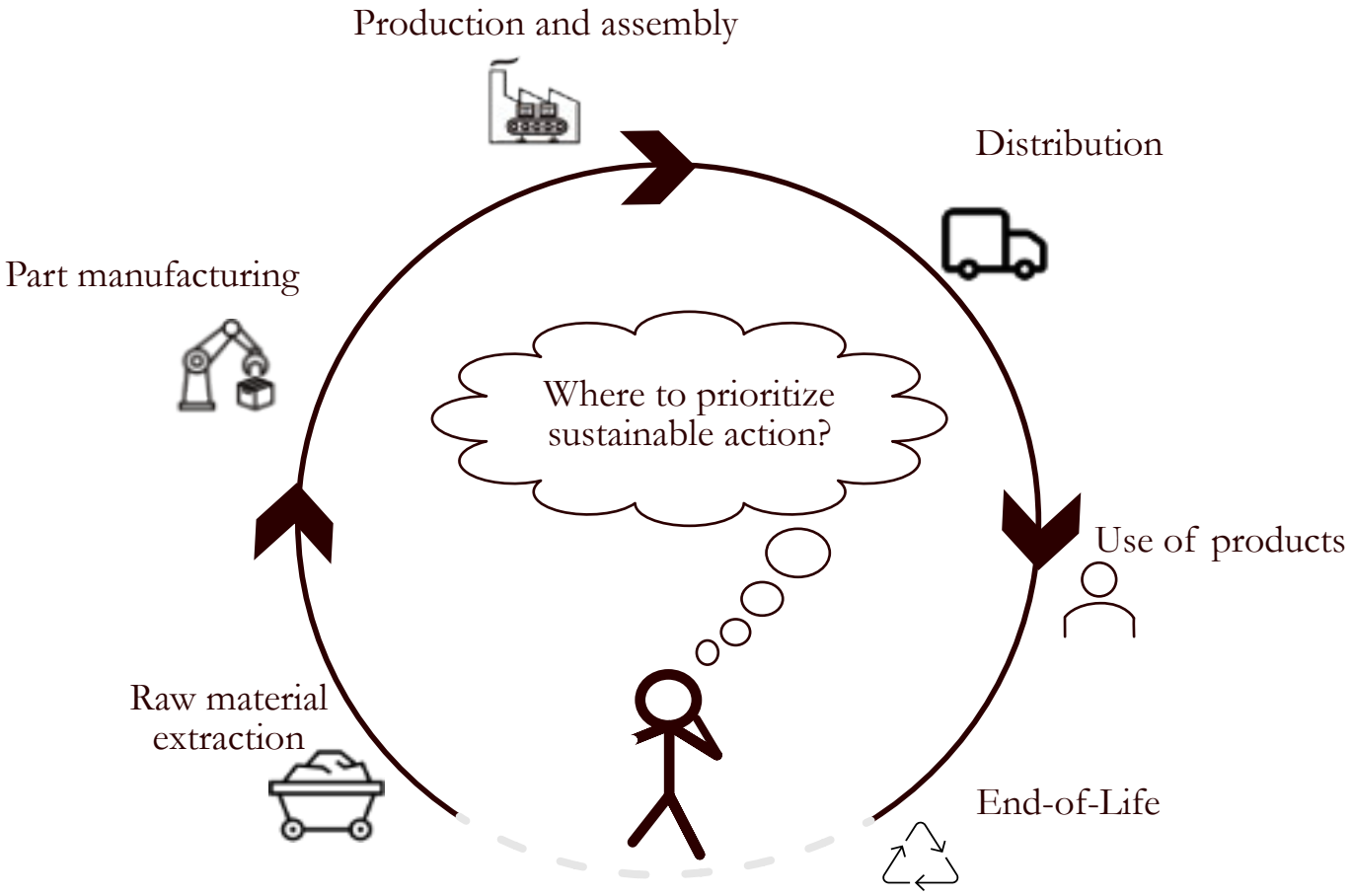
Master's Thesis

Addressing the complexity of Scope 3 emissions: *How SMEs strategically can address and facilitate environmental sustainability across supply chains*



2023

Preface

Aalborg University – Campus, Copenhagen

MSc. in Sustainable Design Engineering

Master's Thesis, Spring 2023

Title:

Addressing the complexity of Scope 3 emissions: How SMEs strategically can address and facilitate environmental sustainability across supply chains.

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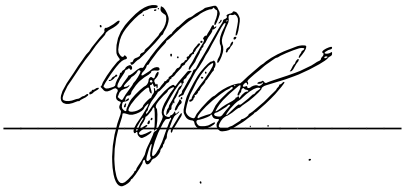
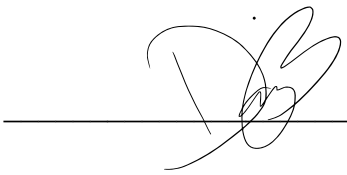
Signature:  

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Partnership organizations: Gamma A/S and Viegand Maagøe A/S

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Date: June 2nd, 2023

Abstract

With the upcoming European Corporate Sustainability Reporting Directive (CSRD), the current climate crisis, and the over-exploitation of natural resources, environmentally sustainable actions are needed within all industrial sectors and through entire supply chains. Here, Small and Medium Enterprises (SMEs) play a key role as they account for 64% of the total CO_2 equivalent emissions within the European Union. However, research indicates that SMEs lack the capabilities needed to counteract this challenge, hence, resulting in an urgent need for research and guidance on how to aid SMEs in the transition toward environmental sustainability. Additionally, due to complex sustainability issues, SMEs must act beyond organizational boundaries and thus initiate strategic actions to mitigate environmental impacts on a supply chain level.

Hence, this thesis seeks to investigate this issue through a participatory design approach in the conduction of a qualitative case study of a Danish manufacturing SME. Based on the theoretical perspectives of Life Cycle Management, Path Creation, and delegation of agency, the organizational capabilities in addressing supply chain (scope 3) emissions have been investigated and strategic initiatives co-developed. Our analysis emphasizes that a hotspot analysis, a supply chain overview, and an understanding of organizational capabilities are prerequisites for SMEs to address scope 3 emissions. To this end, a tool has been developed to aid organizations in prioritizing strategic action based on these prerequisites. Furthermore, it is found that SMEs can take part in facilitating (sustainable) changes in their supply chain through explorative approaches such as the initiation of pilot projects in close collaboration with key suppliers to enable knowledge transfer across organizational boundaries.

Keywords

SMEs, Scope 3, Sustainability, Path Creation, Life Cycle Management, Circular Economy, Strategy Development, Design, Organizational Capabilities, Supply Chains.

Acknowledgments

We would like to thank the case company (Gamma A/S) for making this project possible. Specifically, we would like to thank their CEO and Shipping Coordinator for being open, and honest, and for allowing us to follow their path towards sustainability.

Furthermore, we have collaborated with the Danish consultancy firm Viegand Maagøe, to whom we are grateful for giving us this opportunity and providing the facilities to conduct this project. Also, we would like to thank them for giving valuable feedback during the entire project.

Finally, we would like to thank our supervisor Andres Felipe Valderrama Pineda for his insightful guidance and dedication throughout the project.

Table of Abbreviations

Abbreviation	Explanation
CBM	Circular Business Models
CE	Circular Economy
CO_2e	Carbon Dioxide equivalents
CSRD	Corporate Sustainability Reporting Directive
DCs	Dynamic Capabilities
EOL	End-Of-Life
ESG	Environmental, Social, and Governance
EU	European Union
GHG	Greenhouse gas
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LCM	Life Cycle Management
LCT	Life Cycle Thinking
PSS	Product Service System
RQ	Research Question
SBM	Sustainable Business Models
SBMI	Sustainable Business Models Innovation
SBTi	Science-Based Targets initiative
SC	Supply chain
Scope 1	GHG emissions directly from the company
Scope 2	GHG emissions from purchased electricity and heat
Scope 3	GHG emissions from the supply chain
SD	Supplier development
SDE	Sustainable Design Engineer
SME	Small and Medium-sized Enterprises
SSCM	Sustainable supply chain management
SSD	Sustainability-oriented Supplier Development

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1. **Introduction**

"W*e need to address the climate effects caused by our consumption, production, and global value chains. The task is both necessary and complex because the carbon footprint is difficult to detect and reduce throughout the whole supply chain. For a successful global green transition, the strong engagement by the private sector is absolutely crucial.*" (Danish Minister for Development Cooperation and Global Climate Policy, 2023 26th April).

With the growing challenge regarding the overexploitation of natural resources, global warming, and health issues action is needed (Mahapatra et al., 2021). Accordingly, multiple societal and private actors have taken on different initiatives to address these issues and to ensure a sustainable transition. Internationally, the United Nations has adopted the Sustainable Development Goals, as well international commitments to limiting global warming below 2˚C have been agreed upon (Giesekam et al., 2021; Sachs et al., 2019; United Nations, 2022a). These international commitments are some of the cornerstones in the transition towards sustainability and an urgent call to reduce Greenhouse Gas (GHG) emissions by 45% by 2030 and net zero by 2050 which science shows necessary to avoid the worst consequences of climate change (United Nations, 2022b).

Due to the international awareness of climate change, environmental legislation, and green tax regimes have been introduced. Recently the Corporate Sustainability Reporting Directive (CSRD) by the European Union (EU) entered into force which strengthens requirements for listed and large companies to disclose environmental impacts and social risks (Agyabeng-Mensah et al., 2023; European Commission, 2022). Here, disclosing direct emissions (Scope 1) stemming from activities owned or controlled by the reporting firm, and indirect emissions such as purchased electricity (Scope 2) is not enough. Large companies are to also disclose and report non-financial activities such as climate change impacts and mitigation in a supply chain (SC) perspective (Scope 3) following the GHG Protocol (Dahlmann et al., 2019). Scope 3 includes emissions from upstream and downstream SC activities and is estimated to be significantly higher than Scopes 1 and 2. Hence, the need for addressing Scope 3 emissions is increasingly vital (Anquetin et al., 2022; Li et al., 2020).

There is a building consensus that non-state actors should act towards climate targets to ensure or aid the transition necessary for creating a safe operating space for humanity (Li et al., 2020). Corporate organizations have initiated strategic approaches and activities to address these issues to comply with public and regulatory pressure and to gain a competitive advantage (Li et al., 2020; Turnheim & Sovacool, 2020). With increasing commitments to mitigate emissions internally and across SCs, larger companies require (additional) environmental information from business partners and suppliers (Baumüller & Grbenic, 2021; Giesekam et al., 2021). Thus, being able to calculate and deliver such information to stakeholders increasingly affects business opportunities and public legitimacy which also contributes to ensuring a transparent culture about the impact of

businesses (Dahlmann et al., 2019; European Commission, 2022). However, while businesses' engagement in reducing environmental impacts varies due to challenges in operating in more sustainable ways, the active reduction and management of firms' environmental impacts have become a business necessity (Mahapatra et al., 2021).

To this end, Smaller and Medium-Sized enterprises (SMEs) which supply larger companies with goods and services will indirectly be affected by the CSRD and growing stakeholder and societal pressure. However, while it is estimated that 64% of the environmental impact within the EU is generated by SMEs many SMEs lack the resources needed to meet these requirements such as financial constraints and knowledge limitations (Hampton et al., 2022). However, since SMEs make up 99% of the companies within the EU, there is an urgent need for research and guidance on how to operationalize Scope 3 targets within SMEs in the transition toward sustainability (Li et al., 2020). Here, a holistic view of emissions across the SC is relevant to investigate firms' interconnectedness, but current literature considering all three scopes of emissions is relatively scarce (Mahapatra et al., 2021). As well the literature does not provide an understanding of how external pressures affect decision-making in the SC of SMEs (Jia et al., 2021).

We seek to address these issues by investigating how an SME deal with the transition toward environmental sustainability, through a SC perspective. By conducting an empirical case study, we aim to understand how SMEs navigate stakeholder requirements regarding environmental impact and disclosure and gain insights into how SMEs can strategically initiate, drive, and facilitate environmentally sustainable change across their SC (Scope 3). We are specifically interested in understanding the capabilities needed and how these are developed internally. Hence, we aim to illustrate how to develop and initiate practical actions, which can aid organizations in reducing their environmental impact which we consider relevant, as businesses globally are failing to reduce e.g., GHG emissions, despite increasing commitments on strengthening actions (Rekker et al., 2022). Hence, we are to investigate the following research question (RQ); *1)* **how are SMEs able to strategically address and facilitate environmental sustainability in supply chains (Scope 3)**?

We have chosen an ethnographic research approach and conducted a case study to investigate this RQ.

1.1 Introducing our Case Study

The case study was undertaken in the spring of 2023 in a Danish manufacturing SME with around 60 employees, established in the 1960'ies, from here on named Gamma A/S. Operating in the business-to-business market it is an enterprise delivering both single components and complete end-of-line handling and packaging systems for packing, stacking, or palletizing. They have developed, produced, and installed over 500 customized installations globally, minimizing client costs and downtime. As a main strength, the enterprise houses a design department, an assembly workshop, and a testing team ensuring

the internal know-how needed for the creation of smarter solutions and easy implementation. It has been identified that Gamma A/S sources its upstream components from two big German suppliers and a multitude of small Polish suppliers.

While SMEs differ in areas such as sector, industry, size, and value chain position, the case study of Gamma A/S is considered a relevant case to investigate within the manufacturing industry since they face a situation that most SMEs would be able to recognize, being forced to engage with sustainability and face rigorous accounting demands, and be required to make ambitious emission reduction programs, even though they have few resources and capabilities to address sustainability issues (Korsakienė & Raišienė, 2022). In the case of Gamma A/S, external pressure stems from customers who have ambitious climate targets and programs for mitigating scope 3 emissions, hence affecting Gamma A/S which illustrates a situation to which several SMEs across different sectors can relate (Liboni et al., 2022).

As it has been identified (see Section 5) Gamma A/S experiences difficulties in initiating scope 3 changes due to a of lack knowledge resources and the ability to influence SC actors. However, through our design approach, we have identified three potential areas which they have capabilities to address. Hence, we hypothesize that if Gamma A/S can use this approach to initiate changes on an SC level, other SMEs might have the same potential, thereby making it a critical case study, as a critical case study focuses on choosing a case strategically to achieve information other cases can learn from (Flyvbjerg, 2010).

1.1.2 Sustainability Approaches in Gamma A/S

In terms of sustainability, Gamma A/S has recently committed itself to initiating and improving activities regarding Environmental, Social, and Governance (ESG) issues. To this end, they have recently engaged in their first CO_2 equivalent (CO_2e) accounting exercise enabling them to make strides toward environmental sustainability, especially in Scope 1 and 2, however, they are eager to expand these developments into Scope 3 to be at the forefront of the upcoming CSRD initiatives and requirements from the Science Based Targets initiative (SBTi). The CO_2e accounting exercise was conducted by Viegand Maagøe, whom we collaborated with during our case study. To this end, it is worth noticing that representatives from Viegand Maagøe assigned the case to us and provided the related climate calculations and data.

According to the accounting report, the largest proportion of CO_2e emissions in Gamma A/S is identified to be in scope 3 covering 99% with 95% stemming from energy use of sold products. Other notable emissions stem from the production of steel, the production of engines, and electric components, business travel, and end-of-life (EOL) treatment of products (See Figure 1).

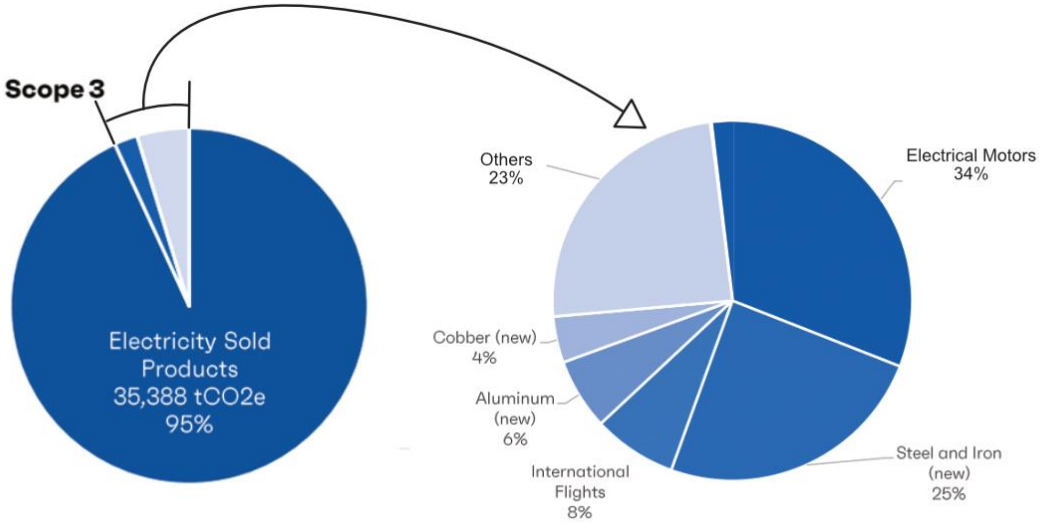


Figure 1: The carbon emissions of Gamma A/S (left) and carbon emissions without Electricity of Sold Products (right)

The issues of scope 3 emissions were further investigated in interviews conducted with representatives from Gamma A/S, which led to the identification of general problem areas in terms of lack of knowledge, an overview of as well as the power to influence emissions across their SC:

"We lack knowledge about our supply chain, and it would be very nice to expand this knowledge to know how to navigate in the supply chain." (Appendix 1)

"It is difficult to push sustainable change and switch to competitive sub-suppliers." (Appendix 1)

To this end, we were eager to understand how to overcome these challenges and to develop sustainable strategies addressing the scope 3 emissions identified in the CO_2e accounting report by Viegand Maagøe. Hence, we focus on the environmental aspect of sustainability in our work and specifically on decarbonization strategies and Circular Economy (CE) initiatives to lower CO_2e emissions on an SC level. We consider this particularly relevant, as scope 3 includes the highest emissions identified and as Gamma A/S currently has no strategies for addressing these emissions. Furthermore, this scope of intervention has been agreed upon between us, Gamma A/S, and Viegand Maagøe.

However, while decarbonization is currently critical due to climate change issues and strategically prioritized within Gamma A/S, we are aware that the sustainability agenda is broader than that. Hence, we intend to encompass the need for integrating system thinking in the development of sustainable change, to capture other value than financial, and the necessity to broaden market conditions to encompass such value capture (Brozovic, 2020). Therefore, system thinking becomes central along with investigating how systemic strategies for decarbonization can be developed, to avoid burden shifting and ensure global emissions are lowered (Hauschild et al., 2017).

The remainder of this thesis is organized as follows: In section 2, a review of academic literature is presented which leads to our theoretical standpoint presented in section 3. Hereafter, our methodological approach is presented in section 4 whereas our findings and results are presented in section 5. Findings are then discussed and reflected upon in sections 6 and 7, whereas conclusions are drawn in section 8.

2. Literature Review

In this section, a review of relevant literature is presented. With a focus on addressing scope 3 emissions, literature on the development and implementation of sustainable and circular strategies that can aid to lower CO_2e emissions on a SC level is reviewed. Furthermore, we link supply chain management literature with CE approaches and how Circular Business Models (CBM) can be innovated. Lastly, it is considered relevant to present literature on the organizational capabilities needed to realize sustainability across SCs as well as how such capabilities can be developed. Our literature search process is further explained in Section 4.1.

2.1 Implementing Sustainability

Societal expectations have made sustainability become a business necessity and an interest in businesses to respond to environmental issues is highly reflected in the academic literature which among different topics addresses practices and strategies which organizations can use to lower negative impacts (Dahlmann et al., 2019; Mahapatra et al., 2021). Such knowledge is needed as current unsustainable business models and activities result in major societal injustices which (if not addressed) will intensify in the coming decades. Hence, firms must take responsibility and initiate activities to lower impacts and contribute towards the sustainable development of our society (Ibid.). To do so, businesses are to formulate and incorporate sustainable strategies and address environmental impacts across the SC, since it is argued that businesses cannot reach sustainability alone (Anquetin et al., 2022; Jia et al., 2021).

Within the current literature, the concept of corporate sustainability has gained popularity within economic literature focusing on sustainability and while it is defined in different ways (Elkington, 1998; Montiel, 2008; Salzmann et al., 2005) it is broadly understood as strategies aiming at balancing environmental, social, and economic needs of both the firm and society (Engert & Baumgartner, 2016). Nonetheless, the formulation of such strategies remains challenging for businesses, and assuming there is a strategy in place, organizations face obstacles in implementing and translating strategies into actions (Ibid.).

To this end, Engert and Baumgartner (2016) have identified six success factors for implementing corporate sustainability strategies 1) organizational structure, 2) organizational culture, 3) leadership, 4) management control, 5) employee motivation and

qualifications, and 6) communication. Sustainability needs to be considered and prioritized at the top management level and establishing a requisite knowledge base and building internal awareness of how to use it in daily activities is vital (Ibid.). Thus, employees must be qualified to understand the implications of sustainability in their daily work. Furthermore, Engert and Baumgartner (2016) argue that sustainable strategies require employees' time, acceptance, and motivation to change. Manninen and Huiskonen (2022) further emphasize that the process must be all-encompassing and that changes should be initiated from a top-down and bottom-up perspective.

Here, Alvesson (2002) set a framework for change on three levels, a bottom-up level of daily reframing, a societal level of influence, and a top-down management level. If action is undertaken at all levels, it should ensure alignment throughout the organization (Wolff et al., 2020). Czarniawska and Joerges (1995) further argue that social tendencies must be considered fashionable or popular tendencies to influence and distribute agency to the change process and considering change management, sustainable changes are no different from other organizational change processes (Sancak, 2023) which are disputed as "*sustainability constitutes a rather new strategic imperative that requires actions to which many firms are not accustomed [...] and which are not yet part of employees' mindsets*" (Schneider et al., 2014, p. 466).

However, Alvesson (2002) mentions that visions and re-framing eventually changes employees' mindset. To this end, change management points to organic coordination and constant negotiations to make sustainability central as emphasized by Sancak (2023).

Additionally, it requires management control to assess sustainability performance and to develop targets along with measurable indicators which can track development and progress (Engert & Baumgartner, 2016). To this end, sustainable accounting standards and practices are tools that can support companies in gaining knowledge about their climate impacts and setting targets for future work or initiating stakeholder collaboration (Godelnik, 2021). However,

> *"Commonly assumed factors, such as greater transparency and "what gets measured gets managed," do not necessarily lead to real sustainable change at the societal level and therefore, need to be treated with caution to avoid detrimental consequences."* (Hahn et al., 2023, p. 4).

Hence, sustainable accounting alone does not lead to sustainable changes but is a tool in the pursuit of sustainable changes (Garcia-Torea et al., 2022). Nonetheless, Dahlmann et al (2017) argue that target-setting can trigger motivational and cognitive processes which can direct and encourage the persistence needed to work towards common organizational achievements and hence can stimulate collaboration, innovation, and learning to improve (sustainable) performance (Brockhaus et al., 2019). Moreover, Garcia-Torea et al (2022) point to change management to understand how results from sustainable accounting can contribute to ensuring that companies increasingly work with sustainability, and it can be argued, that sustainable accounting can be used to initiate dialog toward sustainable

changes as well it helps setting visions for the company (Alvesson, 2002; Hansen & Clausen, 2017).

Additionally, the focus on the entire company in the change process also poses a reason to include the SC when addressing sustainability issues (Lozano & von Haartman, 2018). Lastly, while non-financial accounting itself is insufficient to enable change, literature shows the potential that it has and that it can be used as a catalyst for initiating dialogues leading to sustainable SC (Hahn et al., 2023).

2.2 Sustainable Supply Chains

Beyond direct environmental impacts, businesses are to address environmental impacts outside their organizational boundary since businesses cannot achieve sustainability singlehandedly (Jia et al., 2021). To this end, literature within Sustainable Supply Chain Management (SSCM) points toward SC collaboration as a main operational capability to turn existing environmental orientations into actions toward the sustainable transition (Chavez et al., 2021;). The notion of SCs is used to describe complex networks of business-to-business or business-to-consumer relations and was developed as a logistics concept (De Angelis et al., 2018). It has been investigated in numerous studies where the responsiveness and effectiveness of a system from raw material extraction, through processing and production, towards the delivery of products to end-users is considered (Shekarian et al., 2022). However, with current environmental concerns, the importance of sustainability and its influence on supply chain design is realized by business practitioners, and hence, strategies, tools, approaches, and solutions that can aid organizations in improving sustainable performance have been investigated (Shekarian et al., 2022). The importance of looking across the entire SC when considering different sustainability measures is increasing and neglecting indirect (Scope 3) emissions when assessing GHG emissions can lead to an underestimation of an organization's footprint, and thus hinder business' possibilities in establishing climate resilient SCs and in identifying suitable mitigation strategies (Li et al., 2020; Mahapatra et al., 2021).

Following this, Shekarian et al. (2022) have developed a framework to classify SSCM practices which include aspects such as green production (incl. service and maintenance), sustainable product design, reverse logistics, supplier management, SC design, strategic purchasing, and the assessment of a business' sustainability performance through management systems and standards. These practices require businesses to initiate internal and external activities which refers to businesses' engagement with an outside business to coordinate environmental strategies (Mahapatra et al., 2021). However, it is a complex task to measure emissions from upstream and downstream activities which require organizations to obtain information from businesses outside organizational control (Patchell, 2018). Nonetheless, there is an incentive for organizations to develop and manage their supply base more proactively to achieve long-term (sustainable) strategic

goals (Jia et al., 2021) as SSCM is found to be a high-impact driver of corporate sustainability even within SMEs (Bari et al., 2022).

2.3 Supplier Management

Supplier management primarily focuses on broad operational aspects, such as flexibility and quality, but as businesses increasingly focus on sustainability, a lack of sustainability-oriented capabilities becomes a main cause of supplier violations (Jia et al., 2021). However, instead of cutting business relations with poor-performing suppliers, businesses increasingly seek to initiate activities that contribute to the improvement of suppliers' sustainability capability and performance, which is known as sustainability-oriented supplier development (SSD) which requires abilities to influence actions and performance of SC partners (Agyabeng-Mensah et al., 2023). While it is defined as being "*one-way supportive initiatives from the buyer with a long-term outlook towards investments in developing suppliers in terms of their sustainability*" (Jia et al., 2021, p. 2) such initiatives can be classified into two types of practices: direct and indirect Supplier Development (SD). Direct SD is seen via supplier education, training, or management involvement while indirect SD focuses on supplier improvement incentives, feedback, assessment, or monitoring practices without necessarily requiring changes (Jia et al., 2021).

The overall aim of SSD is to improve sustainability along the SC, which is a complex process. Jia et al (2021) have found that most SSD practices involve both types of activities and argue, that initiating specific SSD practices should be contextualized around the sustainability issues in question. To this end, SSD initiatives can benefit both the supplier side and buyer side as SC collaboration is considered vital for gains in environmental performance (Ibid). Such collaboration between SC partners requires information exchange as well as a clear understanding of objectives and responsibilities. Furthermore, coordination practices across SCs can support organizations in exchanging information on product design and circular initiatives and strategies (Chavez et al., 2021).

2.4 Circular (supply chain) Practices

CE is another stream of academic literature on sustainability and focuses on the implementation of sustainability at both organizational and product levels (Korhonen et al., 2018). It is defined as a "*regenerative system in which resource input and waste, emission, and energy leak are minimized…*" (Schulz et al., 2021, p. 19). More specifically, CE approaches look at the entire lifecycle of materials and seek to add new value to them through the principles of narrowing, slowing, and closing the loop of product materials (Sanchez et al., 2004). Following the CE perspective, EOL treatment is critical as the value of the products should be renewed by

"… *1) maintenance to prolong durability; 2) reuse for the same purpose with either little or no change; 3) refurbishment/ remanufacturing involving replacements of some relevant components and recovery of components to be used within a new manufacturing process respectively, and 4) recycling, e.g., the recovery of materials for the same or different purposes*." (De Angelis, et al. 2018 p. 429).

Initiating such activities requires collaboration across the SC, but also fundamentally rethinking means of value delivery and SC structures (Howard et al., 2022; Schulz et al., 2021). This relates to the organizational level of CE which is the development of CBMs – that is, establishing circular business logics – such as making new offers by utilizing value in used products, or by extending the use-phase of products (Babri & Corvellec, 2018). To realize such circular strategies, organizations need to develop reverse and recycling logistics which encompass capacities to "*track, collect, and make use of embedded materials and components*" (Ibid. p. 1).

However, while CBM is considered a type of Sustainable Business Model (SBM) (Guldmann et al., 2019), strategically incorporating such closed-loop SC approaches into a business model is argued to be a complex task as it is currently not considered a value-creation approach (Eisenreich et al., 2022). Furthermore, CE strategies need to be integrated into main organizational strategies, however, when initiated, strategies such as take-back systems are often treated as a silo and thus, decoupled from core business practices. Additionally, as products may be distributed globally, it results in the creation of take-back systems being challenging and remanufacturing processes thus specifically difficult to practice (De Angelis et al., 2018). Hence, it is argued that the possibilities for establishing circular SC practices lie within the development of local or regional loops, as it limits geographic barriers (Ibid.)

While SC collaboration is considered important to realize CE principles, an issue highlighted by several academic authors is that it is difficult to initiate (e.g., Guldmann & Huulgaard, 2020; Konietzko et al., 2020; Schulz et al., 2021). SC collaboration is even understudied and a literature gap in CE as "… *few studies have systematically investigated the intersection between core supply chain processes and CE"* (Hazen et al., 2020, p. 530).

This gap is further emphasized by Schultz et al., (2021) who state that there is a knowledge gap concerning how stakeholders work together in implementing CE, such as an identification of roles undertaken by actors in CBM and SC processes. To this end, they argue that listing barriers and drivers is insufficient since it neglects the dynamic interactions in the SC when developing CE practices (Ibid.). Further employee skills are also seen to be relevant when understanding and ensuring the implementation process (Straub et al., 2023).

Hence, this area of research needs further exploration, and can learn from adjacent fields. Moreover, while circular SC practices have been acknowledged as an effective approach to achieving zero waste for SMEs (Agyabeng-Mensah et al., 2023; Howard et al., 2022), a second research agenda identified within CE is how it particularly affects SMEs as:

"*There are limited empirical insights on what drives CE, particularly within SMEs, such as leadership vision and success factors. Transitioning SMEs towards CE is crucial to improving both developed and developing country's economies and reducing negative contribution to the environment.*" (Sohal & De Vass, 2022, p. 595).

Thus, CE approaches align with other identified areas to achieve sustainable transitions, however, a need to view sustainable changes more holistically and better understand collaboration within SCs is identified. While there is a gap concerning the implementation of CE on an SC level, CE can be used to identify possible strategies and tools for the implementation of sustainable and CE practices through goal setting, stakeholder collaboration, communication, reproducible methods, culture, innovation, and a positive internal mindset (Hofmann & Jaeger-Erben, 2020; Howard et al., 2022; Saidani et al., 2019; Schulz et al., 2021).

Nonetheless, there are some implications of CE approaches as presented by Korhonen, et al (2018) who argue, that there is a need to ensure that sustainability is considered on a larger scale to avoid rebound effects in other parts of the SC, which M. Bianchi and Cordella (2023) also emphasize:

"… *it is far from certain that higher recycling or circularity rates necessarily reduce the extraction of primary resources, as global trends such as increased consumption could more than offset the gains in circularity.*" (M. Bianchi& Cordella, 2023, p. 7).

Thus, the example here is that the reuse of materials (as the main strategy) does not mitigate enough resources and that CE needs to be understood from a holistic perspective (Babri & Corvellec, 2018; Kjaer et al., 2016). Nonetheless, it is argued that SBMs and (circular) SCM are interconnected, as the development of business models can affect configurations of SCs and vice versa (De Angelis et al., 2018). Therefore, it is considered relevant to present some key insights from the literature on Sustainable Business Model Innovation (SBMI).

2.5 Sustainable Business Model Innovation

Sustainability is argued to be incorporated strategically and placed at the core of an organization's business model (Amui et al., 2017; Bari et al., 2022). However, Brozovic (2020) states that the traditional business model is insufficient when addressing environmental impacts due to its short-term, market-oriented focus which disregards ecological limitations. To accommodate these issues, sustainable business model approaches have been developed which consider and emphasize the balance between economic, social, and environmental sustainability which relates to what is known as the triple bottom line (Brozovic, 2020).

SBMI – that is, embedding societal issues in the process of innovating value creation, delivery, and capture mechanisms - is considered a key driver for corporate sustainability

and is a corporate interest that has recently expanded (Bocken & Geradts, 2020), as well it is seen that companies with bigger innovative capabilities have a lower environmental impact (Zhang et al., 2022). Business model innovation is investigated in the analysis of business model redesigns, improvements, or transformations to incorporate environmental and societal concerns into core business practices. Hence, SBMI is considered a key leverage to improve the sustainability of organizations as it is about innovation on the business model level which is viewed as a necessity to reach sustainable ambitions (Geissdoerfer et al., 2018). Furthermore, SBMI is considered a means to deliver economic value while preserving natural and social capital beyond organizational boundaries, and thus, extends the traditional business model concept (Bhatnagar et al., 2022).

Innovating for sustainable business models requires an integral and system-thinking approach which implies that direct and indirect impacts are considered (Bhatnagar et al., 2022). Furthermore, it is a process where Bhatnagar et al (2022) point toward the need of involving a diverse set of internal and external SC stakeholders. This can accommodate their resources, values, and interests to align these and develop a shared vision. To this end, Bhatnagar et al., (2022) recommend three key design principles relevant when initiating SBMI processes, 1) making sustainability goals explicit by selecting an appropriate approach for measuring sustainability impacts, 2) involving various stakeholders to create a shared understanding and building acceptance and legitimacy of the resulting business model, and 3) integrating a systemic perspective to achieve sustainability goals by considering the business models' both direct and indirect impacts on the environment and society, making it necessary for organizations to consider impacts across their SC (Ibid.).

However, it remains somewhat unclear how organizations can develop sustainable business models in practice, and research into organizational capabilities to make sustainability integrated with strategies and turned into a business asset is currently scarce (Amui et al., 2017; Guldmann et al., 2019).

2.6 Organizational Capabilities

As identified by Bari et al. (2022) the transition toward sustainability in any organization could become challenging if not equipped with the ability to develop Dynamic Capabilities (DCs). The kind of DCs which can be developed in organizations to overcome emerging challenges has also been investigated in previous studies (Amui et al., 2017; Bari et al., 2022; Bocken & Geradts, 2020; Teece et al., 1997).

The notion of DCs was proposed by Teece, et al., (1997) to explain how businesses respond to changing market circumstances through the ability to build, integrate and reconfigure external and internal competencies and resources. Teece (2007) later expanded on DCs through the notions of sensing, seizing, and reconfiguring capabilities. Hence, how a given company can sense new possible business opportunities, then how it can seize such opportunities (mobilize resources to capture value from opportunities) and lastly, how it

can reconfigure the entire company to the opportunities identified (Bocken & Geradts, 2020; Teece, 2007, 2018) Thus, DCs are about creating, as well as adjusting and recombining, ordinary capabilities, and it is argued that such capabilities are deemed critical for the selection and innovation of (sustainable) business models and thus the ones top management should prioritize (Teece, 2018).

Amui, et al., (2017) further states, that a capability becomes dynamic when it strengthens an organization's ability to solve problems, identify opportunities and threats, and make decisions. Thus, DC is the ability to develop and implement new capabilities (Amui et al., 2017, p. 312). In this lens, sustainability must be seen as an internal dynamic choice (Ibid.) and linking the notion of DC to corporate sustainability is argued to be needed, since knowledge in this area is currently scarce and "… *up to 90% of business model innovations fail, due to lack of understanding of the implementation of sustainability practices*" (Bari et al., 2022, p. 2).

To this end, achieving DCs toward sustainability requires learning orientation, knowledge assessment such as strategic partners, and risk management which are the core of DCs. Furthermore, research has shown that the theory of DC is an insightful and practical lens to understand the knowledge and skills needed in sustainable SC contexts (Amui et al., 2017).

However, while DCs are considered pivotal to transforming business models, problematically, Bocken and Geradts (2020) have found that corporate organizations lack the DCs to innovate for SBMI as well as the resources and capabilities to achieve CE targets (See also Bag & Rahman, 2023). Such capabilities can relate to the ability to engage SC partners as SSCM can lead to the development of capabilities for CE strategies and initiatives. This is known as engagement and alliance capabilities, where the business either engages partners or creates partnerships with key actors to achieve strategic goals, thus contributing to the competitive advantage (Bocken & Geradts, 2020). To this end, it is argued that organizations should incorporate sustainability from a DC viewpoint, and by enhancing learning capabilities a business can develop sustainable DCs which is a major driver for achieving corporate sustainability (Bari et al., 2022). In this view, sustainable DCs become a dynamic process in which resources are allocated and organizational learning orients toward sustainability change (Liboni et al., 2022). However, a lack of learning capabilities is often considered a barrier for SMEs to initiate sustainable changes, and to this end, Korsakienė & Raišienė (2022) emphasize that *"… the scarceness of resources and capabilities of SMEs can be compensated by participation in networks, cooperation with various partners, and governmental support mechanisms."* (Korsakienė & Raišienė, 2022, p. 8).

Additionally, they propose a solution where SMEs collaborate to gain the ability to combine capabilities and resources to make changes, which also results in SMEs having more agency in the SC as suppliers are not able to switch to other customers as requirements are aligned (Olarewaju et al., 2023). This is, however, a difficult process and requires unity between competitors and in some cases across vastly different regions of the

world and this perspective is often not considered in SSCM and CE, therefore creating a gap in these strands of literature (Porter, 2008).

2.7 Organizational agency

Another focus area within this field is related to the roles of change agents which are human actors who facilitate and involve other people in the change process through everyday activities (Alvesson, 2002). Change agents need to be politically skilled to further a change process and engage different parties strategically. Hence, change agents are seen to be important within SMEs as

"*Apparently, personal values play a significant role in the sustainability of SMEs. On the other hand, scarce studies in the field of human capital demonstrate a research gap in the current literature*" (Korsakienė & Raišienė, 2022, p. 9).

Thus, the value of individuals and a positive internal mindset has a big impact on the change process in SMEs (Hampton et al., 2022; Sohal & De Vass, 2022). The value-based change agent view matches the CBM perspective, as CBM often focuses on adding sustainable value at both an individual and an organizational level (Hazen et al., 2020). Hence, the learning process and resource capacity are central to distributing agency both within and outside organizations to further sustainable development, however, this is a difficult task for SMEs as they are already low on resources and need to rely on individual commitments and agency from the SC.

Moving the attention toward key decision makers (change agents) is increasing as it is argued that top management plays an important role in developing capabilities and guiding organizational action (Sunyer, Torrents & Gibb, 2013). Pandza and Thorpe (2009) highlight that managerial agency is embedded in creativity, intuition as well as proactive behavior, and have found that managerial agency is instrumental when unbundling DCs, which they understand as an organizational phenomenon accountable for the creation of novel knowledge that diverges from existing knowledge trajectories (Pandza & Thorpe, 2009, p. 119).

2.8 Summary

The above review of literature exposes the need to initiate sustainable strategies in organizations and integrate these into core business models and activities (Dahlmann et al., 2019; Jia et al., 2021). However, the literature further highlights that changes toward sustainability are very difficult and complex and that the formulation of such strategies remains challenging for businesses. Assuming a strategy is in place, organizations further face obstacles in implementing and translating strategies into actions, and while CE strategies need to be integrated into main organizational strategies, strategies such as take-back systems are often treated as a silo and thus, decoupled from core business practices.

Additionally, it is identified how SMEs lack the resources and capabilities in playing a key role in the creation of paths toward decarbonization on a systemic SC level.

Moreover, several academic gaps have been identified such as 1) a lack of knowledge about how non-financial accounting can be used as a catalyst for achieving sustainable SCs, 2) what drives CE initiatives in SMEs, and 3) how SC and stakeholder collaboration can support the development and implementation of CE strategies and sustainability in general terms. Additionally, it remains unclear how organizations develop SBMs in practice and while it is found that personal values play a significant role in the sustainability of SMEs, studies about individual agency are currently scarce.

Hence, we are eager to address these academic gaps within this thesis and we intend to rely on the most important insights of the literature presented which are related to (but not limited to) SCM, circular practices, a systemic sustainable perspective, SD, and the development of organizational capabilities. Based on these insights, we are to explain our theoretical approach to our study in the section below.

3. Theoretical Perspectives

In this section, our theoretical viewpoints are introduced. First, we introduce Life cycle management (LCM) as an umbrella perspective covering the main findings identified in our literature review. This theory is chosen as its life cycle thinking (LCT) perspective encompasses several identified strategies for sustainability and integrates a system thinking perspective. Second, we will discuss perspectives of path creation and path dependency and their theoretical implications when understanding change processes and the emergence of novelty in organizations. In relation to this, the notion of agency and the delegation hereof is discussed as the understanding of such processes is pivotal for the analysis of our case.

3.1 Life Cycle Management

In relation to change and more precisely sustainable change LCM describes how to operationalize sustainability through tangible analysis of environmental impacts such as Life Cycle Assessment (LCA) or sustainability accounting (Bey, 2017). Additionally, LCM is an integrated management approach that connects different concepts, techniques, tools, and procedures (Sonnemann et al., 2015) and has been described as:

"*A product management system aiming to minimize environmental and socioeconomic burdens associated with an organization's product or product portfolio during its entire life cycle and value chain. As a management concept, LCM includes both formalized structures and social practices within the organization and in its external relations*" (Lindén et al., 2021, p. 3)

Being a management approach providing an interconnected and holistic perspective on environmental impacts, the notion of LCT is utilized to understand how an organization's footprint is highly affected by its contextual conditions such as processes across the entire SC from material extraction to production, distribution, and use of products (Lindén et al., 2021; Sanchez et al., 2004). Hence, this approach goes beyond focusing on environmental impacts on single production sites and provides a link between organizations and their emissions and resource use across their SC (Lindén et al., 2021).

LCM not only emphasizes the need for calculating environmental impacts but also where organizations have the capabilities to affect and initiate changes internally and on an SC level. More generally, the LCM provides a framework to align various concepts and tools to exploit their synergies and is viewed by scholars as a means to translate sustainability into practice since no calculations or measurements (such as CO_2e-accounting or LCAs) itself can tell what action should be initiated (Bey, 2017; Sonnemann et al., 2015).

Furthermore, LCM also considers several organizational aspects and highlights a need to grow and manage skills and capabilities while capturing new knowledge, challenges, and perspectives posed by external stakeholders (Manda et al., 2015). This entails that the organization must navigate stakeholder views, as well as build capabilities to constantly learn and adapt, which over time can lead to actors being able to affect the path creation process and sense opportunities for new market areas to implement still more complex sustainable processes (G. Bianchi et al., 2022; Lindén et al., 2019; Teece, 2007). G. Bianchi et al. (2022) also show that having the right capabilities to sense and seize opportunities has a significant impact on the implementation and success rate of LCM processes:

> *"Moreover, firms need to invest in the development of capabilities to increase organizational resilience and their capacity to face difficulties"* (G. Bianchi et al., 2022, p. 320).

LCM both considers internal changes affecting the life cycle and SC changes, through complex power relations, collaboration, or contextual pressure on the SC (Bey, 2017). LCM, therefore, takes in a wide variety of impacts on an organization's capability to incorporate sustainable changes. To this end, LCM points toward the need for involving, communicating, and sharing ideas with all organizational departments when coordinating LCM activities to ensure that the tools and materials necessary to inspire and carry out activities are in place (Sonnemann et al., 2015). In this regard, the question of who has the power and responsibility in the product life cycle is emphasized – both internally and across SCs (Ibid.). This aspect is key within LCM and connects with an organization's overall possibilities for integrating product sustainability and LCT into core business practices such as purchasing decisions, product design and development, logistics, or production processes as illustrated in Figure 2.

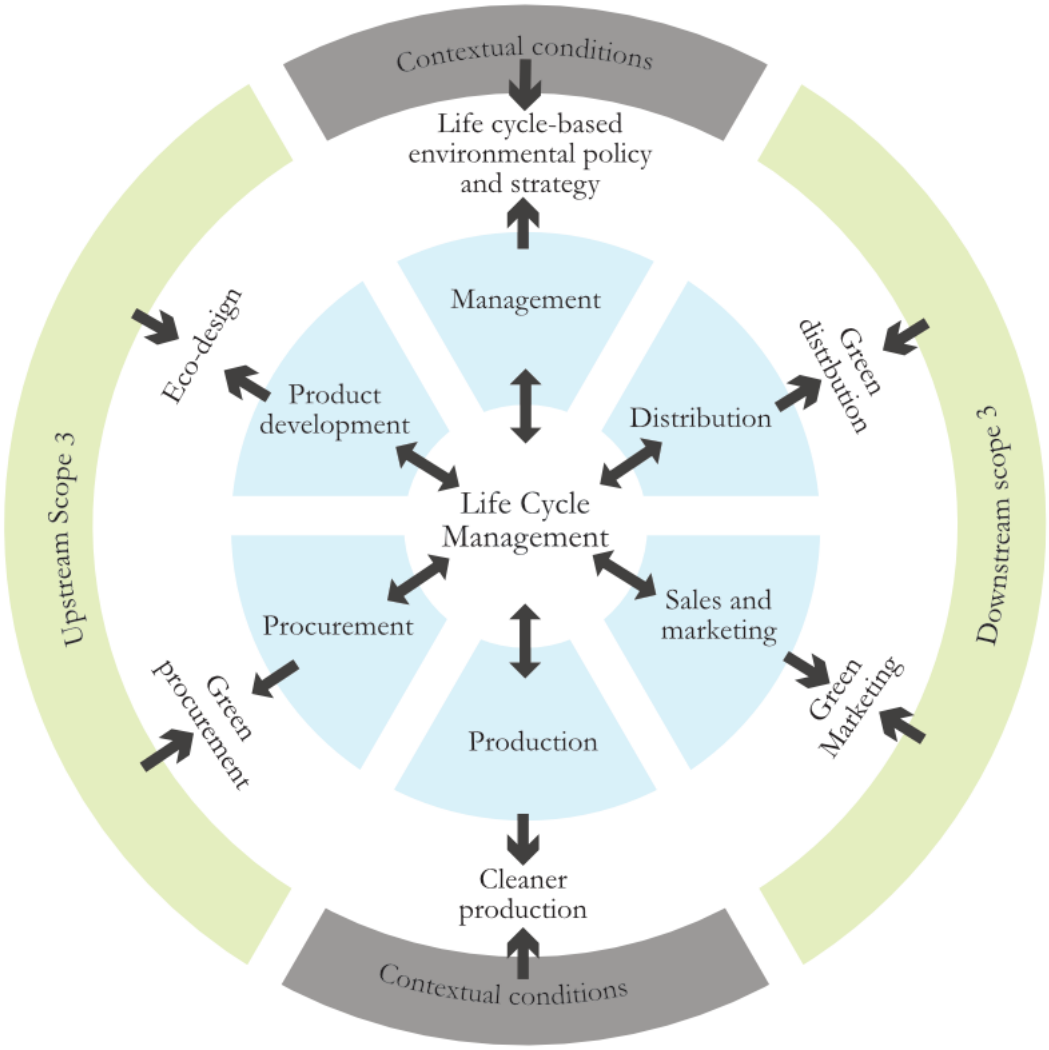


Figure 2: The context of LCM. Own figure but based on (Bey, 2017).

Moreover, the focus of LCM is on the ability to cleverly delegate agency in the SC and internally in the organization to invoke changes that can enable better sustainable performance from a holistic perspective (Sanchez et al., 2004). The word cleverly is used as LCM can imply huge decision spaces and changes without the right capabilities will lead to failed change process (Ibid). Therefore, a capability maturing model has been introduced to understand how organizations can build capabilities to strengthen sustainability performance in their SC, thereby where to most efficiently delegate agency to make changes (Swarr et al., 2015).

However, while several scholars have defined normative approaches to LCM and defined the approach in prescriptive ways as given (Lindén et al., 2021) with a desired final state (Sanchez et al., 2004) we rely on an understanding of LCM as depictured by Bey (2017):

"*The application of Life Cycle Management fundamentally incorporates that the practitioner makes choices before and during the application itself, rather than that she or he follows a predetermined procedure. The reason for this is that LCM is a management concept (…) and not a deterministic method*

or algorithm, with concrete steps or rules, that would lead to concrete, repeatable outputs, if triggered by the same inputs". (Bey, 2017, p. 538)

With this in mind, we argue that instead of these eventualities being determined by structures, they are determined by the work of the actors. Linden et al. (2021) further argue that social science can be used to understand the diffusion of LCM practices as a *performative* approach, thereby attributing agency to the involved internal actors in forming the change process toward a life cycle approach. Accordingly, we view LCM as being fluid, temporary, and situated in organizational practices (Ibid). With this perspective, we intend to understand what potential LCM has and how such practices emerge in organizations since the academic literature on this phenomenon is currently scarce (Ibid).

Moreover, we find it relevant to theoretically discuss notions of path dependency and path creation when investigating organizational change and how agency is distributed in such processes.

3.2 Path creation or path dependency?

To understand the notions of change and novelty within organizations, as sustainability require, Karnøe & Garud (2001) points towards two perspectives; one which acknowledges and views change from historically initiated actions and embedded structures, resulting in future choices being conditioned by past events. Another acknowledges the sum of work put into the change process and the actor's abilities to constantly affect the creation of paths. The former is known as path dependency and the latter as path creation (Ibid.) where 'paths' refers to a sequence of events or courses in which an organization is heading (Sotarauta & Grillitsch, 2022).

Path dependency implies the stickiness associated with specific trajectories which are enforced through contingencies and self-reinforcing mechanisms that lock the path of the future in (Karnøe & Garud, 2001). Hence, the path evolves around structures and strategic historical events giving strength to the path itself creating dependencies and inertia toward the original vision (Garud et al., 2010; Mahoney, 2000). Another aspect of path dependency is that it plots a path toward a universal and perfect end-destination (Sotarauta & Grillitsch, 2022). Hence, while most of the literature presented in our review focuses on change processes from an economic perspective such as SSCM, SD, and Corporate Sustainability, it could be argued, that it implicitly follows the path dependency perspective (Karnøe & Garud, 2001; Teece et al., 1997). This is further seen in the way such perspectives describe the possibilities for initiating change (i.e., towards sustainability) in relation to *existing* structures, knowledge, and capabilities.

In contrast, advocates for path creation argue that actors (entrepreneurs) have the ability to mindfully deviate from existing structures embedding them and thus escape 'lock-ins' (Karnøe & Garud, 2001). This implies, that entrepreneurs have an awareness of their

embeddedness, and can depart from these in meaningful ways (Ibid.) To this end, attention is drawn toward phenomena in the making and how actors create paths by enrolling other actors through exploration and experimentation processes (Ibid.). In this view, there are no pre-existing nor universal benchmarks (especially within developing fields) to reach or which can flag outcomes as 'mistakes' or 'errors' (Ibid.). Furthermore, visions or plans are not considered pre-conditions for entrepreneurial action, instead, these emerge through entrepreneurial processes. Nonetheless, an ability to cross the boundaries of structures, mobilize time and translate objects is required for entrepreneurship, where paths are modified as a collective effort (Ibid.). Additionally, to create an entrepreneurial process it is required to translate knowledge across boundary domains by equipping objects to translate knowledge and mobilizing time for dialogues (Schein, 1996; Vinck, 2011).

When considering sustainability as a path-creation process, new knowledge is needed, and entrepreneurs must detach from the current path. In such change processes, resistance is often met, which acquires entrepreneurs' skills to involve and interest other actors to initiate and re-iterate the change process and direction (Karnøe & Garud, 2001). The entrepreneur must also be a politically skilled navigator to act upon new knowledge and the attitudes of engaged or resisting stakeholders (Buchanan & Dawson, 2007).

In Figure 3, the differences between path creation and dependency are summed up, as path dependency delegates agency through structures and historical events to the actors determining the changes process, wherein contrast, path creation provides an understanding of how entrepreneurial actors use their agency to mindfully deviate from existing structures and alter the direction of the path.

Accordingly, in this thesis, we support a path creation understanding since this allows us to investigate and interact with the work of the actors in creating the path toward sustainability. Furthermore, it allows us to possibly understand how organizations with no prior experience in sustainability issues adapt and integrate environmental sustainability practices; hence creating a path towards sustainability that path dependency approaches are unable to explain.

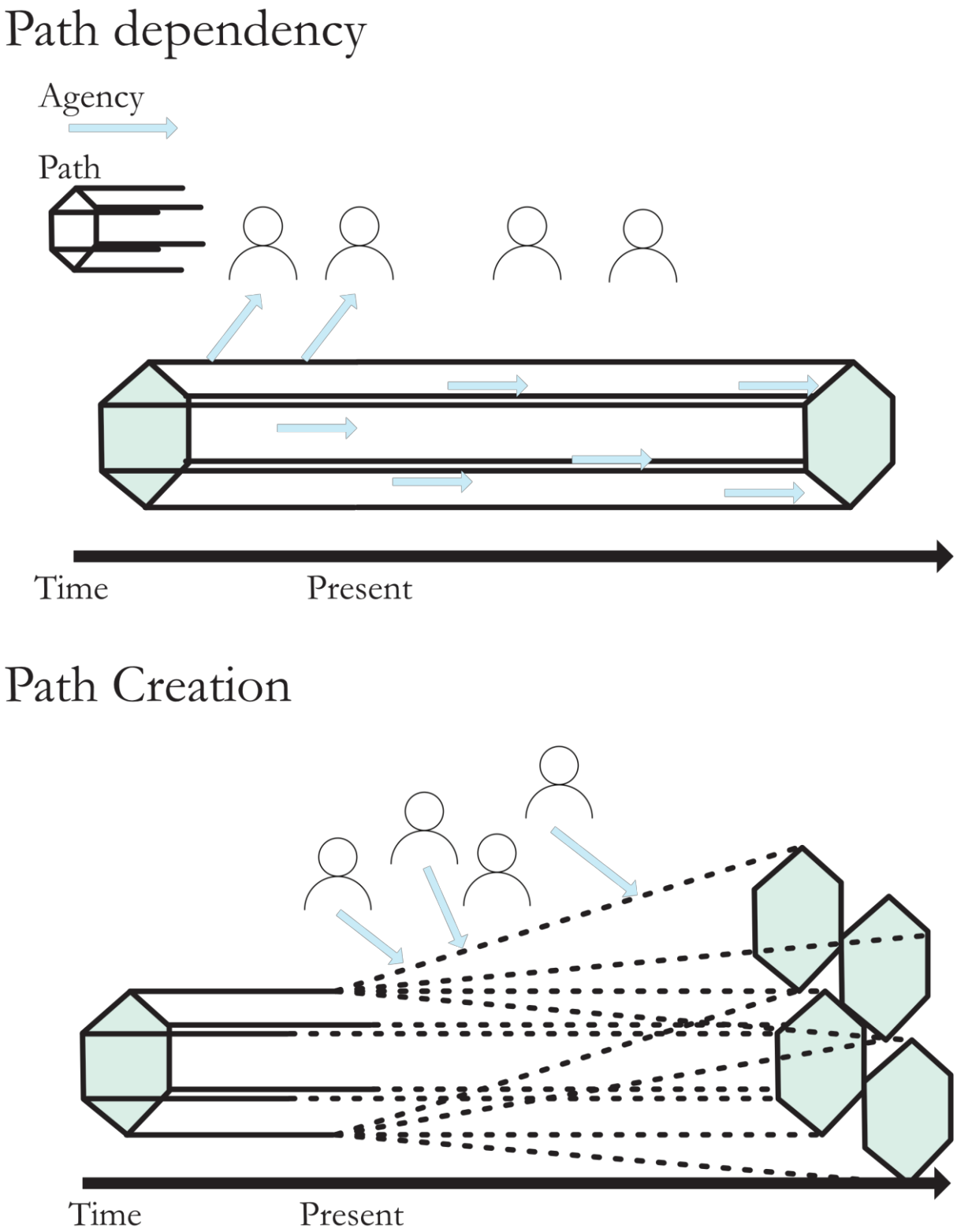


Figure 3: Path Creation and Path Dependency,

3.2.1 Delegation of Agency

As path creation entails that agency is delegated between actors forming the work which drives the path of change, a definition of agency is considered relevant. Being a loosely defined concept, entailing many different aspects such as power, delegation, and relationships, agency is also understood in different literature such as economics, management, and law (Shapiro, 2005). Though it is difficult to describe, we characterize agency based on Thaler and Somekh (1997), as a competence an actor has that can affect and initiate changes within organizations. Additionally, agency can be viewed as pertaining to every entity that promotes differences in networks, and to this end, both human and non-human elements can have agency (Hansen & Clausen, 2017, p. 346).

In this thesis, nonetheless, we focus on the delegation of agency to understand different actors affecting the creation of paths toward sustainability. We use this notion to investigate stakeholders and understand how they interact with each other by delegating agency to certain tasks, problem areas, or groups of people (Thaler et al., 1997).

This understanding of delegation of agency works in the boundary between different actors allowing them to discuss, alter, or create objects or new knowledge (Carlile, 2004; Thaler et al., 1997). Hence, the delegation of agency can take different forms such as delegating agency to suppliers via direct collaboration or through the establishment of Key Performance Indicators (KPIs) which suppliers must comply with. To this end, different approaches to addressing SC emissions imply different means of agency delegation and as the delegation of agency happens between knowledge boundaries, intermediary objects can also transfer agency and change the knowledge basis (Vinck, 2011). Building on this, interessement devices in the form of workshops were also used to involve actors in the path creation process (Hansen & Clausen, 2017; Herzog, 2022).

The delegation of agency within the SC is what furthers collaboration, as it visualizes what is at stake, however, things at stake often lead to tensions (Zu & Kaynak, 2012). These tensions may arise when parties have different goals, have data asymmetry, or need different resources (Ibid). Thus, to alleviate this we call upon the notion of action nets which are a way to understand the world as constituted by interrelated actions (Lindberg & Czarniawska, 2006) or in Czarniawska's (2008) own words action nets *"… are made up of connections between actions that, when repeated and made routine, construct the identities of its actors*" (Czarniawska, 2008).

Garud et al (2010) also use action nets to describe agency and that different actors have a different amount of agency to affect the change process. They called this *human agency* in contrast to the structural agency that does not allow human interactions:

"[I]n action nets, agency is not uniformly distributed because any actor's capacity to formulate options and visions depends on their specific socio-material entanglements" (Garud et al., 2010, p. 770).

Action nets highlight the intricate processes of delegating agency and that new tasks and agency need to replace or align with current action nets. The delegation of agency thereby becomes a process or possibility for human actors to transfer knowledge and navigate political processes to create novelty and influence path-creating processes (Buchanan & Dawson, 2007).

3.3 Summary

The theoretical perspectives are constituted by LCM, Path creation, and the delegation of agency. These fit together as LCM seeks to understand how to make changes on a systemic level considering the entire life cycle, therefore integrating strategies for sustainability, but also the relevance of the context and the SC. However, as LCM does not explain the intricate change process, we intend to conduct our case study by using the theoretical perspectives of path creation and delegation of agency to understand how actors impact the change process and thus how the strategies of LCM become actionable. LCM is therefore used to create situational understanding and develop system-level strategies while path creation is used to understand how changes happen with a human-centered focus.

4. Methodology

This section presents the methods used to generate and structure knowledge research and development. This includes how the literature review was structured, how the case study was conducted, and the methods used to analyze and develop results in the design phases of this thesis.

4.1 Literature review – *as a method*

The literature review was conducted based on Hart (2018) who emphasizes the need to "*compile accurate and consistent bibliographies and summarize key ideas showing a critical awareness.*" (Hart, 2018, p. 17).

To investigate how SMEs strategically can address environmental impacts in Scope 3, we digitally searched for academic literature on the 'AAU library' and 'Scopus' databases, as these open a wide variety of literature strands needed to open our field of search. More specifically, we initiated our search on relevant literature by using keywords such as "scope 3", "sustainability", and "supply chain" through which we identified interesting topics related to our field of study. From this simple search much literature was found and through a critical review, precise keywords were found and used in developing more specified search strings which included the notions of "circular economy", "strategy formulation", "organizational capabilities" and similar areas such as "change management" and "supplier development" (Ridley, 2009). Hence, an iterative approach was used as some literature opened new areas that required new searches. In some cases, we also followed the bibliography of relevant articles to understand certain areas of literature. However, we

intended to identify the most recent literature and thus we primarily searched for literature published between 2018-2023. Additionally, relevant texts were categorized and structured in an Excel sheet highlighting different important perspectives.

4.2 Ethnographic Research Approach

Our study is based on the qualitative method of ethnography. The ethnographic perspective focuses on the knotworks of actors and the human world and seeks to understand the perspective of actors, as well as the perspective of possible *a priori* knowledge brought by the researchers. This awareness about *a priori* knowledge is important as it allows the researchers to be aware of their bias and to the best extent discard it when they explore and truly learn about the field of concern (Schensul et al., 2012). The ethnographic perspective also allows researchers to be open-minded and explore the situatedness around the matter in focus and not only the central theme allowing for a more heterogeneous understanding of the possibility to generate knowledge or novel findings in the situation and thereby, gaining a deeper understanding. This implies that ethnographic perspectives enable us to follow and engage with narratives and change direction *in situ* when unexpected knowledge arises (Hansen & Clausen, 2017).

Ethnography takes place in the local field around the studied actors allowing them to feel safer, meaning that they might be willing to share more. Researchers must, however, be aware of their presence and what they bring as this can determine the confidentiality between informants and in the end the willingness to distribute knowledge (Hansen & Dorland, 2016). Additionally, an ethnographic perspective helps ensure that the analysis is thoroughly based on generated knowledge and not on *a priori* knowledge, meaning that the knowledge generation is inductive and transparent. Even though knowledge gained from literature creates a deductive perspective, this combined process can validate or contradict patterns pertaining to literature or the case and create validity of the knowledge creation (Teegavarapu et al., 2008).

4.2.1 Case Study

A case study is an approach allowing one to go in-depth within a specific area to develop detailed and specific knowledge about a certain problem area (Chavali et al., 2008). The detail of the case study allows it to show intrinsic knowledge and follow narratives, which aligns with our ethnographic perspective. Furthermore, as there are no one-size-fits-all solutions when addressing sustainability and wicked problems in general, it is considered relevant to investigate such processes in a single case study (Pyykkö et al., 2021).

A case study also helps in generating new knowledge or seeing new relations (Martin, 2021; Teegavarapu et al., 2008). However, to be able to use the knowledge of a case study the methods need to be transparent and replicable, therefore we follow Teegavarapu et al, (2008) to construct validity, internal validity, external validity, and reliability. We construct validity through interviews with a wide range of actors both internal and external to the

case company, and then link our findings to prior research to establish a chain of evidence. We ensure internal validity by pattern matching and explanation building of narratives through an affinity diagram (see Section 4.2.3). We ensure external validity through links to the theory and literature and by discussing results and findings with other scholars, collaboration partners, and university personnel.

However, when taking a case study approach, we need to be aware of critiques, such as 1) bias, 2) that case studies are difficult to generalize from, and 3) the time frame (Flyvbjerg, 2010). Though we intend to limit bias by ensuring transparency and linking our knowledge with relevant literature, we are aware that bias is unavoidable. An example of bias is that our first round of interviews is based on our literature review, resulting in the themes discussed being influenced by these insights. We argue that generalizing from a case study is possible due to the detailed results of the in-depth analysis of the case study and when linking findings to prior research, as well we argue that our case is a critical case study (Teegavarapu et al., 2008). Another limiting factor is time, however, case studies can and should focus on specific things needed to accomplish a result meaning that the case study can be set to fit a timeframe by addressing the scale of the case study (Flyvbjerg, 2010). This links to the perspective of our research question being feasible as further described in section 4.4.

4.2.2 Interviews and Observations

Interviews and observations were made through the ethnographic perspective, meaning that we engage with an ability to change direction and follow narratives (Hansen & Clausen, 2017). To do this, qualitative semi-structured interviews were used to guide the conversations, allowing us to focus on certain themes on a conversation level but also to follow narratives important to the interviewee (Hansen & Dorland, 2016). The purpose of such interviews is to get a dialogical in-depth knowledge of experiences and meanings that would not be able to be communicated through surveys or structured interview guides.

In total, seven semi-structured interviews were conducted with representatives from Gamma A/S including a Board Member as well as their Group Director, the CEO, an Operations Manager, their Sourcing Manager, and two production employees. Moreover, interviews were conducted with representatives from two of their primary suppliers covering a Sustainability Manager, an Account Manager, and a Head of Marketing and Communication, as well as an interview with a Sustainability and Compliance administrator from one of their main customers. The interviews lasted 30-45 minutes and the majority were conducted at the production site of Gamma A/S while some were undertaken online through Microsoft Teams due to long physical distances. Nine out of eleven interviews were conducted in Danish, and hence, citations are our translations.

In all cases, the interviews were recorded digitally to minimize loss of data, to make the data accessible, and to avoid bias. The variety of the interviewees was important for us to ensure that we were able to understand the situation in Gamma A/S and gain insights from

several angles. Accordingly, the interviews conducted with external representatives are also considered strongly relevant to gain insights into their SC.

Furthermore, observations were made when visiting the production site of Gamma A/S, and while participating in meetings between Gamma A/S and Viegand Maagøe. From both the interviews and observations notes and quotes were written down and later plotted into an affinity diagram.

4.2.3 Affinity Diagram

An affinity diagram allows one to keep an open focus and let the knowledge and narratives gathered induce their result to the researchers and not the other way around and thereby exploring problem areas as they present themselves (Holtzblatt & Beyer, 2017). The affinity diagram encourages links to other theories and methods to discuss and connect the collected knowledge (O'Reilly, 2014). In the affinity diagram, a focus on challenges when invoking changes in and from the case company was used, based on knowledge gathered from text analysis from the company, observations, and interviews. This led us to the identification of current (lack of) capabilities to initiate change towards sustainability in scope 3 which are presented in Box 1 in section 5.1.

4.3 Design Approach

In relation to our theoretical standpoint, we understand design as an approach aiming for solutions to culturally based problems and hence, not to describe or investigate universal regularities (Young, 2008). Furthermore, when exploring culturally based and wicked problems, a design approach focusing on designing the context becomes relevant, as understanding and influencing the context leads to an identification of possible solutions and not just treating the symptoms of problems (Ibid). Therefore, we intend to design contexts at a more complex level of systems thinking when studying how organizations strategically can address and facilitate environmental sustainability in SCs. Hence, our research focus directs our design work beyond the level of product design which is viewed as design *in* contexts (Ibid.). However, this has first become clear to us *during* our design process as we did not know the exact scope of the design process beforehand. More specifically, we have conducted our work based on the Double Diamond design approach, where the specific (design) strategies co-developed in the second diamond (see Section 5) (Pyykkö et al., 2021).

This relates to the perspective of our design approach covering the design of strategies through system thinking, but also by co-design processes to better involve actors and their problematizations. Here, potential (design) strategies that can address scope 3 emissions which include re-engineering of products, circular initiatives, and supplier collaboration were discussed in a participatory context (workshops) (See Section 4.3.1).

Anyhow, as elaborated in Section 5.2.3 our primary scope excludes the re-engineering and focuses on the latter two (a broader design level). However, with an LCM approach, we

still view these strategies from a product level, as they relate to specific products, systems, or components as further argued in Sections 5.3 and 5.4. Furthermore, the co-design approach was used to stage and facilitate participation and co-creation processes during our intervention. More specifically, we planned to use design 'actively' when engaging with our case company for us to stage explorative design dialogues to explore case-specific circumstances such as challenges and opportunities towards addressing environmental sustainability (Brandt et al., 2008).

To this end, we facilitated two workshops with representatives from the case company, where potential strategies could be co-created, and future visions negotiated (Ibid.). Here, we incorporated the notion of participatory design games to collectively gather the participants around activities supported by defined game materials and guided by simple rules (see Appendix 2) (Ibid.).

4.3.1 Workshops

Workshops are a means of bringing actors together to design, develop or simply discuss, and are in our case understood as a space for participatory design. Therefore, workshops were held to validate knowledge, choose, and develop strategies, and involve actors actively in this process (Callon, 1986; Pedersen, 2020). The workshops were staged to ensure these aims by carefully selecting actors from Gamma A/S and by bringing design games and objects that can transfer knowledge and create discussion about certain elements pertaining either to co-designing solutions or gathering knowledge in a more creative frame (Pedersen, 2020; Vaajakallio & Mattelmäki, 2014; Vinck, 2011). Accordingly, their CEO, Shipping Coordinator, Group Director as well as the Operations Manager were invited to participate in the workshops. However, in the initial workshop, only the CEO and the Shipping Coordinator were able to participate, which limited potential discussions and the level of participation. Nonetheless, as this workshop could be viewed as a 'validation' workshop, we consider the representation of the CEO and Shipping Coordinator as being most valuable as these are the two actors primarily pushing for sustainable change internally. To the second workshop, the four actors were again invited, and the CEO, their Shipping Coordinator, and their Group Director participated. It is considered vital that the Group Director was able to join as it was here the design game was brought into play to facilitate the discussion of potential challenges and opportunities related to the implementation of the strategies prioritized.

The workshops included relevant objects which were equipped to facilitate knowledge transfer on multiple levels, so the employees of Gamma A/S not only created an understanding of the situation but also were able to actively take part in decision-making and gain insights to further develop this process even after the end of this project (Vinck, 2011). Aligned with the ethnographic approach, the workshops value the opinions of the attendants, to create more in-depth knowledge and be open-minded and follow new narratives and thereby reframe the project when more knowledge from relevant actors is acquired (Pedersen, 2020).

4.4 Research Question

The first RQ directing our work was *"How to formulate sustainable strategies covering all scopes and how to translate and realize those through collaborative approaches?"*.

This initial RQ was based on early identified literature that showed the complex task for companies to initiate changes and strategies toward sustainable changes in their SC. However, the RQ also structured our first literature iterations and the frame of our initial interviews. During this process, the RQ was iterated along with new knowledge further framing the design work. From this process, the final RQ was "**How are SMEs able to strategically address and facilitate environmental sustainability in supply chains (Scope 3)**?".

We argue that this RQ is relevant based on the RIN.AFE model of Goldschmidt and Matthews (2022). This method is used to ensure that the research and RQ are Relevant, Interesting, Novel, Appropriate, Feasible, and Ethical. We argue that the RQ is relevant and novel as it addresses current literature gaps and adds to the field as discussed in Sections 2.8 and 6. We further argue that it is interesting as it relates to climate change and more specifically scope 3 emissions, which the literature highlights as complex to address. The second part of this model focuses on the methods and theories and how they are undertaken. Here the appropriateness of the theoretical approach is argued in Section 3, and the ethical and feasibility of the case study and design approach in Section 4 (Goldschmidt & Matthews, 2022).

5. Results and findings

In this section, the main findings and results from our case study and design process are presented, following the Double Diamond design process (Pyykkö et al., 2021). Based on this approach, we divide our work into four main phases being discover, define (section 5.1), develop (section 5.2), and deliver (section 5.3) (Ibid.).

In the discover- and develop phase we diverge and explore opportunities and in the define- and deliver phase we converge knowledge to take decisions based on the previously explored opportunities of the design process as depictured in Figure 4.

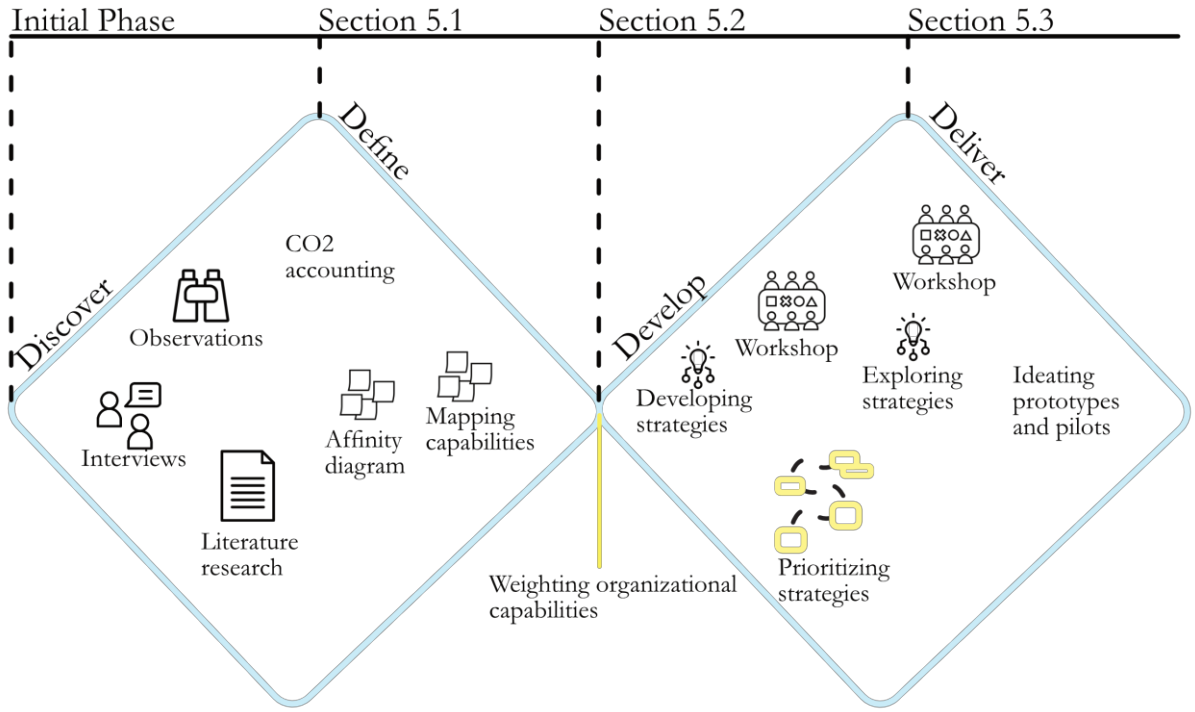


Figure 4: Our Double Diamond design process (DesignCouncil, 2023).

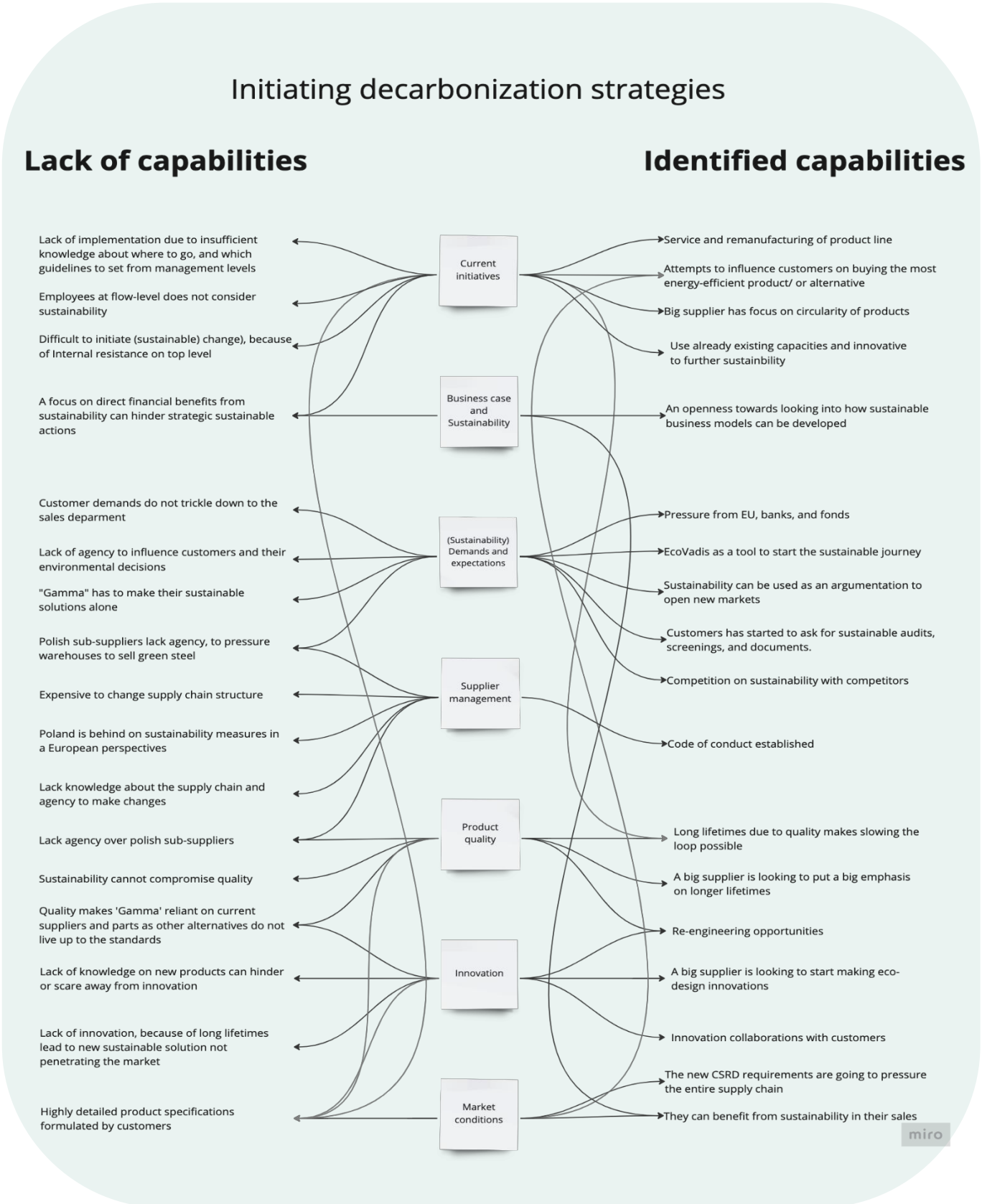
5.1 Collecting and Interpreting Data

The first step of our design process was to discover and familiarize ourselves with the problematizations at hand which we did through literature research iterations, observations, and interviews with representatives from the case company (as described in section 4). Based on the empirical data collected we started the define phase by processing the knowledge generated by using an affinity diagram, as described in section 4.2.3 (See also Appendix 1). Here, groupings of relevant concerns and possibilities emerged regarding Gamma A/S's capabilities in addressing environmental sustainability in scope 3, where the main knowledge categories were identified as being:

- *Current (circular) practices*
- *The importance of business cases in sustainability*
- *Sustainable demands and expectations from stakeholders*
- *Market conditions*
- *Lack of power or agency to influence the supply chain*
- *The importance of selling products of high quality*
- *Innovation in the industry*

As the categories contain vital knowledge it was important to understand how they influence Gamma A/S in working with decarbonization strategies in their SC (scope 3). Thus, we considered it important to further investigate the (lack of) capabilities to understand where Gamma A/S has opportunities in influencing and initiating life cycle practices. To this end, new subcategories focusing on organizational capabilities were

developed based on our empirical material. The main categories and subcategories supporting these are visualized in Box 1 and further elaborated on in sections 5.1.1-5.1.6.



Box 1: An overview of the clustered knowledge categories from the Affinity diagram, along with the main implied capabilities or lack thereof related to each category.

5.1.1 Current (circular) Initiatives

Based on insights from interviewees, several environmentally friendly practices were identified including waste sorting and electrification of manufacturing processes, however, more interestingly, also circular practices such as on-site services, sales of spare parts to prolong product lifetime, and in a few cases refurbishment activities were discovered. However, while such practices cover up to 4% of their total revenue, these circular initiatives can be considered non-systematized, as they require the customers to take the lead:

"I have experienced that (…) parts of a production line have been refurbished and put on a new line, but it only happens on the account of a customer." (Appendix 1).

Furthermore, it has been identified that Gamma A/S in some cases can influence customers to buy the most energy-efficient products and that some main suppliers focus on sustainability initiatives. Moreover, they have some existing capabilities in innovating for environmental sustainability across their SC and thus, such practices are viewed as relevant capabilities in an LCM context. These are highlighted by a customer complaining about high energy consumption from a furnace, which then led Gamma A/S to develop an alternative with 90% higher energy efficiency.

However, already existing attempts on working with sustainable initiatives within Gamma A/S have shown a lack of capabilities, which include 1) a lack of implementation activities due to insufficient knowledge since employees at the floor level do not consider sustainability, and 2) difficulties in initiating sustainability, due to resistance at the management level. This is summed up by their Group Director showing his journey from resisting change to advocating for sustainability:

"*I just had to get over a point to be able to see it as an advantage for my sales. It is a bit expensive at the start, we must make green accounting, we must do different things, and invest something in it, but I also think that the operation of it will be easier than the initial phase. Partly it is this whole learning curve, what is this, and why and how...*" (Appendix 1)

This aspect leads to the importance of integrating sustainability from a business case perspective, which several interviewees emphasized as a necessity.

5.1.2 Business Case and Sustainability

The need of viewing sustainability from a business case perspective was argued upon by various interviewees and relates to the concern of (more) sustainable practices such as procurement of 'greener' materials and reverse logistics being high-cost operations. Hence, their main argument is that the integration of sustainability across the SC must be paid for somewhere in the chain. As their Operation Manager stated:

"It must work economically; it is not my opinion that there is anyone who wants to pay for 'the climate' alone. There must be a business case - and this also applies if we reuse equipment, then it is because

there is a business case for it. (…) But if we could reuse more, sell it a little cheaper, but with a higher profit, then it is not a bad idea and then you must work the business in that direction." (Appendix 1)

The need for sustainable initiatives to generate economic profit both highlights positive and negative aspects. It can be considered positive if sustainable and circular initiatives can mitigate environmental impact while improving profits and it can be negative due to a focus on direct financial benefits which can hinder strategic sustainable actions. That is, environment-friendly activities might not be realized if they are not considered economically beneficial. However, the aspect of integrating sustainable practices at the core of business activities could be a necessity to avoid it being an 'add-on'. Another point is that growing external expectations towards sustainable practices illustrate a potential business case.

5.1.3 Sustainable Demands and Expectations

Several insights relate to external demands and expectations, primarily from customers, which emphasize the rising need for capabilities in sustainability in general. Since main customers have formulated ambitious targets to lower their scope 3 emissions, Gamma A/S needs to do CO_2e accounting and initiate activities to mitigate environmental impacts to stay compliant. More specifically, such requirements take their form through specific tools (e.g., Ecovadis) through which Gamma A/S is assessed on different environmental and social parameters (Appendix 3). Hence, sustainability can be viewed as a means to engage with new customers and such internalized tools furthermore guides sustainable action.

However, customers' sustainability-related expectations are not yet translated into specific demands, hence, not yet visible in some customers' procurement departments as highlighted by the Group Director in Gamma A/S:

"The procurement team is valued on how good salesmen they are, even though they communicate sustainability from the top of that company, the integration of sustainability seems to be lacking." (Appendix 1)

This illustrates a current situation with 'ordinary' parameters (e.g., quality and price) still being the main sale factors for some of their main customers despite growing awareness and expectations toward sustainability. Accordingly, sustainable expectations are 'only' measured indirectly through assessment tools where no collaboration projects have been initiated by customers. As a result, Gamma A/S is in a situation where they must create sustainable initiatives themselves while lacking the agency to influence customers and suppliers. Moreover, knowledge about their (lack of) capabilities in terms of supplier management further emerged in the affinity diagram.

5.1.4 Supplier Management

Even though a Code of Conduct has been established to manage and measure supplier activities, Gamma A/S currently has no KPIs related to sustainability when choosing suppliers. Moreover, while Gamma A/S has shifted towards Polish suppliers to strengthen their market competitiveness, interviews with their CEO and their Sourcing manager highlighted a *lack of agency in the supply chain* as their CEO pointed towards:

"We lack knowledge about our supply chain, and it would be very nice to expand this knowledge to know how to navigate in the supply chain." (Appendix 1)

Furthermore, it was emphasized that 1) changing SC structures might be expensive, 2) it is difficult for Polish suppliers to influence their steel suppliers, and 3) Poland is behind the sustainable transition, as their Sourcing manager stated:

"Some suppliers are small steel buyers which have no power to influence local warehouse, and it is difficult for us to push for sustainable change and change competitive sub-suppliers." (Appendix 1)

However, Gamma A/S's possibilities in addressing environmental sustainability are furthermore limited due to specific customer requirements:

"*It is difficult for us to say that we would like to use more energy-friendly components because it is simply locked-in which components we have to use (…) and what leads to change within this area (sustainability), is when the big multinational companies decide to do something, it doesn't lead to change if we call and say, 'isn't it an idea to do this or this'* (Group Director) (Appendix 1).

Nonetheless, with knowledge and know-how related to product innovation, certain capabilities can be used to initiate change at a product level.

5.1.5 Product Innovation and Quality

A focus on product quality internally and externally results in quality being weighted higher than sustainability and makes Gamma A/S reliant on current suppliers and components as alternatives do not live up to quality standards. Moreover, customers have highly detailed product specifications which thus results in a lack of capabilities in innovating products and developing sustainable improvements. As their Group Director highlights:

"*What is common for our customers it that they have very well specified requirements, and there are typically about a thousand pages of standards which we must comply with*." (Appendix 1)

Another insight was weak threats of new substituting products and new entries since the products Gamma A/S produces are of high quality and incredibly detailed, which makes it difficult to replicate or substitute. Considering sustainability issues, this emphasizes existing capabilities where they can utilize knowledge 1) to ensure long product lifetimes, service, and refurbishment activities 2) to possibly re-engineer product portfolio to lower input of raw materials but also, 3) to get help from big suppliers indulging in circular practices.

Interviews with representatives from big suppliers wherefrom Gamma A/S purchases electrical motors and other equipment, illustrate already established strategic actions towards energy efficiency as well as service, maintenance, and refurbishment operations. Here, Gamma A/S might be able to contribute as a direct link to end customers and hence, strengthen and broaden initiatives.

Accordingly, it has been identified that collaboration with big suppliers might be an opportunity for Gamma A/S when innovating more energy-efficient products and systems. In general, big suppliers have formulated eco-design product strategies, which benefit Gamma A/S indirectly. This can help Gamma A/S overcome a current lack of capabilities in disrupting market circumstances, as the long lifetimes of products mean that new innovative solutions take time to stabilize, and customer expectations might hinder the innovation of novel (disruptive) solutions. Furthermore, several conditions in their market affect Gamma A/S in initiating and developing sustainable initiatives.

5.1.6 Market Conditions

When processing the data, knowledge regarding market conditions emerged which relates to how large multinational customers in 2024 will be affected by political and EU requirements such as the CSRD, forcing them to take further sustainable action (European Commission, 2022).

This illustrates, that Gamma A/S consider the growing awareness and possible future customer requirements for sustainability which is also the primary reason for them to engage with and develop sustainable initiatives:

"*If we do not incorporate sustainability in our operations, we're out of the game*." (Board Member) (Appendix 1)

"*We can use this sales-wise as it is valuable to have these aspects (sustainability) in place*." (Group Director) (Appendix 1)

Another market condition is the rivalry among competitors, which is compromised due to few competitors, growth within the sector, and products being produced when paid for. However, while Gamma A/S estimates that they have the potential to be at the forefront of sustainability among competitors, there is a sustainable rivalry to offer sustainable compliant products to the customers, as highlighted by the CEO:

"We (Gamma A/S) are in an 'Ecovadis' competition with one of our closest competitors to get the highest score." (Appendix 1)

Furthermore, while their customers have SBTi-approved climate targets their CEO points toward the potential benefit of Gamma A/S being SBTi validated in terms of setting strategic goals and using this when strategically communicating with external stakeholders. However, while sustainability approaches might benefit future sales, Gamma A/S still

struggle regarding how they can influence sustainable change systemically and suppliers to mitigate environmental impacts.

As a result, the Gamma A/S looks to have low agency in invoking changes at small Polish suppliers since they have spread the production to many different suppliers which results in a low percentage of spend at each supplier. A lack of power makes sustainable changes difficult which can be considered a problem for Gamma A/S because the Polish suppliers do not value sustainability themselves. However, there might be some opportunities for initiating change processes towards sustainability at suppliers, where Gamma A/S constitute 25% of their annual revenue. Furthermore, the power is also low toward the engine suppliers due to Gamma A/S being a small part of their income, however, as argued the engine manufacturers have started to develop more sustainable solutions themselves.

5.1.7 Visualizing the Supply Chain

To illustrate the current situation as well as the influence and implications of current capabilities within Gamma A/S their SC is visualized in Figure 5 based on the above-presented insights and the interview with their Sourcing Manager. Divided into the three scopes of emissions, the illustration highlights how different problem areas interact with high sustainable impacts (illustrated in red) to show where strategic action can be initiated when using an LCT approach to enact changes along the entire SC. Moreover, it illustratively highlights important relations influencing their ability to inflict changes and delegate agency on an SC level. Furthermore, relevant knowledge about the location of raw material extraction and the percentage of recycled steel is incorporated.

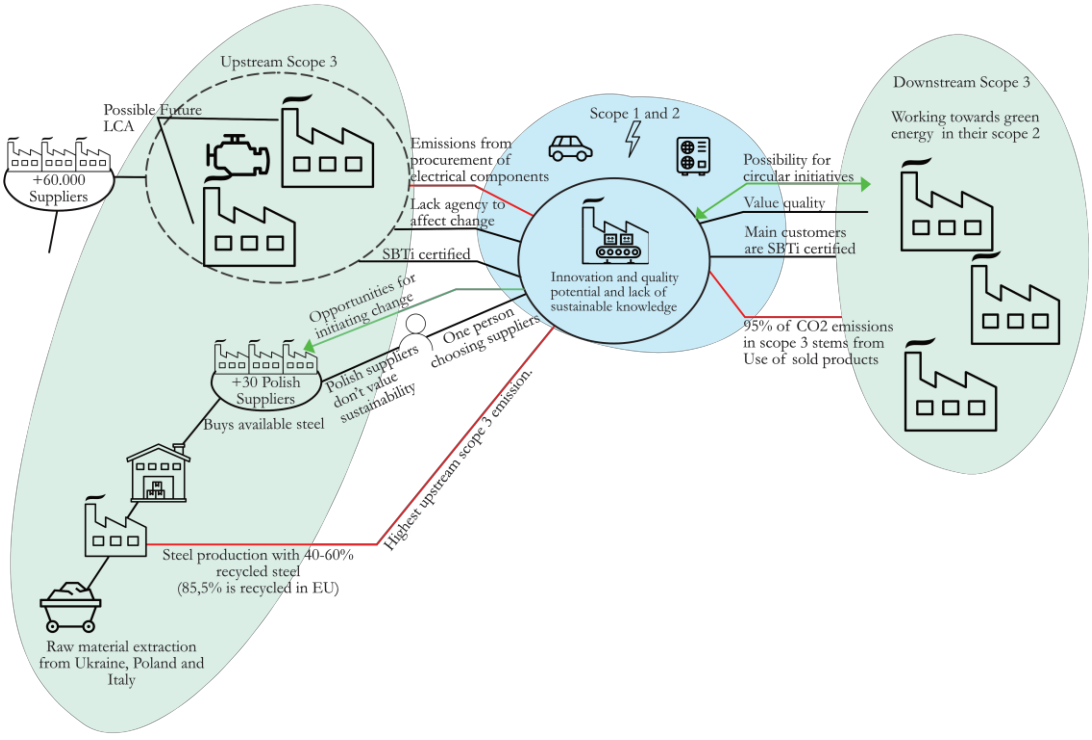


Figure 5: Supply chain overview

Creating such an overview of the SC is key to implementing LCT and hence, considered a necessity for us to direct our analysis of intervention toward a systemic approach that includes all product stages and activities (Oliveira et al., 2021). When considering environmental impacts in scope 3, no product life cycle can be neglected in decision-making, as each life cycle stage of a product influences its sustainability profile (Bey, 2017). Hence, managing sustainability with an LCT perspective can aid organizations in identifying specific circumstances influencing sustainability issues and enhance organizational learning aspects which are beneficial when considering scope 3 emissions (Ibid.).

With this in mind, and with a focus and willingness to initiate change on an SC level, Gamma A/S was interested in knowing where and how to begin, as well as how to define a relevant scope of intervention. To this end, our design process aimed to develop a framework that can aid the organization in strategically prioritizing specific areas of intervention. Accordingly, we are interested in bridging qualitative knowledge related to their organizational capabilities (presented above) with the quantitative calculations of their environmental impact provided by Viegand Maagøe.

5.1.8 Prioritizing strategic activities

With the environmental calculations in our hands and our understanding of the (lack of) capabilities within Gamma A/S, we set out to categorize where strategic action could be taken. Here, we categorized identified emissions following the GHG Protocol (See Appendix 4). As presented in Section 1 and Box 1, the main environmental impact of Gamma A/S stems from emissions in scope 3, more precisely 1) energy use of sold products, 2) procurement of steel and other raw materials, 3) procurement of electronic components, and 4) the EOL treatment of the products.

In relation to categories 10 (processing of sold products), 13 (Downstream leased assets), 14 (Franchises), and 15 (Investments) (Greenhouse Gas Protocol, 2023) these are discarded in this case as Gamma A/S has no emissions within these categories, as well category 1 (Procurement) has been split into three (1a: Purchased electrical motors, 1b: Raw materials, 1c: Other purchases) for us to further highlight different areas of emissions related to procurement activities (Appendix 4).

Having divided the emission hotspots into these categories (following the GHG protocol) we could weigh the environmental impact and place the categories on a diagram related to Gamma A/S's organizational capabilities in addressing each category of CO_2e emissions. Here, organizational capabilities relate to Gamma A/S' abilities to *use* resources in terms of knowledge, power (agency), and learning capabilities in initiating change in each category (Amui et al., 2017; Teece, 2007). Accordingly, we weighed their capabilities based on the

insights presented in sections 5.1.1-5.1.7 which thus cover knowledge related to internal and external conditions, existing power structures as well as innovation and collaboration opportunities.

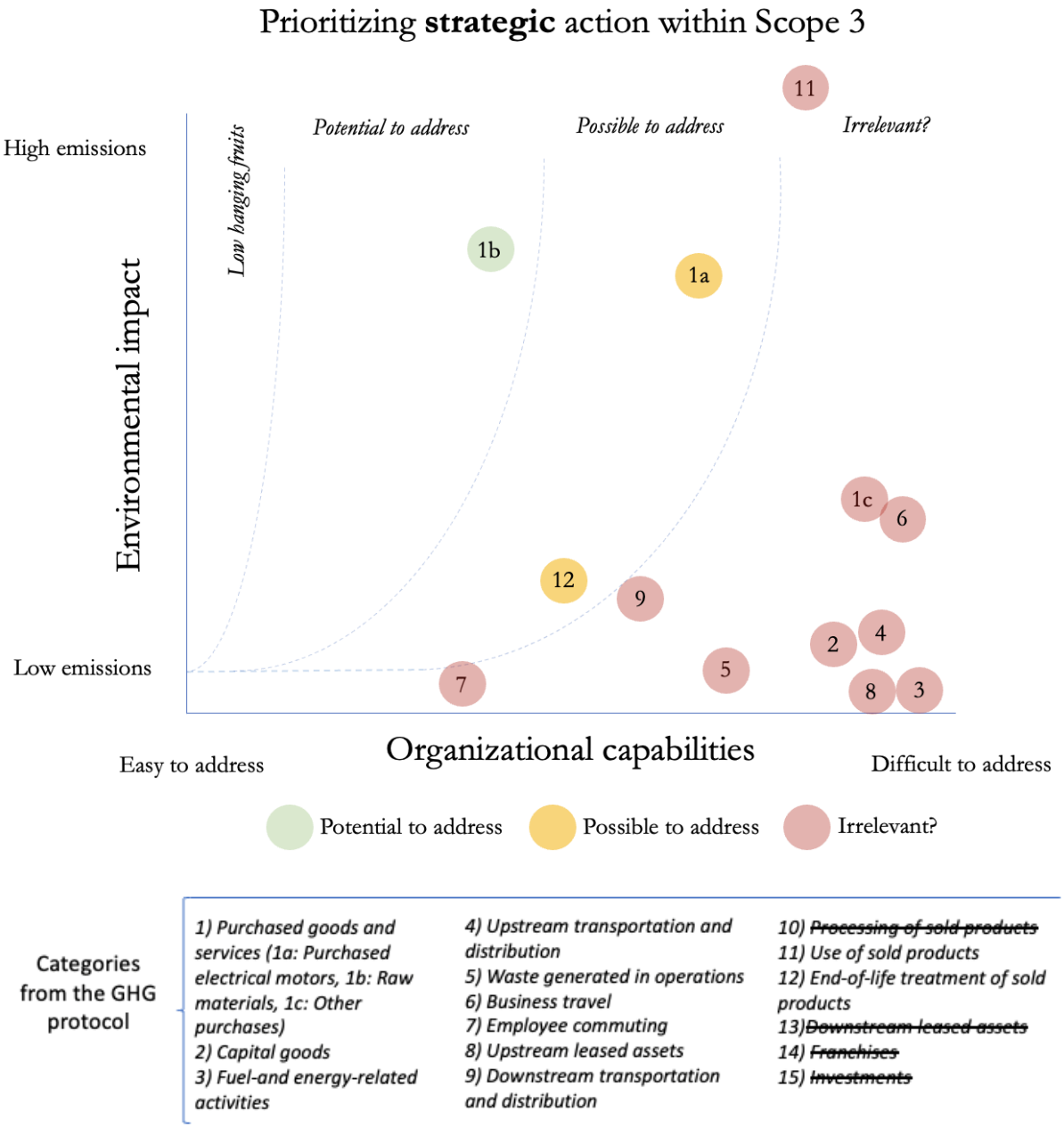


Figure 6: Diagram of GHG emissions weighted by carbon emissions and organizational capabilities in the context of Gamma A/S (Greenhouse Gas Protocol, 2023).

By grouping the categories by adding three lines and color coding the categories accordingly, it becomes clearer which categories to address. While categories left from the first line highlight low-hanging fruits (here non), categories that potentially can be addressed are highlighted in green and placed between the first and second lines (here 1b).

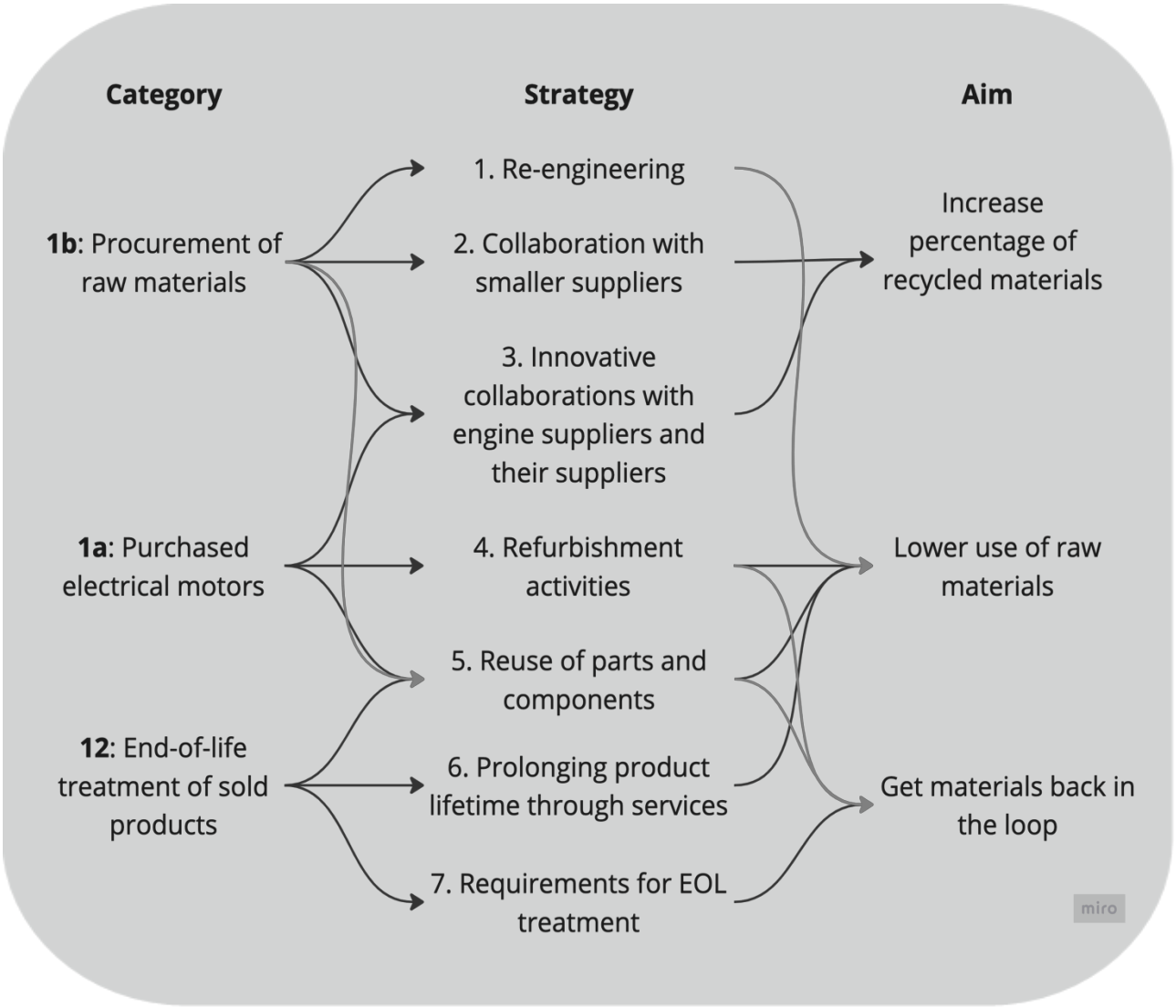
Categories marked in yellow constitute possible interventions (here 1a and 12) whereas categories marked in red are considered irrelevant or difficult to address. Here, categories with low sustainable impacts are disregarded even if they are easy to change for the company, in this example, category 7 (Employee commuting) is relatively easy to change, as electric vehicles are already rolling out and electric charges are at their production facility, but the sustainable gain of this is minuscule, as the commuting kilometers are low. Another example is category 11 (use of sold products) which is difficult for Gamma A/S to influence as it depends on customers' use of renewable energy sources. However, as this category accounts for the largest proportion of CO_2e emissions it should be frequently re-considered, and improvements initiated when possible. Additionally, it must be noted that changes can happen suddenly, which makes other categories (the red) become more important and relevant to address, either through the identification of rising emissions or specific pressures from external stakeholders. Hence, we need to emphasize that the above diagram only represents a snapshot of their current situation and how to prioritize strategies now.

Nonetheless, the weighting highlight categories **1b**, **1a,** and **12** within which Gamma A/S has the potential and possibilities to initiate change and address emissions on an SC level. As our analysis has shown so far, Gamma A/S seems to have the opportunities to 1) affect the procurement of raw materials (by re-engineering products), 2) collaborate with big suppliers in developing energy-efficient products or service activities, or 3) systematize and scaling up circular practices. Consequently, we limit our scope of intervention to include these three categories.

5.2 Developing Strategic Action

The prioritization of where to initiate strategic action was the conclusion of our define phase in the Double Diamond, from here we will diverge our knowledge and (co) develop possible strategies within categories 1b, 1a, and 12 to further the sustainability agenda within Gamma A/S.

Our first iteration of strategy development was done by combining identified strategies from the literature on SSCM, SD, CE, and LCM with identified existing approaches within Gamma A/S (such as re-engineering and circular activities). As a result, seven possible strategies to pursue within Gamma A/S were developed (See Box 2). In Box 2 the link between the emission categories, the strategies proposed, and the overall aim of initiating each strategy is further illustrated. The strategic activities are proposed to mitigate CO_2e emissions by 1) lowering the use of raw materials, 2) keeping materials in the loop, and 3) increasing the percentage of recycled materials used (Blomsma et al., 2020). Some of the strategies relate to design at the product level while others require context design e.g., to develop more circular practices which require collaboration across the SC. Accordingly, the strategies require Gamma A/S to view strategic action from an LCT perspective.



Box 2: The relation between emission categories, strategies, and aims.

Each of the seven strategies influences specific decision-making activities at Gamma A/S such as when selecting materials for products, choosing suppliers, or establishing product recovery practices (Bey, 2017). Yet, it could be argued that each strategy requires different forms of delegation of agency since some of these decisions can be agreed upon internally while others depend on external stakeholders. Examples of the internal decision-making process are the choice of suppliers or when to strategically determine to re-engineer products and systems, which can be agreed upon on a management level. However, strategies on a broader SC level regarding refurbishment, reuse of parts and components, EOL treatment, and service activities to some degree go beyond ordinary organizational boundaries and hence require external collaboration and a willingness from external stakeholders to participate. However, this contributes to an understanding of the interdependence of businesses when initiating actions to improve sustainability issues on an SC level as emphasized in LCM literature (Oliveira et al., 2021). With this in mind, we included these preliminary findings and insights in two workshops held with representatives from Gamma A/S. (See descriptions of workshops in Box 3).

The Workshops

In our initial workshop, we presented our preliminary findings to Gamma A/S as presented above. The reason for this was twofold; first, to get our knowledge and interpretation of their SC and situation validated, and second, to explain our findings to the employees of Gamma A/S.

Furthermore, we presented the potential strategies to 1) get feedback on which they found most important, 2) develop possible new strategies based on our combined knowledge, and 3) discard proposed strategies if found irrelevant or impossible to initiate. Here, we expected that they would find the strategies related to CE relevant for further development. Furthermore, our expectations of this workshop were that they would validate most of our insights, find it interesting, and gain new knowledge.

In the second and active part, an intermediary object was included (Vinck, 2011) to support the participants in prioritizing four of the strategies proposed, first individually and then collectively by using post-its. Here, they individually had to make up their mind and then afterward combine their knowledge and discuss their ratings giving important knowledge about their capabilities to engage with certain strategies.

During the workshop, most of our knowledge was validated and as the workshop had a dialogical nature, discussions also arose which created new knowledge for both parties. Here, it was beneficial for Gamma A/S to gain further insights about their SC as well as how they potentially can address scope 3 emissions through our presented strategies. Moreover, we experienced openness towards our proposals and ideas which further validated our interpretations.

Having prioritized the different strategies and discussed their potentials and implications, a second workshop was held to further develop the strategies and discuss problem areas and opportunities to identify how Gamma A/S potentially can implement these strategies.

During the second workshop, the participants were first asked to individually reflect on potential problem areas and opportunities regarding the reiterated strategies from the first workshop, they were procurement and circular strategies. Then two game boards with the strategies in an SC context were laid out, intending that the participants would place opportunities and problem areas according to their SC relation (See Figures 9 and 11). Hence, serving a contextual understanding of the conditions needed to initiate the strategies in an SC view. Following this participatory exercise, we expected that the participants were able to identify means to overcome potential challenges related to each of the strategies and discuss a potential time plan for initiating change activities towards the realization of the strategies.

Box 3: Description of the workshops.

5.2.2 Prioritizing Strategies

In the first workshop, we presented our collected knowledge and the first seven strategies to narrow them down and further develop the strategies in collaboration with Gamma A/S. In the second workshop, we took the further developed prioritized strategies from the first workshop and reiterated them, as well as discussed their potential and challenges.

After each of the participants had presented their thoughts, the prioritization of the strategies in the first workshop led to the participants collectively choosing *re-engineering* as the main strategy as this is an already established strategy towards 2025; something we were unaware of before the workshop. The second prioritization was a collaboration with steel manufacturers, as this could help ensure the input of 'greener' materials. The third prioritization relates to circular initiatives, such as take-back logistics and increase reuse and refurbishment activities, and the fourth prioritization was the development of closer collaboration with suppliers (see Figure 7). These four strategies are further described in the following sub-section.

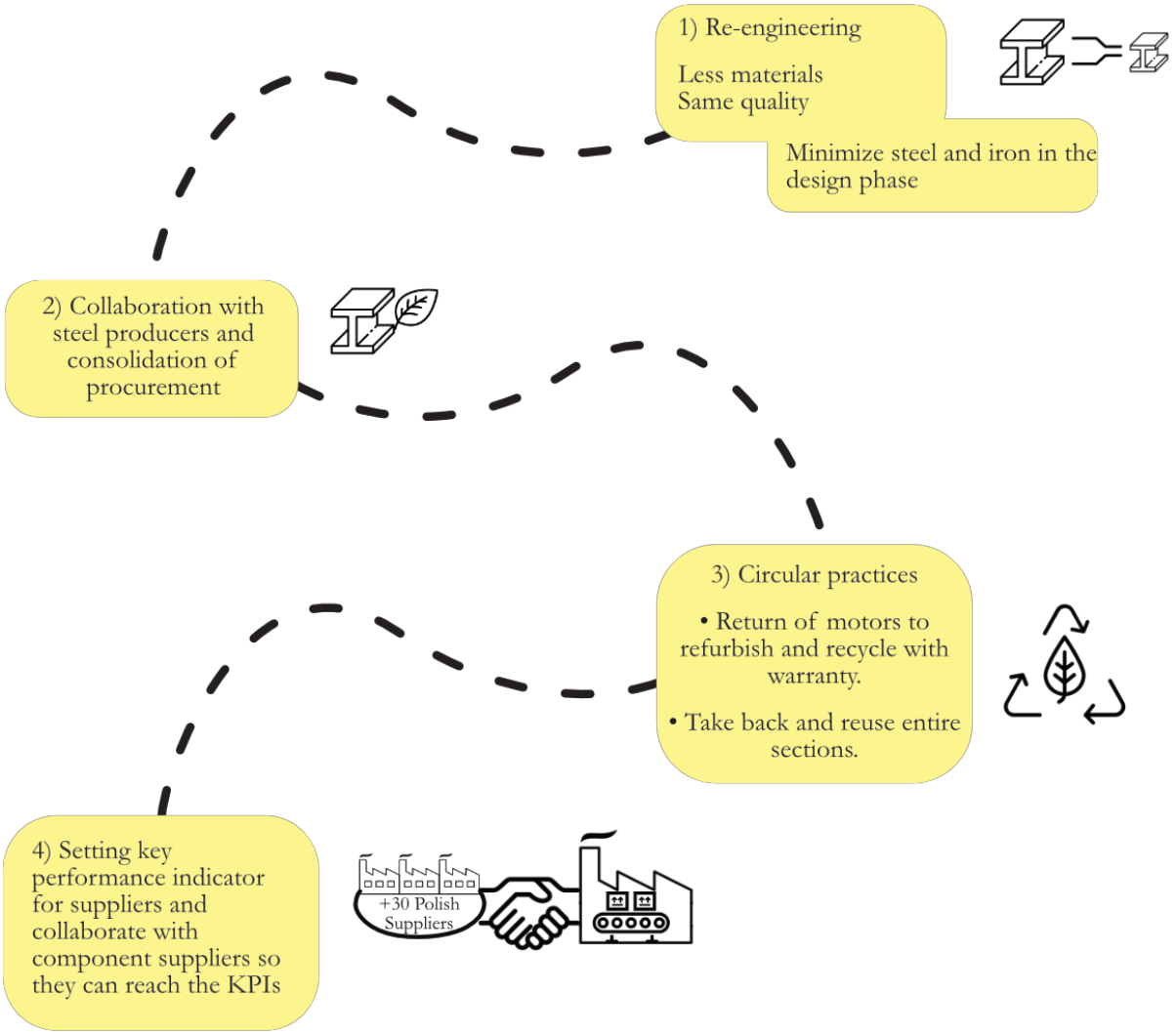


Figure 7: Illustrating the collectively prioritized strategies at the workshop.

5.2.3 Strategy 1: *Re-engineering*

As current products can be produced more environmentally friendly through design features that require less processing and by using fewer materials, re-engineering is considered a highly relevant strategy to pursue. Related to the notion of narrowing (Blomsma et al., 2019) this strategy can have a significant impact on the decarbonization of Gamma A/S as they currently design products with an extra quality margin, to the end where designing quality products with fewer materials is possible. Re-engineering is a strategy that can be initiated without supply-chain interference making it simpler to start developing and harvesting the outcome. Simultaneously, there is a potential business case here as procurement of materials will be lowered and hence reduce expenses.

However, as re-engineering is already strategically prioritized within Gamma A/S we chose not to focus on this strategy in the second workshop as Gamma A/S already has the knowledge and capabilities available to pursue this strategic approach. Nonetheless, re-engineering is a strategy that focuses on changes at the product level and not the unsustainable nature of make-use-dispose (den Hollander et al., 2017), why we consider it relevant to support this approach with the CE strategies presented below.

5.2.4 Strategy 2: Sustainable Procurement

This strategy entails that Gamma A/S starts collaborating with one or several of their main suppliers in Poland. Such collaboration will aim to ensure procurement of 'greener' steel along the SC which is considered an opportunity if Gamma A/S and suppliers collectively push for more environmentally produced steel and hence coordinate procurement practices towards 'greener' sub-suppliers. To support this strategic approach, we chose to combine this strategy with the fourth strategy prioritized which relates to the development of sustainability-related KPIs, as it might aid in coordinating and streamlining procurement practices. However, a potential challenge for initiating such practices is that 'greener' steel currently is 20-30% more expensive than conventional steel (Holt, 2023). Nonetheless, as the re-engineering of products can lead to reduced expenses, there might be both economic and environmental incentives to pay a higher price. In general, it is relevant to combine sustainable sourcing practices with re-engineering approaches as they collectively will lead to a lower use of materials and that the use of materials is as environmentally produced as possible. Here, it is estimated that emissions from steel can be about four times less (Ellerbeck, 2022). The strategy is illustrated in Figure 8.

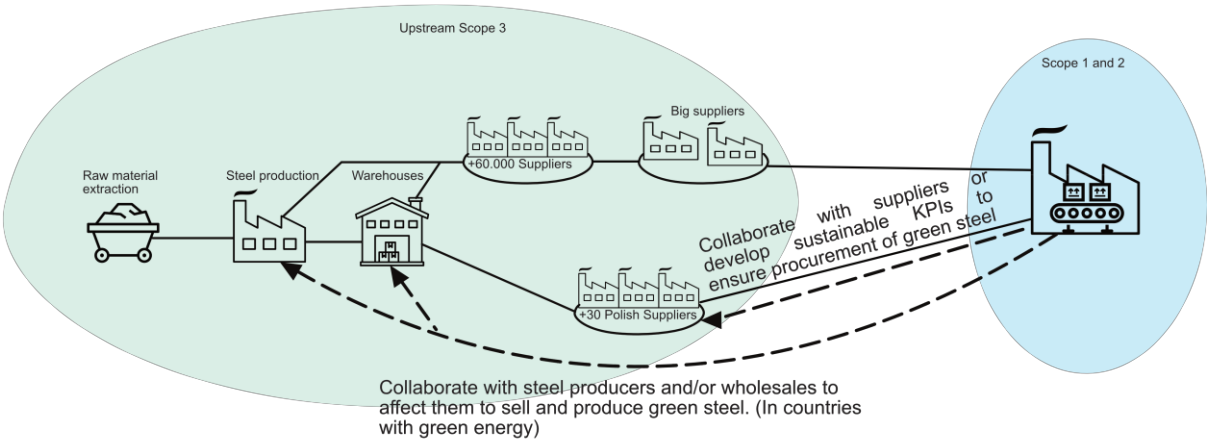


Figure 8: Sustainable procurement initiatives

5.2.4.1 Challenges Related to Procurement Strategies

During the workshops, several challenges were highlighted related to procurement activities as illustrated in Figure 9. One of the main points discussed relates to (a lack of) supplier capabilities in sustainability:

"*With my knowledge about the competencies of the Polish suppliers in relation to the work with sustainable development, I believe, this makes a challenge, but you could choose Polish suppliers who are more established and who are already subject to these (sustainable) requirements, but then the price is probably also something completely different.*" CEO (Appendix 2)

Furthermore, uncertainties about the expenses of 'green' steel were discussed as well as a general lack of knowledge regarding where such green steel can be procured from:

"*The challenge is also our knowledge about procurement of green steel, we know about opportunities in Sweden, but not where else to find it.*" CEO (Appendix 2)

To this end, it was even discussed how to define 'green steel' which illustrates a lack of specific knowledge related to how much steel can be procured and, thus, how (sustainable) KPIs can be developed.

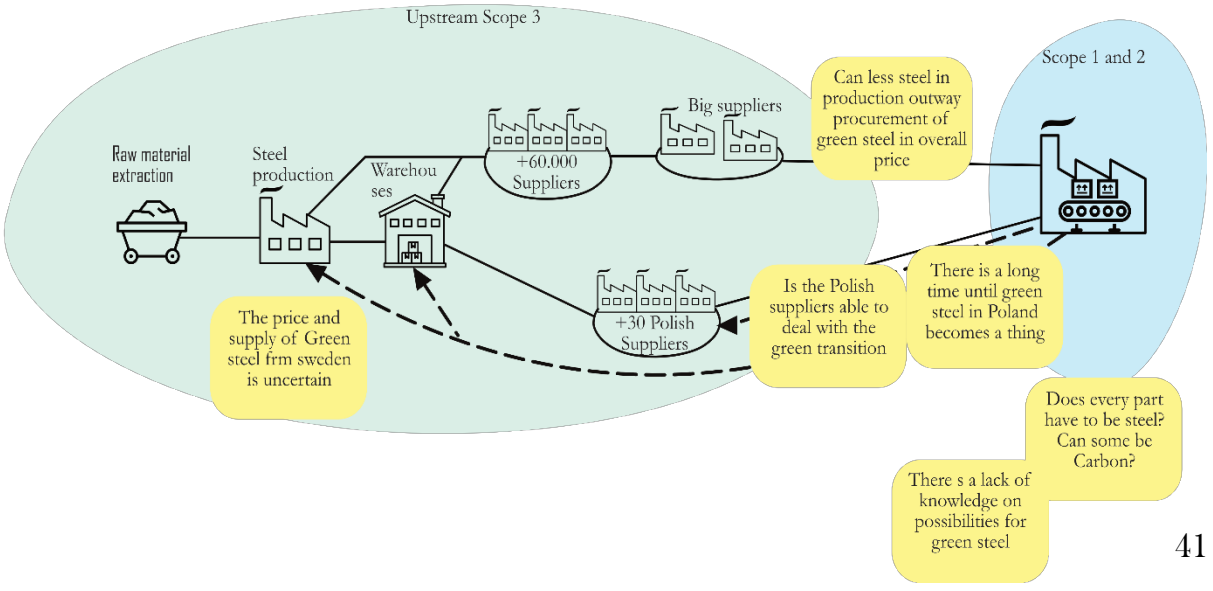


Figure 9: Game board – procurement strategies (Appendix 2)

5.2.5 Strategy 3: Take-back and refurbishment activities

Finally, circular strategies based on take-back, reuse, and refurbishment practices were discussed and prioritized at the workshop (Blomsma et al., 2019). Here, the idea is to develop contractual take-back options so that Gamma A/S can buy back products and systems from customers, refurbish and upgrade these if necessary and then reuse parts and components which are still functional. However, as Gamma A/S operates on a global level, take-back options and opportunities must be considered a country by country to calculate the exact benefit of developing reverse logistics.

Moreover, by combining this approach with a collaboration with the main suppliers of electrical motors, they might be able to take back these engines and either refurbish them or ensure new warranties. We estimate that the suppliers would be willing to be part of this strategy as they are working on similar initiatives and have CE as a main priority in their sustainability strategies. This strategic approach is illustrated in Figure 10.

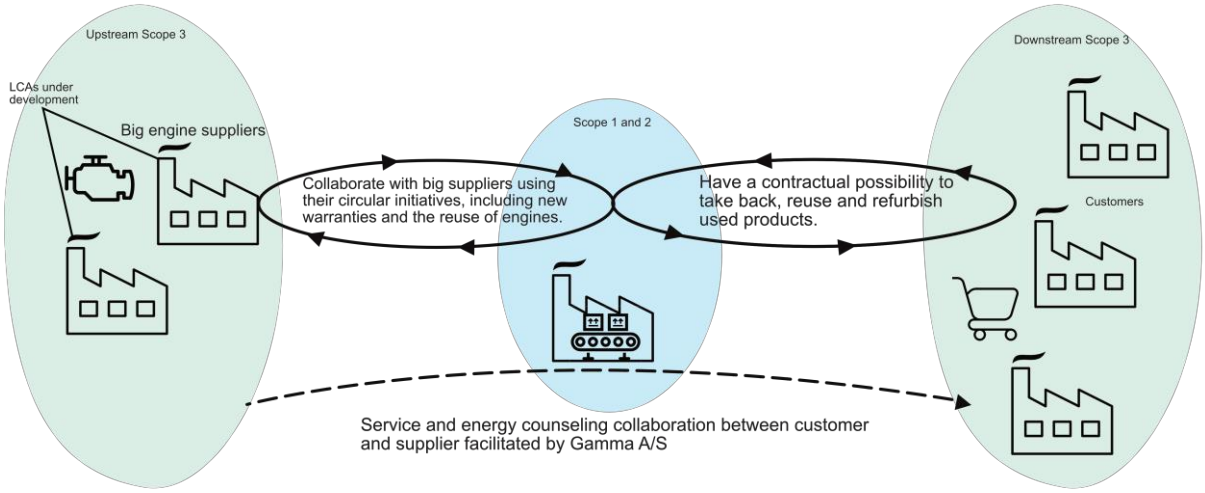


Figure 10: Circular initiatives

5.2.5.1 Challenges Related to Circular Initiatives

Some of the main challenges regarding circular practices (such as take-back solutions and refurbishment) are customer expectations and the setup of reverse logistics. As their Group Director argues:

"*It is about persuading the customers, that 'as new' is as good as new. It is a learning process for them, and they should be open to implementing used solutions.*" (Appendix 2)

When discussing the circular initiatives, it generally became clear that the customer's willingness to source more sustainable solutions might be lacking, as they e.g., have tried

to push for more energy-efficient products in the last decade. This is further emphasized by the CEO:

"*When we participate in meetings about product development, neither they (the customers) nor we have the knowledge or thinks about how we incorporate this (sustainability), therefore it is a challenge for us, and it is something that must be implemented in the entire the organization before it is incorporated into daily practices.*" (Appendix 2)

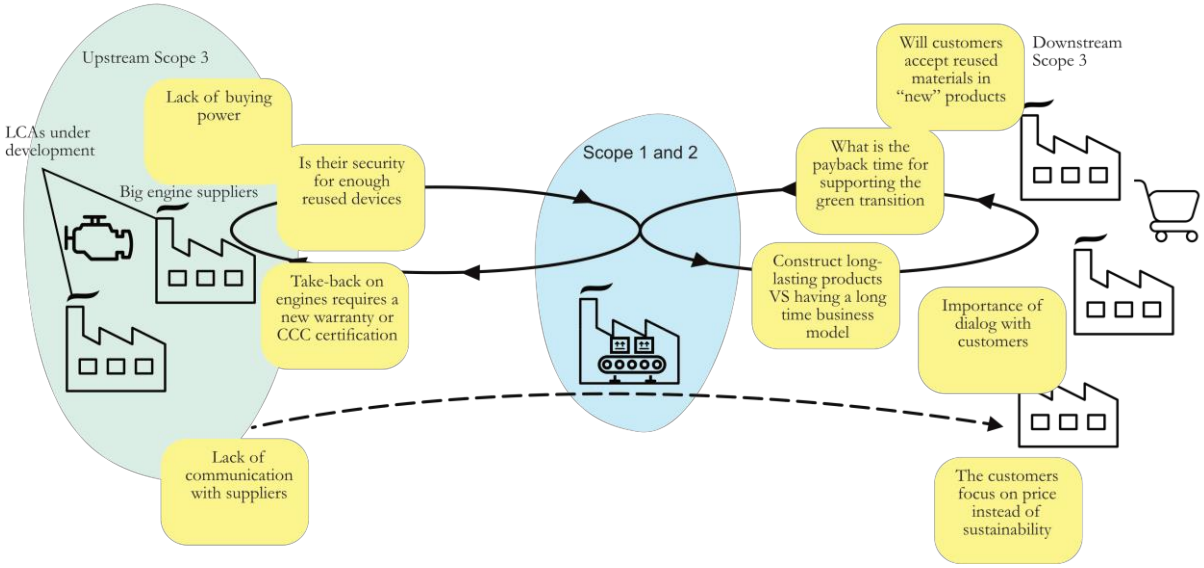


Figure 11: Game board – circular strategies (Appendix 2)

5.2.6 Complementary Strategies

As argued, these strategies depend on each other when effectively addressing scope 3 emissions. This is further illustrated in Figure 12, where it is highlighted that all three strategies are mutually inclusive and affect various parts of the SC and different product life cycle stages. Re-engineering will lower the input of materials needed, but not decarbonize the material per kilogram, sustainable procurement and KPIs might lower the impact of the extraction phases, but not the total amount of materials, and the circular initiatives will prolong the life of the products and strengthen and ensure a higher degree of reused materials in their products, and hence, cut emissions from raw material extraction and manufacturing processes. In the figure, the three strategies are illustrated in green while the conventual flow of materials is depicted in the inner (black) circle.

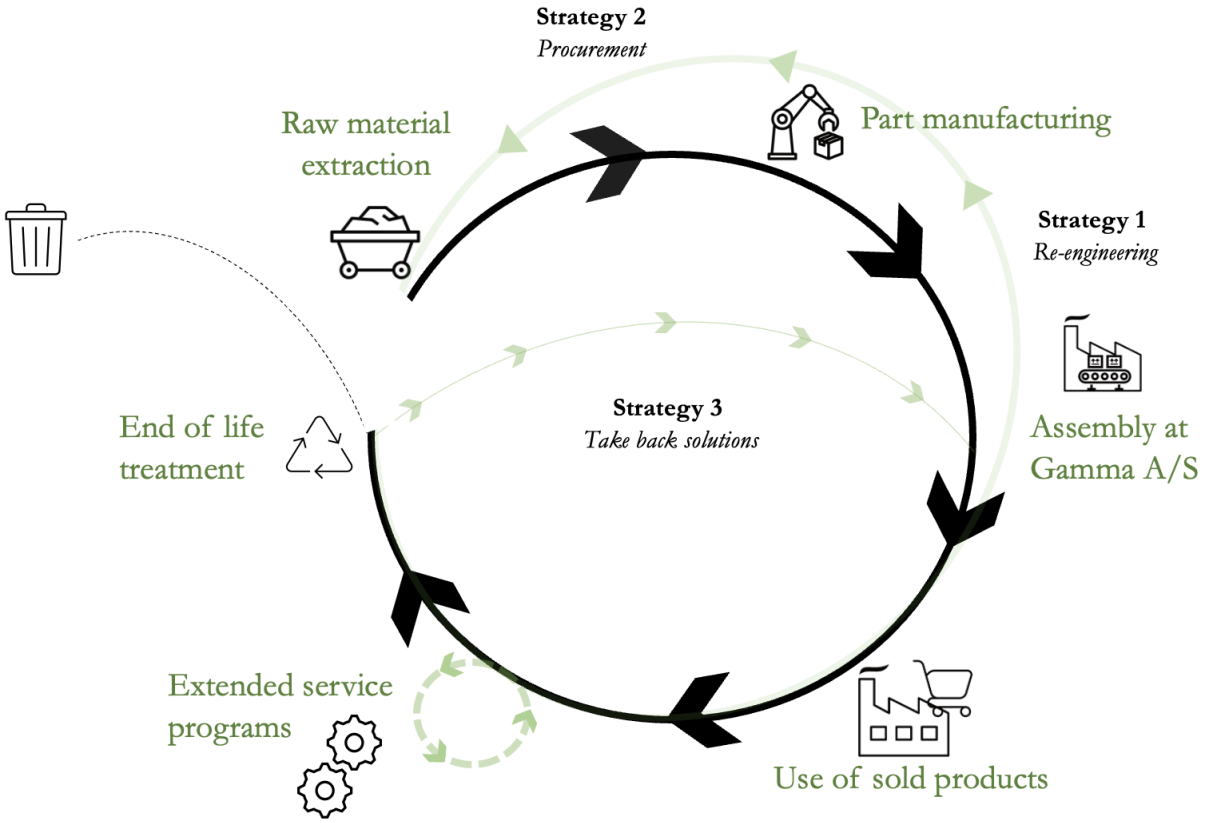


Figure 12: Complementary strategies

5.3 Implementing Strategies

In this section, we initiate the deliver phase of our Double Diamond design process by converging knowledge and investigating how the explored strategies can be implemented. Hence, we are to identify potential and actionable solutions which Gamma A/S could initiate in pursuing the three strategies prioritized.

During the second workshop, a discussion about how to possibly overcome identified challenges and initiate operational activities within each strategy was facilitated. Regarding re-engineering, the development of a prototype was discussed as a means to illustrate what a re-designed product system would look like. A prototype does not require large economic investments and might support the sales of such a new re-designed product, as their customers then can physically experience more environmentally friendly product design as emphasized by their CEO:

"It is a competitive advantage if we can tell we are way ahead of our competitors in this area (…) and it does not require large economic investments in developing a prototype, which moreover can support customers in reaching their sustainability targets." (Appendix 2)

Hence, prototypes might work to counteract the challenge of customers solely focusing on prices and to help mature the idea of *new* products entailing reused and recycled materials.

However, while it is estimated that a prototype could be launched in December 2023, the need for mobilizing actors internally and externally in this process was discussed:

"We need to involve employees and other stakeholders through dialog and ask if this is realistic as well as giving them some ownership in the process." Shipping Coordinator (Appendix 2)

More specifically, they pointed towards the need of involving actors from the construction department to design and re-engineer a product system and then to incorporate Polish suppliers which can manufacture new product designs. And by combining this approach with sustainable procurement practices and involving the internal procurement team, it would be possible to manufacture a prototype made of 'greener' steel. Additionally, when lowering the expenses of steel procurement there is a stronger economic incentive to source 'greener' steel, hence, serving as a potential business case for Gamma A/S. To this end, their Shipping Coordinator argued:

"*Towards 2024 we may well have held some of these dialogues with suppliers and thus have a clarification regarding the purchase of 'greener steel'*." (Appendix 2)

Furthermore, it was discussed how to overcome potential challenges related to take-back strategies and the development of reverse logistics, as Gamma A/S operates globally. To this end, the participants discussed the possibilities of initiating a local pilot project where take-back solutions could be tested before scaling up such activities. The idea here is to initiate a local project with one of their main customers in Scandinavia through which knowledge can be gained in an explorative setting. Additionally, leasing models of products were discussed which is a business model design, they have not thought of priorly. Here, they considered it meaningful to lease robots to their customers, instead of selling them up front:

"*Robots would be obvious and is a really good idea to lease if we are to look at circular business models because we can always use it again afterward and practically illustrate reuse opportunities related to our robots*." CEO (Appendix 2)

Developing prototypes and initiating small-scale projects supports Gamma A/S in viewing products through an LCT perspective and in building relevant capabilities. Hence, by prototyping, new knowledge can be gained internally which can lead to a better understanding of opportunities in terms of sustainability-related activities (Houde & Hill, 1997). Moreover, it also gives external actors capabilities in green construction, and it supports customers' possibility to learn about and source more sustainable products. In sum, gaining knowledge when developing prototypes and screening the market for sustainable procurement options also generates capabilities to work with sustainability and interact with more ideas.

At the same time, prototypes and pilot projects can delegate agency, by translating equipped knowledge to customers, thereby, giving them the ability to act on sustainable market possibilities as well as influencing the development of the strategies by voicing

potentials and concerns (Vinck, 2011). An example is equipping a prototype with knowledge about a sustainable alternative and when actors see this, they are able to interact with it and develop it. However, the prototypes also delegate agency internally as commissioned projects interest and mobilize employees, increasing their stake and willingness to work with sustainability. Thereby, the projects help delegate agency to develop sustainability across different departments within Gamma A/S and if this process is successful these actors can delegate agency to involve even more actors (Karnøe & Garud, 2001). Gamma A/S can, therefore, facilitate change for sustainability by creating intermediary objects equipped with new knowledge, that can induce dialog, which can develop existing capabilities.

5.4 Preliminary Results

The outcome of the workshops illustrates how decarbonization strategies can be identified and collectively prioritized as well as challenges and opportunities influence the implementation of such strategies. To visualize our insights, we have developed Figure 13 based on LCM (Bey, 2017). The internal part of Figure 13 shows the need to involve a variety of departments and how LCM affects these departments if a holistic LCT approach is to be integrated, based on strategic interventions from a hotspot analysis (Ibid.). In this Figure, we have also considered external actors and hence how upstream and downstream operations influence the LCM of the company in focus (scope 3). This creates an understanding of the many complex variables, also including contextual pressures, that are needed to prioritize strategies and use LCM in a way that is beneficial to the company, and the surrounding SC, and work toward the sustainable transition. In Figure 13, some strategies are implicitly connected to different departments and the example of Gamma A/S highlights how the SC can affect a company.

The process undertaken with Gamma A/S highlights that addressing scope 3 emissions requires an understanding of the different life cycle stages of products, along with a contextual understanding of the situatedness of the SME, and their abilities in developing capabilities within the SME as well as the entrepreneurs' carrying agency and pushing for change as argued in section 5.4.1 (Karnøe & Garud, 2001). As identified, addressing scope 3 emissions requires organizational capabilities in estimating power relations on an SC level, understanding their role in the SC, and how to utilize these insights to strengthen and initiate (sustainable) improvements. Hence, realizing scope 3 emission reductions is a complex process, and ensuring a lower carbon footprint also requires an understanding of potential impacts at a broader level. However, our design process illustrates a potential pathway to translate complexity and wicked problem areas into specific, actionable strategies and intervention points.

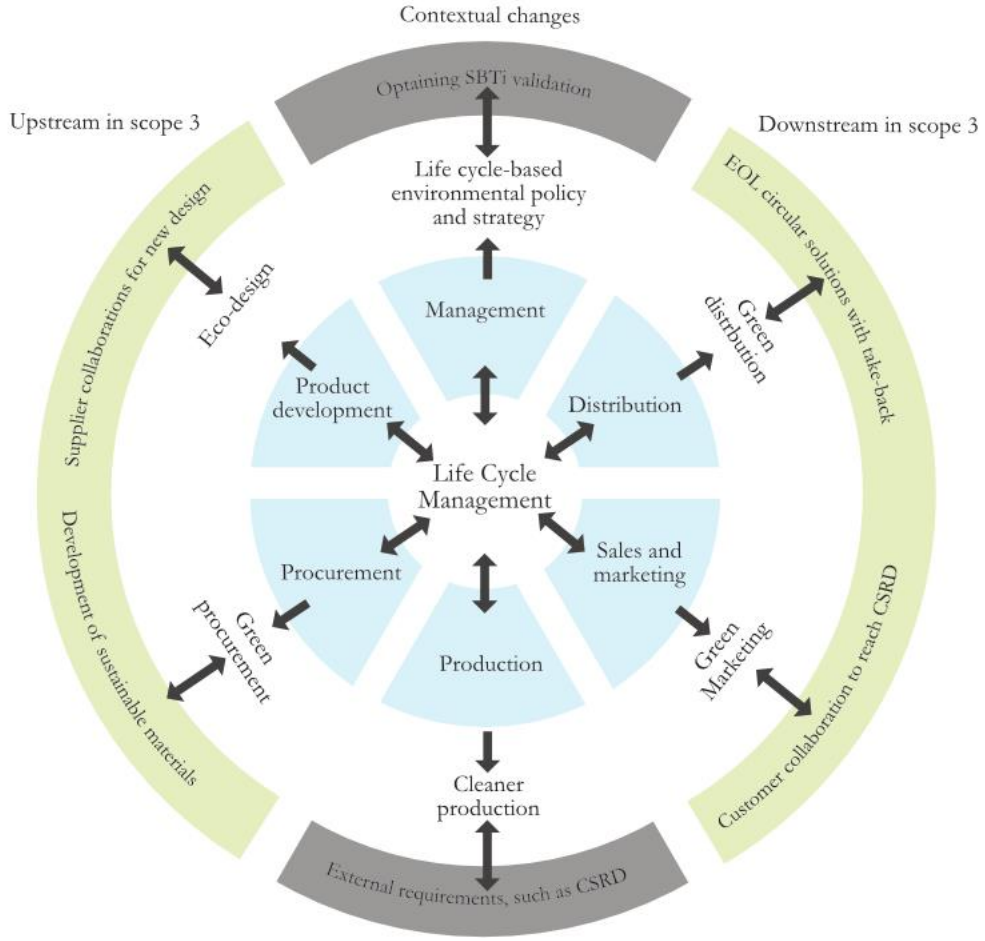


Figure 13: LCM in context applied in Gamma A/S

Additionally, it requires calculating and measuring the specific sustainability issues to identify (emission) hotspots to know where to improve. In relation to this, some emission hotspots might be easier to address than others which can be irrelevant or too difficult to address, as it is shown in Figure 6. To this end, our diagram developed (figure 6) might be a scalable tool, which can be used in identifying intervention areas in other organizations.

Moreover, to further analyze and understand the path toward sustainability in Gamma A/S and to understand how such paths are created, we have observed this process with a path creation lens for us to analytically investigate the work of relevant actors of how these 'disembed' from existing structure (Karnøe & Garud, 2001).

5.4.1 A path creation process

The path creation process for sustainability has been observed during the design process. This process's initial conditions are rising external pressure from SBTi-validated customers and internal pressure from the ownership fund owning 1/3 of Gamma A/S. Over time this pressure grows and the CEO along with the Shipping Coordinator started to initiate a change process, however, this generated resistance among the owners of Gamma A/S (Figure 14) as the Group Director said *"Sustainability is expensive and with less revenue we can't*

get raises" Group Director (Appendix 2), which prompted the CEO to state *"The biggest weakness and strength for us is that we have done the same the last 50 years"* CEO (Appendix 2).

Illustrating that change cannot follow current structures and mindfully deviating from lock-ins is necessary, and that current capabilities play a role in exploring new opportunities. To combat the lock-ins, a carbon accounting exercise was undertaken which became a part of the new path, as this process aided Gamma A/S in delegating agency and in spanning boundaries to (potential) customers. This translated into knowledge showing the owners and sales department the potential in making sustainable changes, and a slow maturing process started to change the mind of the owners.

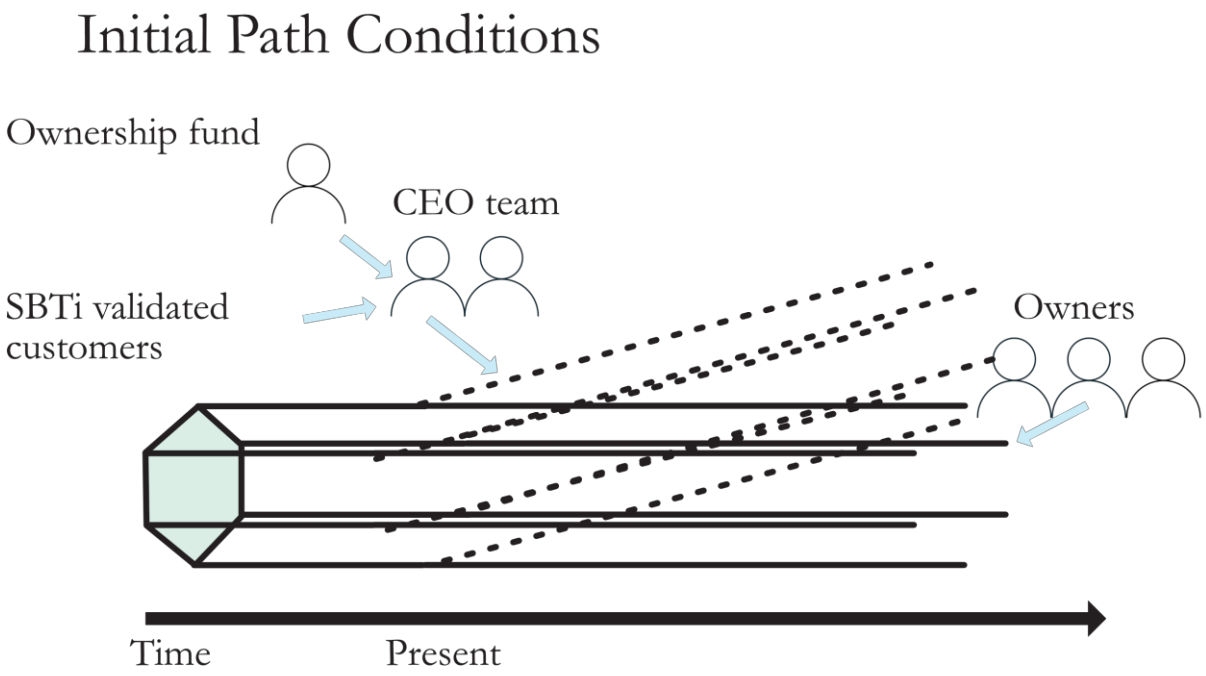


Figure 14: Initial Path creation within Gamma A/S

At this point, we started our project. Our many exploratory interviews showed a lack of actors playing a role in the emerging collective around sustainable changes, but they also showed potential for mobilizing more actors (Karnøe & Garud, 2001). One highlight of our interviews is that the current SC is locked-in a linear economy approach, but has the potential to change through new collaborations, like collaborating with engine suppliers to mindfully utilize their emerging circular strategies such as refurbishment of engines. In this example, just the fact of us as sustainable students having an interview can delegate agency to the discussion of sustainability and show the opportunity to dis-embed from the current locked-in linear SC and expand the organizational control of Gamma A/S.

To involve and familiarize more actors with the strategies including them in the action net the two workshops were undertaken (Czarniawska, 2008). Hence, it is the human agency and entrepreneurship of relevant actors that can interest and involve more people along

with creating knotworks that mobilize actors and delegate agency to act (Karnøe & Garud, 2001; Lindberg & Czarniawska, 2006). This is seen in the maturing of the Group Director, as agency was delegated to carbon accounting, SC actors could voice their approval across the SC boundary which made him more willing to work with sustainability. He then took part in the strategy development at the workshops and became a path creator realizing that sustainable strategies might not have a huge negative impact on revenue (Karnøe & Garud, 2001). This opened the possibility to mindfully open the lock-in of the current business model within Gamma A/S and shows the potential of other business models, through the Group Director becoming an entrepreneur in the action net that delegates agency to create this path.

While developing the strategies some goals were set which include pilot projects that with the right equipping can generate knowledge, capabilities, dialog, and discussion with relevant actors and thereby delegating agency to the process (Vinck, 2011). This can allow external and other internal actors to take part in the project and help develop the pilot, possibly embedding and giving inertia to the strategy as a new sustainable structure, as is seen in Figure 15 (Karnøe & Garud, 2001). Commitment from external and new internal actors can allow continual and progressive modification of the strategy and thereby also the path, however, it will most likely create resistance within some SC actors. On top, pilot projects generate knowledge at the boundary between domains, meaning that they can give agency to certain aspects that can make new designs viable (Carlile, 2004).

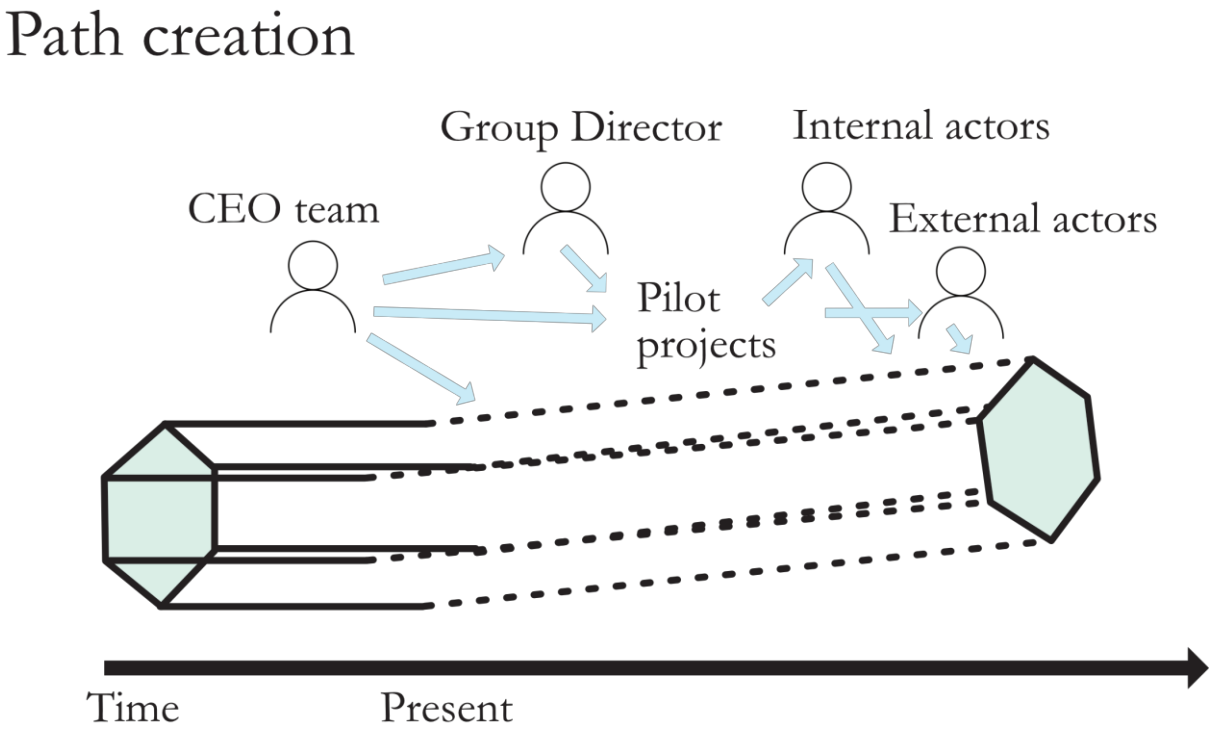


Figure 15: Path Creation within Gamma A/S

The carbon accounting exercise, external pressure, and other micro-level events delegated agency that could initiate a new path and the workshops equipped with knowledge-transferring strategies build on this agency to break lock-ins and mobilize actors in the path creation process. The workshops also showed places where the human agency should be delegated to new entrepreneurs, who can make structures of strategies so more actors can continually and progressively modify the strategies. Hence, the path creation process has been initiated by different actors and Gamma A/S will soon be able to see if it is successful or not, but they can mindfully mobilize SC actors in the path creation process to embed new structures. Based on the results and findings presented, we are to discuss these in relation to insights and gaps identified in our Literature Review in the Section below.

6. Discussion

Within this section, we are to relate our empirical work with the insights and academic gaps stressed in our literature review. Hence, we will discuss how our results and findings contribute to current academic literature and how our design process has aided us in doing so.

6.1 Catalysts for addressing sustainability in supply chains (scope 3)

As presented in our literature review, a gap identified relates to a lack of knowledge regarding catalysts for addressing environmentally sustainable SCs; especially how non-financial accounting can act as a catalyst. Here, we have observed how CO_2e accounting exercises have led Gamma A/S in formulating strategic actions and initiatives which can lead to lowering their environmental impact.

More specifically, with the environmental calculations we have aided the organization in identifying several strategic opportunities and interventions through a participatory design process. This was done by visualizing their capabilities in addressing scope 3-specific emission categories, which itself led to the development of new organizational capabilities as representatives from Gamma A/S gained knowledge about strategic possibilities in influencing sustainable practices along the SC. The development of capabilities is furthermore observed through the potential actions discussed during the workshops, illustrating how such collaborative processes can aid organizations in translating strategic initiatives into concrete specific activities. Hence, this case emphasizes Garcia-Torea and colleagues' (2022) point that sustainable accounting does not lead to sustainable change alone, however, it can be used as a tool to pursue sustainable change.

Here, we have experienced that sustainable accounting can act as a catalyst for initiating dialogues towards more sustainable SCs as our case emphasizes the need for involving a broad range of both internal and external stakeholders when realizing strategic intervention points (Hahn et al., 2023). When addressing emissions across SCs it becomes not only

necessary to involve different internal departments but also to facilitate dialogues and collaboration with external organizations such as suppliers and customers. This relates to the overall necessity of having an SC overview to better understand the relations between businesses herein and to initiate interventions from an LCT perspective (Bey, 2017). Achieving sustainability in scope 3, hence, requires SMEs to understand the different life cycle stages of their products to identify emission hotspots and thus where to strategically prioritize interventions. Thus, our findings contribute to current academic literature as knowledge on how SC collaboration can support the development of sustainable strategies and CE strategies is currently scarce.

6.1.1 Circular Practices in SMEs

As strategic CE initiatives have been discussed in our case study, we have identified multiple elements influencing Gamma A/S in deciding whether to pursue and integrate circular practices. One of our main findings relates to the business case in initiating circular practices (and sustainability initiatives in general) as it is considered vital that there is monetary value in developing reverse logistics, providing service or spare parts for customers, or when refurbishing product lines. However, we consider this element strategically important if organizations are to integrate circularity into their core business model instead of viewing them as an 'add-on'.

To this end, our case study gives insights into how organizations can develop SBMs through a participatory setting. Here, the representatives discussed sustainable activities through a holistic system-thinking approach and how such practices could be incorporated into their business model (Bhatnagar et al., 2022). Viewing the potential strategies from a business model perspective becomes relevant as it is considered a necessity to reach sustainable solutions (Geissdoerfer et al., 2018). To this end, we have through our design process built on Bhatnager's (2022) key design principles when innovating for SBMs by 1) measuring sustainability impacts, 2) making sustainability goals explicit, 3) involving various stakeholders and integrating a systemic perspective to achieve these. Here, our case study provides insights and contributes to bridging the intersection between SC collaboration and CE practices, which is currently limited (Hazen et al., 2020).

Moreover, though we have not conducted the exact calculations of the potential environmental benefits of the strategies proposed, it is estimated that circular practices can aid organizations in lowering scope 3 emissions which is another main reason for organizations to integrate such practices (Danish Business Authority, 2023). This e.g., covers strategies related to take-back solutions, refurbishment, and reuse activities, however, several accounting challenges might act as a barrier to pursuing circular strategies. As we have experienced, defining product lifetime highly influences the emission category *use of sold products* as service and maintenance activities prolong singular product lifetime which increases the overall emissions in the use phase (Holt, 2023). This might leave

organizations with a lower incentive to initiate such activities from an accounting perspective despite its net positive environmental performance such as achieving zero waste (e.g., Agyabeng-Mensah et al., 2023; Howard et al., 2022)

Furthermore, our case study shows that different circular strategies and business models strongly relate to a firm's product portfolio. In this case, initiating take-back solutions were discussed concerning electrical motors and potentially full product lines while business models based on leasing models only were considered an opportunity regarding their robots. Hence, CE initiatives are incorporated and discussed on a product level and do not cover their entire value proposition, illustrating CE as a potential 'add-on' instead of being considered a core business activity. We, therefore, consider it relevant to re-visit these reporting standards, so that the benefits of circular practices are positively considered (Holt, 2022).

Nonetheless, implementing circular strategies might result in the organization being less dependent on the input of raw materials and can strengthen collaboration between the organization and its suppliers and customers, hence increasing operational control over scope 3 emissions (See e.g., Danish Business Authority, 2023).

6.1.2 The Role of Individuals

We have contributed to closing an academic gap as we have conducted our case study with a path creation lens to theoretically investigate the role of individual actors and agency. As this perspective is reflected in several findings it is generally clear how the role of individuals and their personal values influence the integration of sustainability in an organization as argued by Korsakienė & Raišienė (2022). Here it is clear, that some of the representatives of Gamma A/S act as change agents and entrepreneurs in their push for sustainability internally (Alvesson, 2002), and that their individual mindset and understanding of sustainability to a high degree influences the change processes as argued by Hampton et al. (2022) and Sohal & De Vass (2022).

In the case of Gamma A/S it is seen, that the top management focus on sustainability generally influences the organizations' capabilities in addressing such issues and, hence, it can be argued that these individuals collectively have the DCs needed to develop sustainability-oriented strategies by reconfiguring internal competencies and resources as a response to changing market circumstances (Teece, 2007; Sunyer Torrents & Gibb, 2013). This is seen in the management teams' abilities in influencing sustainable change and organizational learning capabilities towards sustainability which can be strengthened if pilot projects and re-engineering activities are initiated. Here, resources and capabilities can mature in an explorative setting and in collaboration with external partners where existing capabilities are combined (Korsakienė & Raišienė, 2022; Olarewaju et al., 2023). Such activities can be viewed as learning processes where knowledge can be exchanged, benefiting both parties, which is central when delegating agency between actors (Jia et al.,

2021). Accordingly, the role of individuals, their commitment, and their abilities in delegating agency are pivotal for initiating change inside and outside organizational boundaries.

6.2 Impact on a broader level?

Some implications of the strategies proposed to address scope 3 emissions need to be further addressed to discuss potential impacts. This is relevant, as Bianchi and Cordella (2023) emphasize that higher circularity rates might not reduce the extraction of primary resources and as Hahn and colleagues (2023) argue, that assumed factors like 'what gets measured gets done' do not necessarily lead to sustainable change at a societal level (Hahn et al., 2023, p. 4).

In terms of the procurement strategy, it was discussed whether the case company was able to buy steel with a higher recycling rate from a low-carbon manufacturer. This implies two things; Gamma A/S pursue a higher degree of recycled materials in their product line, which might lower CO_2e emissions due to less direct extraction of primary resources, and the manufacturer produces steel based on renewable energy sources. However, with an average recycling rate of steel within the EU of 85% it is difficult to increase this percentage (EuRIC AISBL, 2020). Nonetheless, the recycling rate is unevenly distributed across the EU resulting in steel suppliers having significant differences in their recycling rate. This results in businesses looking for suppliers with a higher recycling rate, however, as there is only a limited number of such suppliers, not all steel manufacturers can procure steel with such a high recycling rate. Consequently, on a global scale, this does not influence the recycling rate (which is already high) but might positively affect individual firms' CO_2e impact. Accordingly, mitigation of CO_2e emissions by changing procurement practices might be identified in individual organizations but does not mitigate average emissions on a societal scale.

Regarding circular practices such as the development of reverse logistics to increase direct reuse and refurbishment activities, potential rebound effects must be considered (Korhonen et al., 2018). As the establishment of such activities relates to specific products or components they will, consequently, not cover the entire product portfolio and hence not influence all business activities. Hence, it does not mitigate enough resources in relation to what is currently needed within Gamma A/S (Brozovic, 2020). Moreover, it might be difficult to calculate the exact benefit of initiating circular practices, and as priorly argued, some of these activities even increase CO_2e emissions in current accounting tools. Additionally, circularity increases emissions from logistics which further needs to be considered when calculating potential (reduced) impacts.

Another challenge relates to the uncertainties of take-back solutions as the flow of production systems or components is unknown. Hence, the organization does not know when they can reuse or refurbish materials and parts, making it difficult to scale up such

practices and leading them to continue sourcing primary resources. However, this further emphasizes that addressing scope 3 emissions requires a holistic view and that strategies are pursued and incorporated in a way that makes them act complementary, as argued in Section 5.2.6. To this end, no circular or procurement strategy can stand alone, and several strategic approaches must be considered simultaneously in close collaboration with internal and external stakeholders across the SC (e.g., Guldmann & Huulgaard, 2020; Konietzko et al., 2020; Schulz et al., 2021).

7. Reflections

In this section, we are to reflect upon our design process and engagement with the case company. This includes reflections regarding the level of design, our co-design process, our contribution to the field of Sustainable Design Engineering (SDE), the scalability of our findings, and potential further research areas.

7.1 Design Reflections

While this thesis is conducted on a Double Diamond design process, our insights represented builds on several design approaches such as participatory design, product-level design, and design of contexts as elaborated below.

7.1.1 Participatory (design) Approaches

As dialogical design approaches might increase the likelihood of implementing changes and contribute to building capabilities, we have used participatory-design approaches to include relevant actors in our process of developing potential strategies (Pedersen, 2020). Scholars within co-design further argue that the involvement of actors and the translation of knowledge across boundaries gives ownership to the actors, incorporates professional capabilities, and, hence, results in more distributed knowledge and improved design processes (Carlile, 2004; Pedersen, 2020).

As facilitators, we have helped make the actors reflect more on the identified strategies and their capabilities, creating knowledge about internal capabilities and possibilities (Pedersen, 2020). An example of this relates to how CBM (leasing opportunities) were discussed among participants during the second workshop, which priorly was unconsidered, but which was reflected upon due to our presence, and where potential opportunities were agreed upon. Hence, the knowledge gained from these participatory settings was of utmost importance to us and the development of the strategies in general. To this end, it could have been interesting and valuable to have facilitated more co-design sessions with an even wider variety of actors to bring more knowledge into play and potentially transform more knowledge across boundaries (Carlile, 2004). To this point, the lack of actors at the workshops (as mentioned in section 4.3.1) entails that the workshops were scheduled to

include more capabilities and could have engaged even more actors that could become entrepreneurs in the change process (Karnøe & Garud, 2001). However, due to a limited timeframe, we did not have the opportunity to schedule more workshops or re-schedule workshops due to a lack of individual participants.

7.1.2 Level of Design

Beyond taking a participatory design approach based on the design principles of 1) being people-centered, 2) communicating inclusively and visually, and 3) collaboration (Pyykkö et al., 2021) when conducting our case study and co-developing possible solutions, we have relied on a hot-spot analysis of CO_2e emissions to determine where to make improvements (Bey, 2017). However, while a typical response to this kind of calculation often relates to 'eco-design' or 'green design', such approaches solely focus on technological and insular changes and, hence, lack the systemic perspective needed to achieve a sustainable transition (Brozovic, 2020). Nonetheless, by incorporating the theoretical perspective of LCM which requires one to use LCT in the design process, it enables us to design on a broader level and to relate our approach to the spatial-social and socio-technical level of design (see Figure 15) (Ceschin & Gaziulusoy, 2019; Young, 2008).

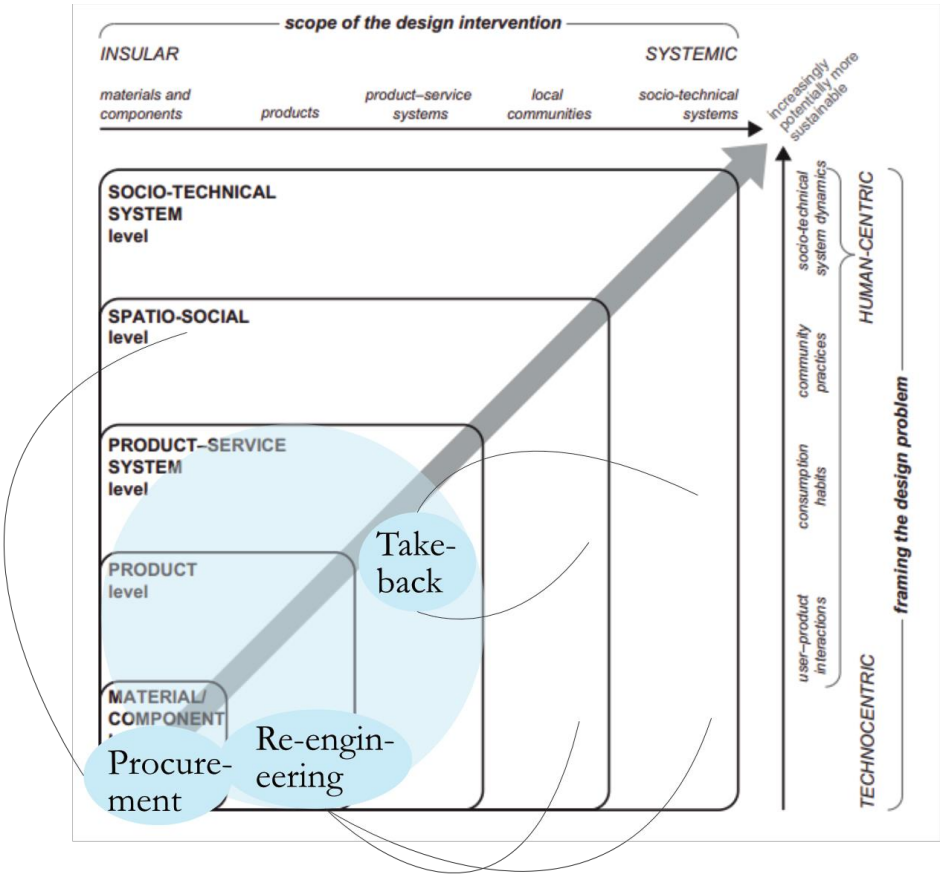


Figure 25: Our approach in relation to the design for sustainability framework based on Ceschin & Gaziulusoy (2019).

As depicted in Figure 15, the three strategies discussed in our design process relate to the levels of material, product, and PSS levels of design, however, they have the potential to influence changes on a spatio-social and socio-technical level. Here, the case of 'greener' steel procurement and re-engineering includes supplier collaboration to incentivize and support organizational learning and capabilities on an SC level, hence, influencing broader community practices and consumption habits. Hereby, agency must be delegated between firms in an SC to enable actors in initiating collaborative sustainable strategies to reach systemic changes. Furthermore, for the development of reverse logistics (take-back solutions) to be effectively implemented, SC actors must be willing to accept reused or recycled materials, hence, current community practices must change (Ceschin & Gaziulusoy, 2019).

7.2 Contribution to the Field of Sustainable Design Engineering

Investigating an SME in its ability to address and facilitate sustainable changes from an SC perspective is relevant to the field of SDE since 64% of all GHG emissions stem from SMEs and research on the role of established SMEs in sustainable changes is currently scarce (Hampton et al., 2022). As well, still more SMEs are eager to act on the sustainable agenda due to societal pressure but lack the knowledge and capabilities in addressing such issues. To this end, our case study and design approach contributes to understanding how sustainable change can be initiated from the perspective of an SME and which role organizations can play in addressing scope 3 emissions.

While the process of conducting sustainable calculations has been addressed in academic literature, our design process provides a means to operationalize such calculations and hence, how to deal with complexity. Here, analyzing organizational capabilities and assigning individuals to be entrepreneurs can create an understanding of how agency can be delegated to certain actionable changes (Swarr et al., 2015). Therefore, this thesis contributes to a contextual understanding of organizational capabilities, where to delegate agency based on a hotspot analysis, and how to initiate and operationalize environmental scope 3 changes and develop sustainable capabilities, which other SDEs can learn from.

7.3 Scalability

We argue that our design approach used in this case study is applicable in other organizations looking for strategic interventions in scope 3. This is particularly due to the flexibility of our approach which can be adapted to fit specific organizational circumstances. Hence, while other scholars or practitioners can replicate our design processes in other cases, they must adjust and base their work on the specific organizational capabilities and the knowledge generated from a given hotspot analysis in developing strategic interventions.

To this end, the diagram used (figure 6) is considered feasible for other companies, and even though we use the emission categories as a prioritization, it could also be based on an LCA or other environmental issues such as water acidification, eutrophication, and human toxicity. There even might be a possibility that the diagram could be used in prioritizing socially sustainable initiatives according to organizational capabilities related to gender equality, work conditions, or anti-corruption issues. Nonetheless, this aspect emphasizes our case as being a critical case study, as Gamma A/S has learned from this approach, and while it is considered possible, that other organizations can learn from this case as well (Flyvbjerg, 2010). However, to determine the scalability of our work further research must be done to draw a stronger conclusion.

7.4 Limitations and Further Research

As our design process is conducted within a single critical case study, further research could test the applicability of our process in other single- or multiple-case studies. Such research would determine the scalability of our work and possibly identify other organizational capabilities which influence SMEs in addressing scope 3 emissions. However, further research could explore how SMEs strategically can address other sustainability-related issues on a SC level such as social sustainability, and compare these findings to their capabilities in addressing environmental sustainability issues.

A challenge related to the development of such complex scope 3 strategies is to calculate the overall environmental gain when influencing multiple processes at once. Furthermore, while we have discussed potential pathways to address scope 3 emissions on an SC level, actual tests of these solutions have not been considered possible to initiate, resulting in a limitation of our thesis (Pyykkö, 2021). Hence, a second research gap that has emerged is how to calculate environmental or climate impacts from complex changes process which also account for rebound effects. Such research would be highly interesting as it might contribute to determining whether developed strategies lead to environmental improvements; not only for the individual organization, but on a broader societal level, which is considered a necessity.

To make sense of complex situations, it is necessary to choose certain theories and disregard others. To this end, we have identified relevant theories outside the scope of this thesis that can add to our approach and generate new findings. One such theory is the actor-network theory, as it can highlight key relations and breakdowns in the change process, which can increase the understanding of where the action is needed to mobilize actors and ensure the implementation of a given strategy (Callon, 1986). Another such approach is a more technical and engineering perspective (e.g., Eco-design) allowing for a deeper understanding of the role of materials and re-design of products in creating environmental changes and how this affects the SC and the development of strategies (Ceschin & Gaziulusoy, 2019). A third interesting approach to investigate the role of SMEs

in a sustainable change context would be to use the multi-level perspective in studying how SMEs can develop entirely new systems, and how the proposed strategies relate to the current regime and niches (Geels, 2005).

8. Conclusion

In this thesis, we have investigated if and how an SME strategically can address and facilitate environmental sustainability across its SC (scope 3). Methodologically, this was done by using a participatory design approach in the conduction of a qualitative case study of a Danish manufacturing SME in their initial work with environmental sustainability on an SC level. On this basis, their organizational capabilities in influencing sustainable changes have been analyzed through the theoretical lenses of Life Cycle Management (LCM), Path Creation, and the delegation of agency.

Based on our theoretical and methodological approach, several findings are considered relevant. First, it has been identified that a hotspot analysis (in this case CO_2e accounting) is a prerequisite for addressing environmental sustainability to understand the environmental impact of activities along the supply chain. Second, while such an analysis does not tell *how* to strategically address emissions, a tool combining the hotspot analysis with the organizational capabilities needed to address each emission category has been developed to support organizations in prioritizing strategic action (figure 6). Here it became clear that the case company had varying degrees of capabilities to address the different emission categories, however, three emission categories were considered feasible and relevant for the case company to strategically address. Our assessment, hence, indicates that organizations might have different capabilities in addressing specific scope 3 emission categories and that the tool developed can work as a means to prioritize strategic action and reduce complexity.

Third, our case study illustrates how an SME can tackle the challenges related to facilitating sustainable change across their SC by developing and initiating pilot projects in close collaboration with key SC actors. Here, organizational learning capabilities towards initiating decarbonization activities can co-develop across organizational boundaries and increase the ability to tackle scope 3 emissions collectively. This indicates that an explorative approach can contribute to strengthening organizational agency and capabilities to influence change on an SC level by including the internal and external actors needed to create paths toward environmental sustainability.

9. References

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