly, corporations place a high value on the welfare of the community, as well as a high focus on employee empowerment, to ensure a good reputation in the local community (Burch et al., 2022).
SMEs frequently supply larger businesses. Due to the rising demand and awareness, these businesses increasingly request that sustainable products are given. Businesses are thus urged to request sustainable materials for their supply chain (Stekelorum et al., 2020).
However, a significant problem with implementing more sustainable processes is that SMEs have not received as much attention in the literature as large enterprises. Thus, there is little data on the most effective ways to deal with them. While there is a lot of evidence from large multinational companies, whether this is compatible with SMEs' strategy and day-to-day business is often in doubt. The success of these companies depends on many different factors, which need to be integrated into the research designs (Hammann et al., 2009)
For SMEs to operate sustainably, they need to balance the financial, human, and material resources aspects with the social and environmental aspects. SMEs, in particular, have a problem with the financial aspect and the lack of time to achieve this balance. This prevents SMEs from seeing the sustainable aspect as a competitive advantage because of a lack of resources and financial security (Burlea-Schiopoiu & Mihai, 2019; Bergmann & Posch, 2018). The main problem with the financial aspect is that budgets are very limited and the introduction of more sustainable methods does not generate any direct financial output but entails high

capital costs and, in the short term, also discourages potential customers through increased prices. This discourages many smaller companies from doing so and prevents the possibility of introducing it in the first place, even if long-term success is suspected (Caldera et al., 2019).
Further financial barriers may still result from regulatory factors. Regulatory requirements are widely identified as one of the driving forces behind environmental management. However, it can be challenging for SMEs to keep up with evolving legislation and absorb the accompanying costs. The higher compliance costs limit SMEs' ability to finance proactive environmental management strategies (Ervin et al., 2012).

2.1.3. Advantages and impact of sustainable SMEs

As mentioned earlier, SMEs make up a large proportion of companies in Germany and can therefore have a significant impact on the environmental field. SMEs are responsible for more than 70% of the global pollution and thus play a key role in sustainable development (Caldera et al., 2018). Questionable, however, is whether the actions actually provide for a change or whether their actions merely help their image and are purely greenwashing. Nevertheless, SMEs are thought to have a more considerable influence per unit than big businesses. However, it is believed that SMEs, in particular, can have a significant influence and engage in relatively little "greenwashing" because these decisions are frequently made for the firm alone and are not widely publicised. Frequently, management's personal beliefs and intentions are the cause for action (Baden et al., 2009)
However, for SMEs to promote a sustainable business model, they must bring competitive advantages. Otherwise, only some will try to contribute resources to the development (Cantele & Zardini, 2018).
By adopting sustainable practices or collaborating with ENGOs, SMEs can reach out to new clientele and suppliers. ENGOs can help to support with their environmental, scientific and professional support to access resources they would not have accessed independently (Stekelorum et al., 2020).
The corporation may change the industry in which it competes if it adopts a sustainable business strategy. Efficiency may be improved, new marketing strategies can be developed, and new business models can be realised by creating new products and services (Masurel, 2007).
Costs may even be decreased with more cost-effective production in terms of energy use and material waste. In a time of energy shortage, conserving energy can go a long way toward saving money, as can cutting back on manufacturing waste (Chavan, 2005).

2.2. The German Assembly Industry

The assembly sector consists of companies that receive various components that have already been manufactured or materials that still have to be processed and then assembled into a finished product. This takes place in two different stages: the fabrication or machining stage and the assembly stage. The complexity and the number of machines can vastly differ (Komaki et al., 2019).

The 23.6% of the working population in Germany works in the manufacturing industry (bpb: Bundeszentrale für politische Bildung, 2020). In the automotive industry, which makes up a large part of the assembly sector in Germany, thousands of parts are purchased and processed (Meyr, 2004). These parts come from both direct and indirect suppliers. The supply networks in the assembly industry are typically lengthy and intricate. For the majority of small businesses, cutting expenses or raising quality is the standard (Bressler, 2012). This is especially crucial in the assembly sector because there is a lengthy supply chain and small in-house production of the products. Hence, this can be accelerated by switching suppliers, quality requirements, etc. Additionally, it's essential to internally minimise assembly overheads in order to cut expenditures (Wagner et al., 2017). The work steps in the assembly industry are often distributed team-wise and often, the individual work steps are very standardised, which allows comparisons of the system to enable continuous improvement (Doellgast, 2007). In comparison to other industries, the assembly industry is particularly committed to using lean production as a strategy, i.e., avoiding product waste while at the same time improving quality (Glass et al., 2016).

2.3. Green Supply Chain Management (GSCM)

A definition of green supply chain management is more or less impossible, as there are dozens of different approaches to a precise definition in the literature (Fahimnia et al., 2015). Initially, the sustainability factor was still separate from the rest of the business. However, this has changed due to the increasing interest of the companies because it is no longer only about being environmentally friendly but also about higher profits and securing long-term growth (Fink, BlackRock, 2018).

Green supply chain management tries to use green design in the supply chain. This describes the design of a product under specific environmental standards, among other things, by extending the product life cycle into the overall closed-loop system, the gathering of raw materials, as well as steps taken after a product has served its purpose and before it is disassembled, remanufactured, or scrapped (Srivastava, 2007; Hunke & Prause, 2014). There

are various possibilities for green purchasing. The most typical ones include requiring an environmental management system of the supplier, defining environmentally undesirable attributes that the product must not contain, defining desirable green attributes that the product must have, and establishing the buyer's environmental compliance standards that must be adhered to (Hamner, 2006). In this way, a competitive advantage can also be achieved under the environmental aspect to save resources, minimise waste, and thus improve productivity (Porter & Linde, 1995). In this situation, one of the main issues is the performance measurement. The ability to do so could determine the company's long-term sustainability and competitiveness in the future. There are internal and external causes that can be distinguished. The internal ones are explained by better management, which leads to successful operations. They are primarily motivated by cost and profit and work to reduce waste streams, disposal expenses, and surplus from non-recycling efforts. External stakeholders, market pressure, or competition are the driving forces behind the external causes. The different industries may have quite different pressures. (Hervani & Helms, 2005). Thus, this research will find out how the pressure is for the assembly industry.

Large and Thomsen identified five potential performance drivers for the German green supply chain management: Green supply management capabilities, the strategic level of the purchasing department, the level of environmental awareness, the level of green supplier evaluation, and the level of green collaboration with suppliers. The findings of this study demonstrate that environmentally solid performance can also have a favourable impact on general purchasing performance when these drivers are taken into consideration (Large & Thomsen, 2011).

2.4. External impact

The sustainability of a company's supply chain depends not only on its management. Several stakeholders, including the media, investors, and notably the government, have an impact on this (Nazari & Irene M. Herremans, 2015). Thus, the following will describe how the government and external impacts can influence the sustainable development of businesses. Germany is not only an exceptional legalised market but mainly consists of a regulated structure, with a social market economy with a clear stakeholder focus (Nuber et al., 2020). The exchange of knowledge can be of great importance for the own company as well as for suppliers and partners in order to successfully develop sustainable strategies (Kavali et al., 2021). The problem is that companies with a lot of knowledge are often unwilling to share their ideas and technologies for fear of losing their advantage, and, on the other hand, smaller companies are concerned that they will then become too dependent. SMEs, in particular, tend to have less

bargaining power, which is why there is a greater risk that they will become too dependent or have to give away too many critical strategic details in exchange. Therefore, they prefer to retain knowledge-intensive activities for themselves (Mukherjee et al., 2013).

The European Commission has already made significant changes. Large corporations and all-listed companies will be required to explain what they see as risks and possibilities emerging from social and environmental issues, as well as the influence they can have on them, beginning in 2023 or the fiscal year 2024. However, only companies with public interest and 500 or more employees are included, as well as all-listed companies. This means that SMEs in the assembly business are exempt from the law and will not be harmed by it (European Commission, 2023). Germany has adopted the directive of the EU directly into German law as it was proposed. However, the concepts developed by the EU are difficult to apply to SMEs. SMEs cannot afford the conditions required/needed for the bureaucratic effort. As a result, transferring these concepts to SMEs is problematic (Bergmann & Posch, 2018).

Apart from non-financial reporting, there are several laws/regulations that also affect SMEs. Among others, there are: the German packaging law, which aims to reduce waste and plastic production (Susan Livingstone, 1994), the "Supply Chain Act" for the protection of human rights from 2021 or the German Resource Efficiency Program, which aims to reduce the use of resources and the associated environmental impact, but this depends heavily on voluntary measures and incentives (Die Bundesregierung, 2023).

3. Methodology

The following chapter describes the methodology used to answer the research questions of this thesis. First, the research questions are explained. Second, the research design is introduced. Lastly, the data collection is presented.

3.1. Research question

Research question 1	Research question 2
What are the key barriers that Small and Medium-Sized Enterprises (SMEs) in the German Assembly Industry face when implementing green supply chain practices?	How vigorously can medium-sized businesses encourage sustainability among small businesses throughout their supply chains?

Table 1 – Research questions

As demonstrated by the literature review, there is a wide range of knowledge about sustainability in the supply chain and among German SMEs. However, much of the literature focuses solely on the importance of making sustainability a core strategy for the company, with little attention paid to the unique circumstances that smaller businesses face, making it difficult to implement sustainable business practices. There is little to no evidence of this in the assembly industry in particular.

As a result, this research will identify just that with research question 1 (table 1). It will be analysed what is preventing SMEs in the assembly industry from implementing green supply chain practices. As stated in the literature review, 99% of all companies in Germany are SMEs, yet the emphasis is primarily on large enterprises, which are already more developed. However, it is debatable whether this is due to a lack of understanding and awareness of the importance of green supply chain practices for the company's future development or whether it is due to the presence of barriers that make this impossible.

The second research question is concerned with suppliers. The supply chain is the focus of this work, and many businesses first consider sustainability in terms of their own production and what they can do directly. The majority of the time, the process around suppliers produces more greenhouse gas emissions and negative environmental impacts than their own operations do on land, water, biodiversity, and geological resources (McKinsey Sustainability, 2016). Therefore, this research question investigates how suppliers can be influenced to achieve a fully green supply chain. Through their power, larger multinational corporations can significantly influence smaller suppliers in their supply chain in terms of sustainable production (Villena & Gioia, 2020). However, whether this is also possible for medium-sized businesses will be discussed.

3.2. Research design

The underlying research employed an exploratory research design. It was conducted following the advice of Eisenhardt (1989) and Yin (2009), following the example of numerous researchers investigating the sustainability in the Manufacturing industry for German SMEs (Sohns et al., 2023; Johanna Klewitz, 2012).

To answer the research questions, a qualitative approach with expert interviews to get primary data will be used. A qualitative method is best suited to the research design because it deals with very specific and subjective assessments of interviewees. Furthermore, it is about German SMEs in the assembly industry, where knowledge in the literature, as well as general population

knowledge, is insufficient to use a quantitative approach. As a result, expert knowledge is required to ensure topic depth (Sohns et al., 2023).

For this, semi-structured interviews will be conducted, which allow addressing the same subjects with the interviewees while allowing them to react to their various responses and the contexts of the organisations (Yin, 2018). The questionnaire for the interviewees included questions about their background and general sustainable knowledge, followed by in-depth inquiries to address the study questions and additional optional inquiries to delve deeper if necessary. A last query is asked to complement whatever further information the interviewee may have to offer (Table 2).

Intention	**Question**	**Additional/optional question**
Background Information	• Please introduce yourself and tell me about your expertise in sustainable business practices and the German assembly industry. • How many employees and suppliers do you have in your supply chain? How much is your revenue?	• Could you share examples of how you successfully integrated sustainability into your supply chain? Why did you do it?
RQ1: What are the key barriers faced by Small and Medium-Sized Enterprises (SMEs) in the German Assembly Industry when implementing green supply chain practices?	• What are some barriers that your company may face when trying to integrate sustainable business practices into their supply chain? (Can you give some examples?)	• What are some barriers that other SMEs in the German assembly industry may face when trying to integrate sustainable business practices into their supply chain? • Is your company impacted by regulations from the government or receives help from initiatives?
RQ2: How vigorously can medium-sized businesses encourage sustainability among small businesses throughout their supply chains?	• Has your company influenced partners in the supply chain to be more sustainable? • How can other SMEs effectively encourage	• How important is it for medium-sized businesses to encourage sustainability among small businesses throughout their supply chains?

	sustainability among their supply chains?	
Conclusion	• Do you have some key take-aways for SMEs in the German assembly industry looking to integrate sustainable business practices into their supply chain?	

Table 2 - Questionnaire

The questionnaires were sent out in advance to enhance the quality of the findings and elicit the highest degree of information so that the respondents could prepare themselves better. Most of the expert interviews were done in German and the critical findings were subsequently translated into English.

Using the qualitative research findings, a comparison to the existing literature will be made to see how well they fit in and what new insights can be gained.

3.3. Data collection

Semi-structured interviews with eight assembly industry experts gave the data needed to answer the research questions. The interviews focused on SMEs' barriers when implementing sustainability into their supply chain and their influence on their supply chain suppliers. Therefore, first, experts were contacted from this industry through social media, especially LinkedIn. Subsequently, the companies were contacted through connections of acquaintances and requested an interview there. Aside from extensive knowledge of the assembly industry, working experience within sustainability is also essential. However, one major issue was that most businesses did not have dedicated employees for CSR. The job titles are more informally described, but they still have to deal frequently with the topics of CSR and sustainability in general in their daily work (Baumann-Pauly et al., 2013). Accordingly, the interviews were conducted primarily with department heads or Companies' CEOs, as shown in Table 3 below:

Interview	Profession	Company facts	Experience (in years)
A	Managing Partner	Area: Healthcare beds Employees: 48 + 12 (Temporary workers) Turnover: €20mio. Suppliers: 60-70	30+
B	Managing Partner	Area: Nursing chairs Employees: 45 Turnover: €15mio. Suppliers: 80	7
C	Team-Leader Purchasing	Area: Machine manufacturer Employees: 170 Turnover: €35mio. Suppliers: 300	10
D	CFO	Area: Dartboards Employees: 15 Turnover: €900T Suppliers: 15	3
E	Assembly Manager	Area: Custom-made (wooden) products Employees: 12 Turnover: €1.4mio. Suppliers: 8+	10+
F	Assembly Manager	Area: Custom-made (metal) products Employees: 30 Turnover: €12mio. Suppliers: 10-20	18
G	Board Director	Area: Automated sensor systems Employees: 148 Turnover: €35mio. Suppliers: 25	13
H	CEO	Area: Cars Employees: 85-90 Turnover: €40mio. Suppliers: 40-50	8

Table 3 – Interview Partners

Eight interviews were conducted in total. The names of the interview partners were changed for simplicity, and the companies were left out for anonymity because they did not influence the results of this work. The interviewees were chosen in such a way that they were all from the management level or at least high up in the hierarchy so that they would have the authority to make decisions in strategic decision-making and thus in the commitment to sustainability. However, a combination of these executives was chosen to obtain the most comprehensive picture of the industry. People with more than 30 years of experience (Interview A) but also with shorter professional experience and younger ages (Interview B & D) were chosen to avoid potential biases due to external circumstances.

In terms of the companies, the interviews were made with large companies with nearly 150 employees and small companies with only 12 employees to cover as much of the SME sector as possible. One of the goals was also to identify differences between small and large businesses and to identify possible patterns regarding experience and the importance of sustainability within the company.

The interviewees have an average of 13 years of experience. The companies employ an average of 50 people and have an annual revenue of €20 million. The average supplier count is 70. This should demonstrate why RQ2 is so essential, as supply chains can be particularly long in the assembly industry and can thus have a significant impact.

4. Analysis & Discussion

The approach of Mayring's inductive methodology of qualitative content analysis is used to evaluate and analyse the results. Unlike the deductive method, in which predefined categories are formed based on the results and then questioned in interviews, categories in this approach are gradually developed and adapted based on the results. The categories are generated through an inductive method since knowledge about the issue, particularly with regard to the German industry, is still in the early stages or lacks sufficient depth. These are intended to break down the material to its essentials and then summarise it in abstract terms using superordinate categories and subcategories (Mayring, 2010). With the help of the software tool MAXQDA, the interviews were first transcribed and then coded in order to be then able to form categories gradually. In relation to this thesis' Research Questions, three superordinate categories were formed out of the interviews: internal barriers, external barriers, and the impact of suppliers, as well as further subcategories (Table 4). The first two categories refer to the first research question and the third category to the second research question.

A comparison with the current literature will be made during the analysis of the results, and new findings will be uncovered. Because, as previously stated, knowledge about the sustainability of SMEs in the German assembly sector is very limited, the literature review serves to reflect basic knowledge about the topic. Hence, a comparison can only be made in broad strokes. However, there are specific notable findings from the research that are generally applicable to SMEs and sustainability in Germany, such as a lack of awareness of sustainability or the cost element.

Internal Barriers	External Barriers	Impact on suppliers
- Costs - Knowledge - Effort - Quality	- Social - Regulations - Dependencies - Covid	- Possibilities - Barriers

Table 4 – Categories for analysis

4.1. Internal barriers

In the following, the internal barriers are described, analysed and discussed, related to Research Question 1: "What are the key barriers that Small and Medium-Sized Enterprises (SMEs) in the German Assembly Industry face when implementing green supply chain practices?".

Costs

Almost everyone addressed the issue of expenses meaning that adding sustainable practices would be too expensive. SMEs are essentially exposed to a very strong price war where every decimal place in the price counts, so accordingly, people tend to use products from Asia, etc. (Interview C). Nevertheless, introducing sustainable practices is expected to incur overhead costs that need to be compensated for because sustainable materials or processes are frequently more expensive than traditional options (Interview F, Interview G). Getting the product to the customers is what matters most in the end and this price battle is particularly relevant to the assembly industry. To gain an advantage in the marketplace, you must choose the cheapest product or supplier and then assemble them (Interviews B, Interview H). This is also agreed by the literature: In the assembly industry, it is essential to minimise assembly costs internally in order to reduce expenses (Wagner et al., 2017). However, the respondents also provided some examples demonstrating that sustainable methods are not always more expensive. This can be done, for instance, by using PV systems, which, considering the exceptionally high cost of power in Germany, can be a good method to reduce production costs. For instance, it can also be done by using electric vehicles to transport the products for companies from the supply chain (Interview B). The Covid-19 pandemic has made the situation even more severe. The producers in the assembly sector were thankful if they obtained materials at all during the pandemic and the accompanying supply challenges, which got worse during this time, heightened the price war even more. After that, sustainability fell into the background for the continued existence of the industry (Interview C). More businesses in the sector have filed for bankruptcy in recent years as a result of these costs no longer being able to be covered by rising prices. Therefore,

the issue is a matter of survival, not sustainability. The question here, however, is whether it is not about becoming cheaper but simply different to stand out from the competition when the survival of companies in this industry is already at stake. Whether this is significant in this industry would have to be investigated further. (Interview A). SMEs, in particular, are unable to simply reduce prices through quantity, as larger businesses occasionally can (Interview C). Additionally, the customers are typically smaller businesses that are unwilling or unable to accept the higher costs associated with sustainable practices, so the need is simply non-existent (Interview E).

Effort

Integrating sustainable practices into your supply chain can be problematic, especially when it comes to changes to the product, as the required customer approvals are a lengthy process that cannot be changed overnight (Interview B, Interview E, Interview G).

In addition to the lengthy process of change itself, however, supplier control is also a crucial factor in introducing sustainable practices throughout the supply chain. Regular controls must be implemented to determine whether the suppliers are genuinely complying with these changes or only pretend to be sustainable while still not segregating garbage, for example, or using the same amount of plastic as previously (Interview A).

As mentioned above, the companies of the experts surveyed have an average of 70 suppliers for their company. If an audit has to be carried out several times a year, then the effort and expense for an SME are not manageable, especially for companies with suppliers abroad. Regularities and certificates are then needed to keep the effort within reasonable limits (Interview A).

The literature further clarifies that when there are insufficient people to handle sustainability adequately, the additional effort is no longer proportional to the benefits that result in (Burlea-Schiopoiu & Mihai, 2019; Bergmann & Posch, 2018). The employees in the SMEs are already overburdened in some cases, as it is not easy to spend the money on an additional employee, as the overhead would then become too high. Therefore, several tasks are often assigned to one employee at a time. There are also difficulties in finding people for such companies. To sum up, the additional time required to assign an employee to sustainable processes is not manageable in some cases (Interview B).

Quality

Another barrier is the quality of the products if they are to be produced more sustainably (Interview G, Interview H). Keeping up the quality was often not possible when trying to use more sustainable products, such as recycled materials, because they did not meet the requirements (Interview C).

However, some of the examples of positive implementation of sustainable practices have also shown that this can be the other way around. For example, quality can be improved so that individual parts or products need to be replaced less frequently, thus conserving resources, as shown by the example of Interview C, where the required certificates meant that a better quality of wood had to be used, which also resulted in significantly longer shelf life.

Knowledge

In the run-up to the interviews, some of the participants said that it was not easy to answer some of the questions. When asked, it emerged that many people in this industry are not confronted with this topic much in their day-to-day work and therefore have limited knowledge, even though the selected interviewees can hardly show more expertise in their industry in general. This was particularly noticeable concerning sustainability in the supply chain. This could also be seen from the examples of already implemented sustainable practices, which primarily focus on sustainability in their own production and less on the supply chains. One possible explanation or conclusion could be that the direct advertising impact is more significant in the case of adjustments in the company's production and sustainability can also be used as an effective advertising strategy decision (Interview A). However, slight differences can also be identified within the categorisation of SMEs between small and larger ones. The larger ones with 50+ or 150+ employees had already introduced many practices in general and within the supply chain, such as combining deliveries by different suppliers into one route, switching to euro pallets, etc. In comparison, the smaller ones were even less confronted with the issue, which may also be due to the lower social pressure and the smaller customers, who are less confronted with sustainability. However, the data situation is not yet sufficient to be able to say this emphatically and can therefore only be assumed as a pure hypothesis.

The reason for the lack of in-depth knowledge among managers and high-ranking employees (Interview D, Interview F) of companies in the assembly industry can also be partly explained by the fact that the managers in this industry are "the older generation", who have not yet had too much to do with the newly emerging importance of sustainability for companies, but only consider pure profits in the sense of the company and do not know how to apply such strategies

(Interview F, Friedman, 2007). This would also be in line with the literature, as mentioned at the beginning, that tends to focus on large companies and that the knowledge is not so easy to obtain for the smaller ones. The lack of knowledge can also be seen partly in the fact that, as previously mentioned, almost all interview partners see sustainability exclusively as a cost factor. This is often the case, as the literature also confirms (Caldera et al., 2019), but they give examples themselves of how they have saved money in the long term, such as by using PV systems, improving quality, and further examples.

4.2. External barriers

In addition to internal barriers, external barriers are discussed below in order to respond completely to research Question 1.

Regulations

The external factors are also significant for the companies. Some of the companies are very interested and want to change something, but this is sometimes challenging in the supply chain for SMEs in the German assembly industry due to external factors. An important topic here is, of course, regulatory disorders. As already mentioned in the literature (European Commission, 2023), the decisive regulations that would have a significant impact on companies, such as mandatory non-financial accounting, tend to affect large companies with several thousand companies rather than SMEs (Interview D, Interview G). There are some smaller regularities, such as the electrical law, or that plastic is saved as packaging material (Interview A, Interview F). The problem is, however, that these are often easy to circumvent and therefore depend more on the company's intention (Interview E). For example, in the case of the Electrical and Electronic Equipment Act, money can be charged for taking back the parts, which means that many companies would rather just throw them away than return them. The law, therefore, has little impact (Interview A).

However, because they are so bureaucratic and involve a lot of micro-work, numerous regulations - many of which may not be circumvented or even intentionally implemented - often generate a lot of work within the organisation, making them a burden rather than an incentive for businesses to think more sustainably. As already mentioned, the effort is already a significant problem in the sustainability field (Interview B).

All in all, changes within the companies will only be possible if some precise laws and regulations measure and control the performance in terms of sustainability because it will be almost impossible for SMEs to carry out or control independently what happens in their supply

chain (Interview A). In addition to pure control, more incentives, such as financial support, need to be created which applies equally to everyone (Interview H).

Social

Regarding corporate sustainability, the social level also plays a role. Interestingly, however, the interview partners mentioned this aspect very little. It can be questionable whether this is due to a lack of community pressure and marketing approach as a main argument for them or because they choose not to include sustainability as a marketing strategy since doing so would have inverse consequences. Local communities were mentioned in the literature as a possible factor (Spence et al., 2003), especially for SMEs, as they often have a solid connection to the community. Only one of the interviewees mentioned the aspect that the supply chain is not directly recognisable in terms of its external impact, unlike changes in the company's own production, which are much easier to predict if there is no precise measurement (Interview H).

Dependencies

Some suppliers might not be able or willing to provide information about their operations. Due to this, the already challenging task of monitoring and enhancing the use of sustainable practices is made even more difficult. This has an impact on their own sustainability as well since an individual cannot positively influence the supply chain if they do not know to what extent it is sustainable or how it can be made more sustainable. This is when the problem with the missing regulations shows up again (Interview D, Interview H).

But when it comes to dependencies, the reliance on specific suppliers is even more critical, even though they frequently operate less sustainably in terms of transportation and production in general. Businesses from Asia, in particular, are sometimes impossible to avoid in this regard. The Asian market is in the lead and almost has no competition regarding products like chips for automation. There is nothing that smaller businesses can do about it, considering the possibility that major corporations may be able to create their own manufacture of such parts or even purchase up enterprises there and subsequently improve the situation. Of course, there are also financial considerations at play (Interview B, Interview C).

However, regarding dependencies, it turned out extremely intriguing to note that, in contrast to the literature, which views stakeholder pressure as a significant external pressure (Hervani & Helms, 2005), virtually little was spoken about external pressure from their stakeholder. This demonstrates how this could be a massive benefit for SMEs. Large firms are frequently heavily impacted by their stakeholders, such as their shareholders, who are more focused on short-term

profits than on the company's long-term success, which can be achieved through sustainable practices. This may be less the case for smaller companies, where managers have much more or even sole discretion in deciding how to implement sustainable practices.

4.3. Impact on supplier

This chapter presents the main findings to answer Research question 2: “How vigorously can medium-sized businesses encourage sustainability among small businesses throughout their supply chains?”

Possibilities

The majority of responses said that the influence SMEs in the assembly industry can have on other businesses in their supply chain is relatively minimal. However, there are at least a few things that can be done to affect supply chain sustainability. Before the difficulties are mentioned, some of the possibilities are explained here.

Particularly positive supplier relations were mentioned. This is frequently feasible, but to have a genuine impact, it is crucial that they pursue similar concepts and strategies. (Interview A, Interview E). In order to achieve this, it is also crucial to specifically choose suppliers who share your beliefs or who generally place a high emphasis on sustainability (Interview A, Interview F). This could indirectly encourage other suppliers in the industry to think and act more responsibly. To make the transportation routes short and, at the very least, to be able to combine transport, it is generally desirable to choose both local and sustainable businesses. (Interview B, Interview D, Interview H). It is crucial to collaborate closely and exchange expertise to enhance shared approaches. This can be done by illustrating to suppliers the possibilities for greater sustainability, ideally through clear and concrete examples (Interview A, Interview B, Interview D, Interview F). Already, external organisations have established a comparable objective for their own experiences. ENGOs and other organisations can help companies identify the benefits and potential applications to make more connections and gain more clientele (Stekelorum et al., 2020). They work to explain to local companies and municipalities how they can cut operational costs while also improving the environment. Larger businesses with more expertise frequently demonstrate how they have already put things into effect and how one can learn from their choices in the implementation, for example, in the adoption of PV systems. (Interview B; Ökoprofit, 2023). This knowledge can then always be passed on to the supplier and partner.

It is definitely accessible to make an impact through effective communication, as demonstrated by the situations provided by the interviewers regarding the constructive examples they have previously adopted in their organisations. For instance, some respondents noted that they were able to reduce their waste production when shipping and transporting items through suppliers by reducing packaging (Interview C, Interview D, Interview G) or, for example, have switched from disposable pallets to reusable Euro pallets (Interview C).

Barriers

Generally, experts agree that the effects on SMEs in the German assembly industry are rather difficult. Little influence can be exercised outside of knowledge sharing and the intentional choice of sustainable partners because SMEs are too small to have a significant long-term impact on other organisations. Typically, the quantities ordered are just too small to be able to direct how another company should produce it (Interview A, Interview B, Interview C, Interview E) because it may quickly occur that the company is without suppliers anymore, and delivery issues are already challenging enough in the sector (Interview A).

Additionally, however, as previously indicated, there are too many suppliers, including those outside of Germany, that make it difficult to monitor this on a regular basis (Interview A). To conclude, it is not necessarily an issue itself. The main obstacle to actually changing anything is just this element of the size of the companies.

We can ask whether those arguments are not too short-sighted if we look at the literature and remember that 99% of German enterprises are SMEs (Federal Ministry for Economic Affairs and Climate Action, 2023). One person might not be able to do much about an environmental problem, similar to how the issue affects the environment as a whole, but things may change once it affects many people. Knowledge sharing may be undervalued since many people view sustainability for companies as merely a social issue rather than for the advantages it might have for a company, especially given that it can even be essential for the firm to survive in the long term. Of course, it ought to be taken into account that SMEs operate under different circumstances, and too much change for financial reasons could also hasten insolvency. However, the claim that they are simply too small might be disputed when considered in the context of a larger picture.

5. Conclusion

5.1. Main findings

This research aimed to figure out the challenges when implementing sustainability into the supply chain of SMEs in the German assembly industry and based on a qualitative analysis, it can be concluded that:

Small companies, in particular, often have different problems than large companies or are at least more affected by them. The supply chain is particularly challenging because it lacks the necessary expertise. Companies frequently see sustainability as a pure marketing tool and use it primarily for this purpose or for the intrinsic motives of the manager. Less often, however, do they use sustainability as a way to strategically differentiate themselves from competitors or as a means of realising the long-term benefits that implementation can have for their own company and the entire supply chain. The analysis reveals that many are attempting to put strategies into practice and have previously done so, but they are primarily doing so in their own production and are also only constrained in what they can achieve. This is especially valid for the assembly industry. An analysis of SMEs regarding the implementation of sustainability does not take into account factors like the particularly long supply chains and increased cost pressure in this industry. This method of analysis, focusing primarily on the assembly industry, shows the main barrier for them in the form of the enormous price war they are exposed to, as it is constantly about finding cheap suppliers and thus differentiating themselves from the competitors. Therefore, sustainability is often pushed into the background. The cost of implementation in many areas is not affordable for SMEs and, combined with the additional effort, is too time-consuming as there are too many other areas to focus on first. This analysis clearly illustrates that, unlike large companies, SMEs are also very limited in their ability to find alternatives. They are dependent on every single employee, producers from other countries and many other dependencies. However, unless there are additional regulations for SMEs that everyone would then adhere to, it also begs the question of whether it can be implemented at all. On the one hand, it will be challenging to implement changes if the competition does not. On the other hand, it will be challenging to influence the supply chain of other companies. Given that 99% of German businesses are SMEs, this study also demonstrates the enormous potential and the impact that SMEs could have. Notably, the supply chain as a whole needs to be integrated more significantly. This could have a significant impact on the assembly business because of the supply chain's above-average number of suppliers. There is little doubt that there

is interest and intrigue among the interviewees, who are all aware of the topic's growing relevance. The only thing missing is the ability to put it into practice.

5.2. Limitations

As with any academic study, the analysis and discussion's findings should be taken into account while considering the study's constraints. Since the interviewed organisations were usually not yet prepared to deal with the corresponding challenges in-depth, many of the aspects stated are hypothetical. As a result, it is challenging to provide concrete examples of when they have failed. Because there are so many other issues that need to be resolved, some of the difficulties that were highlighted have not even been attempted to be solved.

Another limitation to consider lies in the legal aspects of this topic. In Germany, laws largely regulate how companies conduct their business. However, a lawyer's expertise is required to fully comprehend these as they can more accurately judge the likelihood of circumvention. Regarding sustainable accounting, this is also applicable. An additional paper would be necessary to discuss this in detail, which would have gone beyond the scope of this study. Nevertheless, as it was frequently a key topic, it would be pretty interesting to incorporate the potential of such a reporting rule for SMEs into this research.

Furthermore, due to a limited amount of research on this topic, it is difficult to say whether the results of this work are only isolated statements that deviate from or correspond to the literature. Moreover, the assembly industry differs more than initially assumed. Although this paper is about the supply chain rather than the production part of the companies, some differences exist between wood producers and steel producers, for example.

5.3.Further research

Further research could investigate the explicit differences between SMEs and large corporations in the German assembly industry, as there was not enough prior research on this topic. Just the barriers themselves were examined in this work. The review of the results also indicated variations between the small and medium, which allowed for further analysis of those differences. An extensive data set for this topic's examination could be obtained through a quantitative analysis, which is not achievable with a qualitative research method like the one used in this work. Further study on sustainable accounting for SMEs could potentially address several of the issues raised by the interviewees, including the inability to regulate suppliers, as

was already highlighted in the limitations section. It is essential to look into how likely this is and what effects it might have.

In addition, future research could analyse instances from the field to investigate the role that cost plays as a barrier and to what degree sustainability can be used to set oneself apart from the competition. The cost was one of the most crucial factors for the SMEs interviewed. Thus, this can have a significant impact.

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A. Appendix

Interview A **Time of the interview: 45min** **Profession: Managing Partner**	
Issue	**Answers**
Background information	*"At the moment, we have relatively little in the supply chain."* *"I am not yet that familiar with sustainability, even though we as a company […] are certainly intensively involved with sustainability and sustainable action."* *"We use the quality management system 13485 and of course, sustainability is also part of this system."* *"I am very familiar with assembly"*
Examples of successfully integrating	*"Electrical law, which says that the return of things that are no longer used is organized by us"* *"Metal disposes, shreds the wood and passing to the chipboard industry"*
Internal barriers	*"You have to visit suppliers several times a year to see if he complies. We can't guarantee that at the moment. So cost and time"* *"The cost and time factor sustainability then later reflected in the product price"* *"Look how to bring then also the product to the man, if they become too expensive"* *"Care costs are not covered and, in the meantime, several companies have gone bankrupt"* *"We have in the group conditional price increases and the topic sustainability went in the background […]. Sustainability is always good when it is paid for."*
External barriers	*"We also have suppliers in Eastern European countries such as Poland or Turkey, or even China and given the distances involved, we as a company are not in a position to permanently check sustainability in this company as well."*
Regulations	*"A regulated market at the moment with major problems"* *"In my opinion, however, this can only be achieved through regulations in the form of laws."*
Impact on supply chain	*"You have to visit suppliers several times a year to see if he complies. We can't guarantee that at the moment"* *"Selecting companies that value sustainability"* *"We talk to other companies of course"*

	"Whether then one says I am sustainable and is not it at all, throwing further his garbage in one barrel."
Further information	*"Has advertising effectiveness, which should not be underestimated"* *"Could possibly also bring competitive advantage"*

Interview B **Time of the interview: 40min** **Profession: Managing Partner**	
Issue	**Answers**
Background information	*"We differ from other companies in that we choose the best supplier and then create a finished product"* *"Sustainability is a crucial topic for us for the future in order to be positioned even further. We have first approaches"* *"Sustainability is a crucial topic for the future"*
Examples of successfully integrating	*"Previously, our suppliers supplied us with individual parts. Today, we want to specialize in the fact that we organize corresponding products together in a closed trip"* *"Have changed the type of wood […], we are currently working with solid wood studs, which cause a longer shelf life and we have then also explicitly chosen a manufacturer from Germany or in Germany produces"*
Internal barriers	*"Of course, it is a huge effort for a small and medium-sized company to manage something like this"* *"The company has to hire new employees, since we and many other small companies are now already reaching our limits with our employees […] which is also a big cost factor in the current phase. At some point, the overhead for the company is too high for it to pay off."* *"We have to keep track of how much waste we dispose of what data has to be handed in, and that already affects us in that we have a very high overhead."*
External barriers	*"As furniture and interior manufacturers are dependent on some components coming from Asia and therefore it is difficult because there is simply no other choice. I think it is well known that Asia is the leading market for chip technology."*
Regulations	*"We have to record how much waste we dispose, of what data has to be submitted, and that already affects us in that we have a very high outlay."*
Impact on supply chain	*"As a small medium-sized company, we do not have much influence on the large companies"* *"Have little purchase quantities"* *"We explicitly chose manufacturer from Germany or produce in Germany and not one from abroad."*

	"[…] support each other by drawing attention to the topic. […] we also regularly take part in events. We recently had an event at the meeting of […]. This is aimed at improving sustainability, and it is precisely in this context that larger companies are also present, telling stories and reporting on experiences they have made in the past, from which many conclusions can be drawn, and it was through this that we became aware of a company that also wanted to install a PV system at our company"
Further information	

Interview C **Time of the interview: 55min** **Profession: Team-Leader Purchasing**	
Issue	**Answers**
Background information	*"Sustainability is important and increasingly present topic"* *"Not in such a way that it affects me in my daily life, so it's not the number one topic on the agenda right now"* *"In any case, it tends to become more and more important that people pay attention to it in procurement"* *"I've been working at the company since 2013, I did my training there and yes, after the training I'm in purchasing as a team leader"*
Examples of successfully integrating	*"Packaging of our machines changed spare parts are completely without foil"* *"In former times we had one-way pallets in use, meanwhile we have changed on euro pallets"* *"In the past, all the energy or heat from the machines in production was dissipated to the outside, i.e. simply into the air, and now we have bought a filter system that more or less filters the exhaust gases from the machines and releases them again as heat via the ventilation in the production hall"* *"Packaging material area very easy to convert for small companies"*
Internal barriers	*"For several articles we check whether they can be made from different materials, but the problem is each time that this recycled plastic does not meet the requirements"* *"SMEs are exposed to a high price war. Then it comes down to the decimal place and the sustainability is then pushed into the background that it is better to obtain the materials somewhere in Asia at a significantly lower price instead of somewhere in Europe […] especially with the SMEs, you can't come up with a quantity that you can lower the price as perhaps some large companies do"*
External barriers	*"The consumables for our woodworking machines, for example, there are no EU suppliers for the special adhesives or for the glass yarns that we use. That's why we even have to source in Asia"*
Regulations	*"Packaging for the machines is more or less an ISPM 15 standard where we also receive an annual inspection from the Landesbetrieb für Holz. There is a stamp on all the woods from which we build the packaging for the machines, so it says that the woods were manufactured properly or that the origin is reasonable"*

Impact on supply chain	*"We have persuaded our suppliers to use only wood that has this stamp, and we simply can't accept anything else"* *"But on the whole, […] that we can prescribe suppliers that somehow certain aspects regarding sustainability must be met and we otherwise no longer purchase products there. I think we are just too small for that"*
Further information	*"In the current time or in the corona phase it was just difficult for SMEs in the procurement to remain deliverable at all, […] one had to fight then also with delivery delays and I believe straight then also the topic sustainability came again clearly into the background because one was glad if one could obtain at all further article"* *"It is basically important that the employees are sensitized generally"* *"Perhaps as an incentive to pay out bonuses to employees if a suggestion is implemented, in order to really get all employees on board"*

Interview D **Time of the interview: 35min** **Profession: CFO**	
Issue	**Answers**
Background information	*"Sustainability is a very important part of our corporate philosophy"* *"a short span of experience in the assembly industry"*
Examples of successfully integrating	*"Try to use sustainable raw materials"* *"Promotion energy efficiency"* *"We also try to reduce the packaging materials"*
Internal barriers	*"Main issue for us is the cost, which makes it more difficult to implement sustainable practices throughout the supply chain"* *"Lack of knowledge and awareness of sustainable practices throughout the supply chain might be the reason what makes it more difficult to integrate sustainability for the business"*
External barriers	*"Some suppliers may not be willing or able to disclose information about their practices and supply chains, making it difficult to monitor and improve sustainability performance"*
Regulations	*"Legal restrictions or lack of regulations like for the packaging can also hinder or prevent the implementation of sustainable practices"* *"Personally, I am not directly aware of any. There will be some, but so far we are only affected by the usual laws that do not have a big impact on us"*
Impact on supply chain	*"Of course we try to find sustainable partners, best locally"* *"But we can't influence anyone. We are simply much too small for that"*
Further information	*"It is important to set goals that are realistic and achievable"*

Interview E **Time of the interview: 30min** **Profession: Assembly Manager**	
Issue	**Answers**
Background information	*"Increasing factor"* *"My knowledge is accordingly good"*
Examples of successfully integrating	*"Control of certificates and certain regulations introduced"*
Internal barriers	*"Which is of course very time consuming"* *"The additional costs, […] the price for sustainable products is much more expensive. Often there are customers who can't pay the higher price and therefore we have to use non-sustainable products"*
External barriers	
Regulations	*"Many certificates/regulations sound better than they are […] government regulations for certificates have weak points that can be circumvented. Therefore, I would not say that we are influenced by it, but decide all our decisions from a personal or economic point of view"*
Impact on supply chain	*"Small businesses have little power to make major changes for sustainability in supply chains in general"* *"Through good collaboration"*
Further information	*"Sustainability is playing an increasingly important role for our customers."* *"Should work out the points for his industry and then take small steps further and further towards sustainability"*

Interview F **Time of the interview: 40min** **Profession: Assembly Manager**	
Issue	**Answers**
Background information	*"More than 20 years of experience as a manager"* *"More or less responsible for the decisions regarding the production […] including the sustainability as well"* *"I work closely with our CEO and cross-functional teams to identify opportunities"*

Examples of successfully integrating	*"Using recycled materials or materials from certified sustainable sources"* *"Helped us to reduce costs by using more efficient and less wasteful processes"* *"Reduce unnecessary packaging and optimising transportation routes"*
Internal barriers	*"One barrier […] is costs. Some more sustainable materials or processes can be more expensive than traditional options, and it can be challenging to justify these additional costs to our stakeholders"* *"[…] lack of knowledge in sustainable practices. They often just don't know about it. Many managers in smaller assembly industries are the „older generation" where sustainability was never a topic. Now they just don't know about the importance or how to successfully implement such a strateg."*
External barriers	*"Some suppliers may not have the capacity or willingness to make changes to their sourcing or manufacturing processes"*
Regulations	*"Regulation which have required us to make changes to our packaging materials and manufacturing processes to comply with certain standards"*
Impact on supply chain	*"Try to partner with suppliers that shared our values"*
Further information	*"It's better to just educate them and show the advantages"* *"Most important thing is to realize the importance of sustainability not only to act in a good way, but also to improve the company"*

Interview G **Time of the interview: 35min** **Profession: Board Director**	
Issue	**Answers**
Background information	*"Pretty good. Sustainability is now an important aspect in our company due to customer requirements"*
Examples of successfully integrating	*"We use shuttle packaging, adapted delivery batches for reduced delivery frequency, recyclable packaging and product materials, use of self-generated energy. Partly to save costs, but largely also due to customer requirements"*

Internal barriers	*"Additional costs need to be compensated"* *"Compatibility of sustainable materials and product quality is not easy to guarantee"*
External barriers	*"Integrating sustainability can be a lengthy process for changes regarding the product, process or packaging due to required customer approvals"*
Regulations	*"So far, only to a minor extent, since there are few regulations for SMEs with regard to sustainability (e.g., LkSG only from a company size of 3,000 or 1,000 employees). It is rather the requirements of large customers"*
Impact on supply chain	*"In a few cases, yes"* *"You can set requirements, offer support, show opportunities for sustainability or show them practice examples to improve their knowledge"*
Further information	*"It is advisable to commission a sustainability service provider. For an own implementation, one should prioritize possible sustainability aspects, if necessary according to the requirements of the business partners and implement them step by step"*

Interview H **Time of the interview: 40min** **Profession: CEO**	
Issue	**Answers**
Background information	*"I am familiar with the general goals and requirements. In our company, however, only the first steps have been taken with regard to sustainability. The first small successes are visible and sustainability has been declared a goal for the following fiscal years"*
Examples of successfully integrating	*"Adjustment of the supplier portfolio local for local"* *"Reuse of scrap parts & sprue from injection molding lines"*
Internal barriers	*"Sustainability vs. quality"* *"I think the main question we have to ask ourselves is: are end consumers willing to pay extra for a sustainable product?"*

External barriers	*"The mindset of subcontractors is often not yet very well developed or cannot meet our standards"* *"And if I am to be completely honest: apart from my personal interests, sustainability is more of a marketing matter and things in the supply chain are often less marketable than things directly in our own production and are also simply less elaborately"*
Regulations	*"At present, sustainable products are more expensive. Without incentives through regulations (regulations globally for all) or financial support, it will be difficult to establish a market economy"*
Impact on supply chain	*"Yes, but few to date. However, this topic is increasingly demanded by potential suppliers due to corporate goals"* *"Require in supply contracts. If necessary, initially with financial incentives. High importance, as the issue of sustainability is becoming increasingly important globally"*
Further information	*"Customers (OEMs) demand the topic of sustainability as a central element of their contracts. You are prepared to negotiate with the other specifications in order to bring the topic of sustainability more into focus"*