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Positioning Remanufacturing as a Circular Manufacturing Strategy

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ABSTRACT

The transition from a linear "take–make–dispose" model to a circular economy (CE) is critical for reducing resource use and energy consumption while advancing circular manufacturing in industry. Remanufacturing is a key circular manufacturing strategy that restores end-of-life products to like-new condition, offering substantial potential for value retention and reductions in virgin material and energy use. There is considerable potential for original equipment manufacturers (OEMs) to adopt remanufacturing if its associated challenges can be identified and overcome. One such industry is the furniture industry, which faces significant challenges in implementing remanufacturing due to return-flow uncertainty, process complexities, market resistance, and capability gaps. Despite its potential, remanufacturing remains underexplored from a strategic manufacturing perspective, and there is limited understanding of how organizational capabilities enable firms to integrate remanufacturing into their operations.

This thesis addresses these gaps through two studies. Study 1 employs a systematic literature review to develop the concept of Remanufacturing Manufacturing Strategy (ReMS), demonstrating how manufacturing structures, infrastructures, competitive priorities, and capabilities need to be reconfigured to embed remanufacturing strategically. Study 2 employs a multiple-case study of Swedish furniture OEMs to examine remanufacturing from a dynamic capabilities perspective. This study uncovers market-, production-, and sustainability-related opportunities and barriers, providing insight into how firms sense, seize, and reconfigure resources in the pursuit of remanufacturing.

The findings show that remanufacturing is not only an operational activity but also a strategic, capability-dependent transformation requiring alignment between ReMS and dynamic capabilities. This thesis contributes to manufacturing strategy research by extending it into the circular manufacturing domain and clarifying how capabilities enable remanufacturing adoption, while offering managerial guidance for OEMs seeking to build these capabilities and remain competitive in a resource-constrained future.

Keywords: remanufacturing, manufacturing strategy, remanufacturing strategy, circular economy, dynamic capabilities, furniture industry

LIST OF APPENDED PAPERS

Paper I: Chamirangika Madushani Hetti-Arachchige, Mirka Kans, Peter Almström, Dan Paulin. (2025). "From Manufacturing Strategy to Remanufacturing Strategy (ReMS): A foundation for Circular Manufacturing".

An earlier version of this paper was presented at ICoR2025.

Submitted to an academic journal.

Paper II: Chamirangika Madushani Hetti-Arachchige, Mirka Kans, Peter Almström, Dan Paulin. (2025). "Leveraging Dynamic Capabilities for Remanufacturing: Insights from the Swedish Furniture Industry".

An earlier version of this paper was presented at EurOMA2024.

Working paper, to be submitted to an academic journal.

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TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. Remanufacturing as a circular manufacturing strategy 2
1.2. Research gap and RQs 5
1.3. Delimitations of the research 6
2. THEORY AND KEY CONCEPTS 7
2.1. Overview 7
2.2. Remanufacturing 7
2.3. Manufacturing strategy 9
2.4. Circular economy 11
2.5. Dynamic capabilities framework 12
3. METHODOLOGY 15
3.1. Research process 15
3.2. Study 1 16
3.2.1. Research design of Study 1 16
3.2.2. Data collection of Study 1 17
3.2.3. Data analysis of Study 1 17
3.3. Study 2 18
3.3.1. Research design of Study 2 18
3.3.2. Data collection of Study 2 19
3.3.3. Data analysis Study 2 21
3.4. Quality of the research 21
4. SUMMARY OF THE APPENDED PAPERS 25
4.1. Paper 1 25
4.1.1. Background and purpose 25
4.1.2. Findings 25
4.2. Paper 2 26
4.2.1. Background and purpose 26
4.2.2. Key findings 27
5. DISCUSSION ON KEY FINDINGS AND CONTRIBUTIONS 31
5.1. Research question 1 31
5.2. Practical contribution of study 1 34

5.3. Theoretical contribution of study 1 35
5.4. Research question 2 36
5.5. Practical contribution of study 2 39
5.6. Theoretical contribution of study 2 39
5.7. Synthesizing study 1 and 2 39
6. CONCLUSION 41
6.1. limitations 41
6.2. Future research 42
REFERENCES 43

LIST OF TABLES

Table 1: Definitions of remanufacturing from internationally recognized standardization institutions 7
Table 2: Characteristics of manufacturing strategy based on Wheelwright (1984) 9
Table 3: Definitions of manufacturing strategy literature 10
Table 4: SLR content analysis process steps 17
Table 5: Analytical categories 17
Table 6: Data collection methods from the organization........ 19

LIST OF FIGURES

Figure 1: Lifecycle of a product that undergoes remanufacturing based on EMF (2013) 1
Figure 2: Generic remanufacturing process based on Sundin (2004) 2
Figure 3: Industry Sector-specific remanufacturing intensity industry turnover, and employment in the EU based on ERN (2015) 3
Figure 4: Overview of the study 7
Figure 5: CE strategies 10R model 12
Figure 6: Dynamic capabilities view based on (Teece, 2007, 2018; Teece et al., 1997)........ 13
Figure 7: Research process since the beginning of the author's doctoral studies........ 15
Figure 8: Remanufacturing Strategy formulation 33
Figure 9: Identified opportunities aligned with dynamic remanufacturing capabilities 38

LIST OF ABBREVIATIONS

CE	Circular Economy
EOL	End of Life
CM	Circular Manufacturing
MS	Manufacturing Strategy
EU	European Union
HDDOR	Heavy-Duty and Off-road Equipment
EEE	Electrical and Electronic Equipment
OEMs	Original Equipment Manufacturers
SMEs	Small and Medium-sized Enterprises
DC	Dynamic Capabilities
RBV	Resource-Based View
DCV	Dynamic capabilities view
DRC	Dynamic remanufacturing capabilities
SLR	Structured Literature Review
ReMS	Remanufacturing Strategy
CLSC	Closed Loop Supply Chain
KPI	Key Performance Indicators

1. INTRODUCTION

Over the last century, mankind's unsustainable exploitation of Earth's finite natural resources has endangered the very system on which our future development and survival depend. Our planet's natural resources are limited, yet economic advancement and living standards driven by industrial growth have fuelled excessive extraction and overconsumption (United Nations, 2025). To illustrate the intensive resource consumption, the Global Footprint Network annually calculates the Earth Overshoot Day, which marks the date when humanity's demand for ecological resources exceeds what the Earth can regenerate each year. It has drastically changed over the decades, where in 1970 it fell on December 29, whereas in 2025 it occurred on July 2 (Global Footprint Network, 2025). Manufacturing organizations hold significant potential for large-scale impact if they align their strategies with the reality of the planet's finite resources (United Nations, 2025). A successful transition from the current linear economy of "take–make–dispose" toward a circular economy (CE) offers a pathway to decouple economic growth from the consumption of finite resources (EMF, 2013).

CE envisions a system where the value retained in a product at its end-of-life (EOL) is recaptured to reduce waste, utilize resources efficiently, and reintroduce the product into the market (Geissdoerfer et al., 2017; Kirchherr et al., 2017a; Webster, 2017). Circular strategies such as reuse, remanufacturing, and refurbishment aim to keep products, components, and materials at their highest utility and value at all times (Geissdoerfer et al., 2017; Webster, 2017). Manufacturing organizations can contribute to CE goals not only by implementing these circular strategies but also by developing manufacturing strategies that enable these practices (Aljamal et al., 2024; Asif et al., 2021; Paraschos et al., 2024). Circular manufacturing (CM) strategies define how manufacturing systems, processes, and capabilities must be designed and managed to support activities like remanufacturing, refurbishment, and recycling (Acerbi et al., 2021; Asif et al., 2021; Chari et al., 2022).

Compared to recycling, which primarily recovers raw materials for new products, remanufacturing comprises product-level recovery of material that extends the life of a recovered product or part by giving a new life, contributing to the reduction of overall waste (Bras & McIntosh, 1999; Lund, 1984). Refurbishment, on the other hand, extends product life through superficial improvements such as cleaning, refinishing, and minor repair to a good working condition (EMF, 2013; Rashid et al., 2013). While refurbishment restores functionality, remanufacturing ensures original performance and restores the product or component to as-new condition. Remanufacturing thus offers a higher level of value retention by restoring products to like-new condition, making it a more sustainable and environmentally beneficial CM strategy (Matsumoto et al., 2016). Figure *1* illustrates the lifecycle of a product that undergoes these strategies.

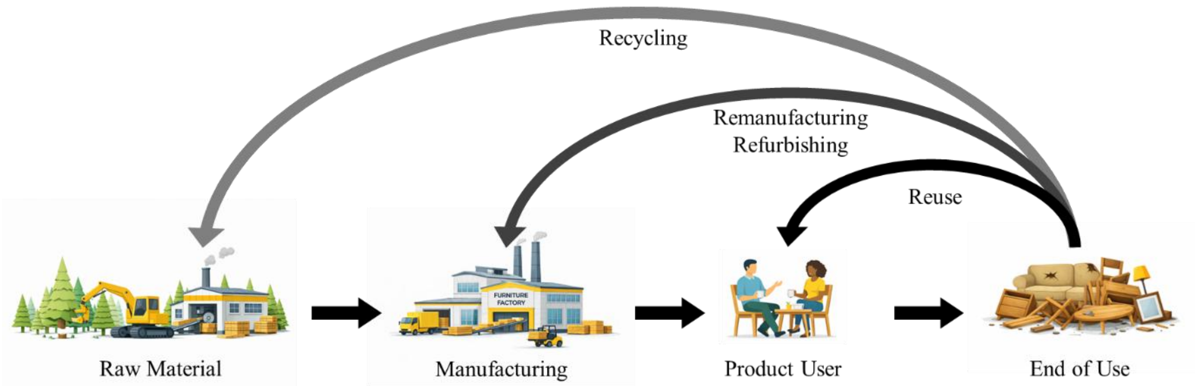

Figure 1: Lifecycle of a product that undergoes remanufacturing based on EMF (2013)

1.1. Remanufacturing as a circular manufacturing strategy

In remanufacturing, EOL products, which are known as cores, are systematically restored through industrial processes to attain similar or enhanced features as new products (Sundin, 2019). As illustrated in Figure 2, the remanufacturing of the core passes through a number of remanufacturing operations, e.g., inspection, disassembly, part reprocessing, reassembly, and testing. Such remanufactured products not only retain their initial performance level but are also accompanied by a warranty that ensures similar or better quality (BSI, 2009). As an essential CE strategy within a resource-efficient manufacturing industry, remanufacturing contributes to the prolonged utilization of components and materials, thereby mitigating substantial energy consumption and emissions (ERN, 2023).

Since sustainability has become integral to competitive advantage, remanufacturing stands out by reducing waste and reducing virgin material use, becoming an environmentally and economically sound approach that aligns with CE goals (Morgan and Gagnon, 2013). By closing the materials use cycle and establishing a closed-loop manufacturing system, remanufacturing exemplifies a holistic and forward-thinking contribution to both economic and environmental objectives (Guide Jr, 2000).

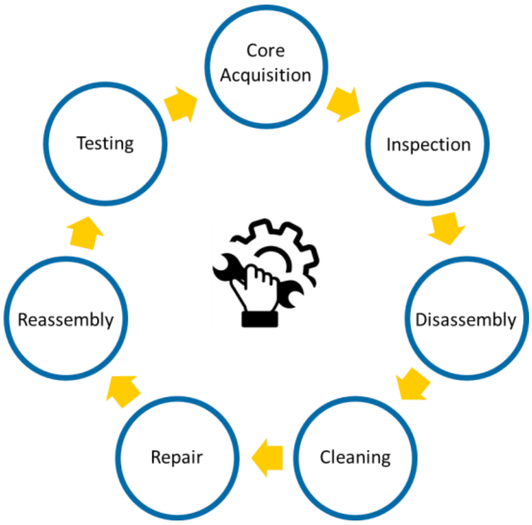

Figure 2: Generic remanufacturing process based on Sundin (2004)

Remanufacturing in the European context

Despite increased attention to recycling improvement in the European Union (EU), there is minimal emphasis on higher-value circular resource flows. Remanufacturing, constituting less than 2% of the EU manufacturing turnover, remains an overlooked aspect. Moreover, remanufacturing has already gained momentum in markets such as China and the USA, leaving Europe trailing behind in these economies (Parker et al., 2015). Furthermore, the remanufacturing-to-manufacturing ratio varies significantly across industry sectors in the EU, as shown in Figure 3.

The blue bars represent the estimated turnover (€ billion) generated by remanufacturing in each sector, the green line shows employment (thousands), and the red dashed line indicates remanufacturing intensity (% of total sector manufacturing). Accordingly, the aerospace sector dominates EU remanufacturing, accounting for the highest turnover of €12.4 bn and intensity of 11.5%, indicating that remanufacturing is a well-integrated practice within this industry. The automotive, heavy-duty and off-road equipment (HDOR), and electrical and electronic equipment (EEE) sectors also show substantial economic and employment contributions, though with lower relative intensities around 1–3%. In contrast, furniture, marine, and rail sectors exhibit both low turnover and low intensity, suggesting limited adoption of remanufacturing practices. Furthermore, it is noted that the highest intensity is in industries where the products are made of valuable metals. Despite this presence, the remanufacturing industry is a devalued part of European manufacturing, albeit contributing to value recovery, economic growth, and job creation (EFIC, 2021; Furn 360, 2018).

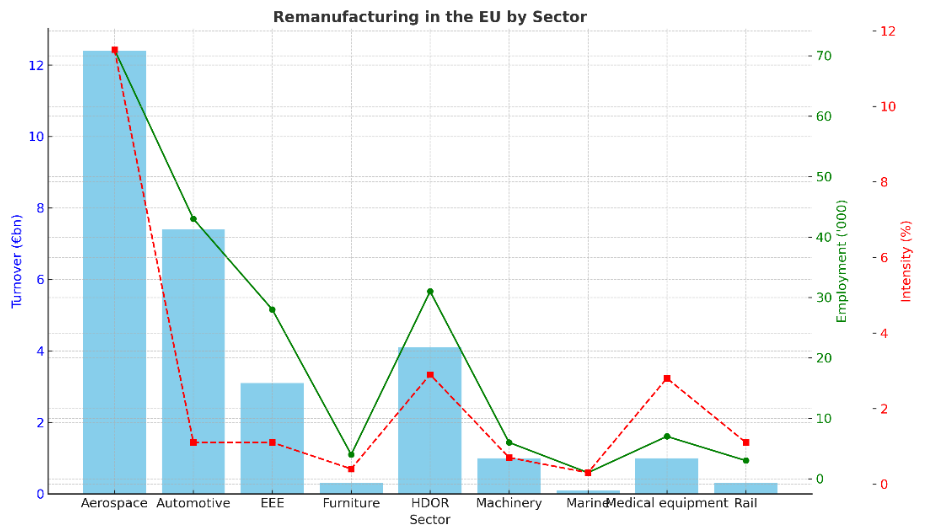

Figure 3: Industry Sector-specific remanufacturing intensity industry turnover, and employment in the EU based on ERN (2015)

Several studies state that sectors, including aerospace, automotive, Heavy-duty off-road (HDOR), and electronic products, have implemented the remanufacturing processes (D'Adamo & Rosa, 2016; Yang, 2020; Zhang et al., 2022). However, certain sectors, despite exhibiting high potential, have yet to adopt these practices widely. One such industry is the furniture sector. (ERN, 2015; Kans & Löfving, 2024). According to the European remanufacturing network (ERN) market study, remanufacturing in the EU furniture sector represents only 0.4% of total manufacturing activity (ERN, 2015). A report by Furn 360 (2018) emphasizes a concerning trend in the EU where 90% of furniture is either sent to landfills or incinerated. Furniture waste within the EU constitutes over 4% of the total municipal solid waste inventory, resulting in an annual output of 10.78 million tons across the EU28 member states. The report also emphasizes the lack of CM activities in the furniture industry.

The Swedish furniture industry remains a significant contributor to the country's manufacturing sector, reflecting strong domestic production and a trade balance. In 2024, total furniture production is estimated at SEK 26 billion, a slight decline from SEK 27.4 billion in 2023 (TMF, 2024). The industry is also export-oriented, with exports valued at SEK 20.5 billion and imports at SEK 20.4 billion, indicating a nearly balanced trade flow. It comprises approximately 2,381 companies, including 775 firms with employees and 1,606 sole proprietorships, collectively employing around 11,304 people. This industry is characterized by small and medium size enterprises (SMEs). In addition, IKEA Industry, with manufacturing operations in Älmhult and Hultsfred, is a major contributor to the Swedish furniture industry, with a combined turnover of SEK 2.52 billion in 2024 (Tillväxtverket, 2023; TMF, 2024).

Manufacturing strategy perspective

The term Manufacturing Strategy (MS) was first articulated by Skinner (1969) as a means of leveraging manufacturing capabilities to achieve competitive advantage. Since then, MS has developed into a well-established field that guides how firms align manufacturing structures, infrastructures, and capabilities with strategic objectives (Hayes, 2006; Hayes & Wheelwright, 1985; A. Hill & T. Hill, 2012; Kulkarni et al., 2019; Miltenburg, 2008; Skinner, 1969, 1974, 2007; Swamidass et al., 2001; Voss, 1995). As organizations face increasing pressure to operate sustainably and adopt CE practices, this body of knowledge must evolve to respond to new forms of competitiveness.

OEMs struggle to integrate remanufacturing into their existing business and manufacturing while maintaining profitability (Krystofik & Gaustad, 2018). Recent studies highlight a significant knowledge gap in how OEMs can strategically embed remanufacturing within their operations (Kurilova-Palisaitiene et al., 2024). MS is particularly relevant here because it provides systematic guidance on how manufacturing should be configured and developed to support a firm's strategic goals. Traditional MS is insufficient for guiding OEMs in adopting remanufacturing, given the characteristics of remanufacturing product return uncertainty, material flows, and capability demands distinct from conventional manufacturing (Abbey & Guide, 2018). These characteristics challenge many of the assumptions underlying traditional MS. However, the literature has a limited focus on manufacturing decisions under uncertainty and sustainability considerations, despite their critical importance for practitioners (Dohale et al., 2021; Kulkarni et al., 2019). Therefore, a MS perspective is essential for identifying which manufacturing structures, infrastructures, and capabilities need to be adapted or reconfigured to support adopting remanufacturing.

Circular manufacturing strategy perspective

While circular strategies specify what forms of value retention (e.g., reuse, remanufacturing, refurbishment) an organization aims to achieve (EMF, 2013), CM strategy defines how manufacturing systems, processes, and capabilities must be designed and managed to realize these strategies (Bag et al., 2019; Rashid et al., 2013). This includes design practices for durability, repairability, remanufacturing, and disassembly, as well as manufacturing structures and infrastructures that support remanufacturing, refurbishment, and recycling activities (Abbey & Guide, 2018; Rashid et al., 2013). In this sense, MS functions aligning with business strategy guide the development of capabilities and resource configurations required to operationalize an organization's circular ambitions (Bag & Rahman, 2021; Rizova et al., 2020). However, despite acknowledging that OEMs' circular transformation challenges core business and manufacturing strategies, there remains a knowledge gap in integrating remanufacturing at OEMs (Kurilova-Palisaitiene et al., 2024). Therefore, understanding remanufacturing as a CM strategy is required to adopt remanufacturing, as it provides the operational and strategic foundation necessary to adopt remanufacturing.

Remanufacturing capabilities perspective

When translating remanufacturing into a concrete CM strategy, OEMs face several challenges, including identifying relevant data and information, reconfiguring business models, and designing products for multiple lifecycles (Acerbi et al., 2021; Amaitik et al., 2023; Asif et al., 2021; Khakbaz & Tirkolaee, 2022). Addressing such challenges requires not only new processes and structures but also the development of organizational capabilities that allow firms to adapt, learn, and transform their operations over time (Khan et al., 2020a, 2020b). The dynamic capabilities (DC) view offers an appropriate lens for this, as it emphasizes a firm's ability to sense opportunities, seize them, and reconfigure resources in response to changing environments (Teece et al., 1997). Because remanufacturing operates under conditions of high uncertainty and continuous change, such as fluctuating core availability, new circular market demands, and technological shifts, OEMs require capabilities that go beyond static resource deployment. A DC perspective therefore, provides systematic guidance on how firms can build, extend, and modify their resource base to integrate remanufacturing strategically, rather than treating it as an isolated operational activity.

While existing studies have begun examining how strategies and decision-making support CE transitions (Chari et al., 2022; Khan et al., 2020a, 2020b), there remains a limited understanding of the specific skills, resources, and processes that enable firms to overcome remanufacturing barriers.

1.2. Research gap and RQs

Despite the potential of remanufacturing, the literature indicates that few strategic approaches have been identified, as traditional strategies are often not applicable to remanufacturing (Rizova et al., 2020). Furthermore, implementing remanufacturing within original furniture manufacturers' facilities is complex due to the uncertain nature of the process (Guide Jr, 2000; Kans & Löfving, 2024). Jensen et al. (2019) emphasize the lack of studies on remanufacturing from the perspective of OEM. Yet, OEMs hold significant potential in this area as they can influence multiple actors across the value chain, strategically design and develop products for remanufacturability from the early stages of production (Abbey & Guide, 2018), and ensure adherence to original product quality. Gaining a deeper understanding of MS to implement remanufacturing allows OEMs to align well with the remanufacturing process (Cetin & Zaccour, 2023).

Although there are potential financial and environmental opportunities for remanufacturing, its implementation encounters many barriers that manufacturing organizations see as an important issue that needs to be overcome (Acerbi et al., 2021; Mejía-Moncayo et al., 2023; Parker et al., 2015). Prior research has identified barriers such as uncertainty in EOL product availability, quality, and return timing (Guide Jr, 2000), technical barriers including limited core information, lack of spare parts, and material challenges (Kurilova-Palisaitiene et al., 2018), and technological barriers related to insufficient visibility, resilience, and flexibility (Bag et al., 2021). Market and supply chain barriers include low customer recognition, lack of economies of scale, product cannibalization, and fragmented supply chains (Silvius et al., 2021). Additionally, regulatory barriers arise from limited public institutional support and incoherent policy frameworks (ERN, 2015; Lingegård & von Oelreich, 2023; Silvius et al., 2021). However, the literature lacks the understanding of industry-specific barriers and opportunities, and identifying capabilities to gain opportunities and address the barriers.

The research by Rizova et al. (2020) emphasizes the necessity of strategic decision-making in implementing remanufacturing within organizations. Their work also highlights that operational-level strategies can maximize remanufacturing outcomes while supporting broader strategic and tactical decisions. In this context, a clear gap remains in remanufacturing-related research, particularly regarding the exploration of strategic perspectives (Rizova et al., 2020).

Therefore, the purpose of this research is to develop knowledge about the strategic perspective of remanufacturing as a CM process. Hence, the Research question (RQ) 1 is formulated as follows:

RQ 1) What are the characteristics of manufacturing strategies that facilitate remanufacturing at the OEMs?

As sector-specific insights into remanufacturing are limited, further exploration is needed. Given the unique characteristics of the furniture industry, individualized approaches and careful analysis are essential to implementing CM strategies (Koszewska and Bielecki, 2020). For OEMs, this means overcoming barriers and leveraging opportunities to remain competitive by developing remanufacturing capabilities. At the same time, organizations operate in dynamic markets with inherent uncertainty when implementing remanufacturing, as well as being shaped by dynamic environments, rapidly evolving technologies, the transition toward a CE, and shifting markets and competition. To address these complexities, the second research question adopts a dynamic capabilities lens to examine how firms can sense barriers and opportunities, seize opportunities, and reconfigure their resources and processes accordingly. Hence, the RQ 2 is formulated as follows:

RQ 2) How do capabilities facilitate remanufacturing at Swedish original furniture manufacturers?

To address the research questions, Study 1 addresses RQ 1 by developing conceptual frameworks for remanufacturing strategy, while Study 2 addresses RQ 2 by providing empirical insights into opportunities, barriers, and enabling capabilities.

1.3. Delimitations of the research

This dissertation specifically focuses on remanufacturing as a distinct CM strategy. Other circular strategies and CM strategies fall outside the scope of this research and are therefore not considered within this study. The research presented in this dissertation is approached from the perspective of OEMs. These OEMs are involved not only in the production of new products but are also adopting and integrating remanufacturing processes alongside their existing, business-as-usual manufacturing operations. The emphasis throughout the dissertation is on the remanufacturing of discrete products. In examining these production processes, the study considers the strategic perspective of OEMs as they integrate remanufacturing activities with new manufacturing. For the purposes of this dissertation, OEMs engage in both new manufacturing and remanufacturing concurrently is referred to as hybrid manufacturing.

Study 2 within this dissertation is further delimited to focus on Swedish furniture original manufacturers, aiming to provide insights that are specific to this industry regarding the remanufacturing of potential products (Koszewska & Bielecki, 2020; Parker et al., 2015). The Swedish furniture industry is noted for its unique characteristics, as SMEs are particularly known for its minimalist designs, craftsmanship, and the designing of timeless products.

2. THEORY AND KEY CONCEPTS

2.1. Overview

This section presents the theoretical concepts utilized in the studies. Study 1 lies at the intersection of manufacturing strategy (MS), remanufacturing, and the circular economy (CE), whereas Study 2 builds on these concepts through the lens of the dynamic capabilities view (DCV). In the following section, these four perspectives are introduced and discussed in turn. Figure 4 represents an overview of the study.

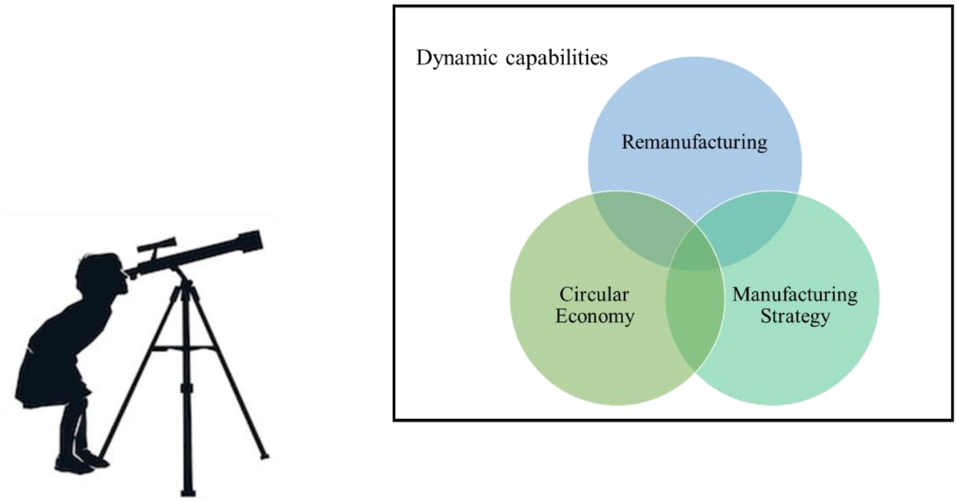

Figure 4: Overview of the study

2.2. Remanufacturing

Remanufacturing is an industrial process in which used, discarded, or broken products are restored to a like-new condition, providing them with performance characteristics and durability equivalent to those of the original product (Lund, 1984). The products or components that enter a remanufacturing facility are referred to as cores, which undergo a series of industrial processes typically including inspection, cleaning, disassembly, reprocessing, storage, reassembly, and testing (Sundin, 2004). Since remanufactured products exhibit similar or even superior quality compared to the original products, researchers and international quality standard organizations emphasize the importance of providing a warranty with such products (BSI, 2009; Ijomah, 2002). Selected definitions from international standard frameworks are presented in Table *1* below.

Table 1: Definitions of remanufacturing from internationally recognized standardization institutions

Framework / Standard	Definition of Remanufacturing	Key Quality Criteria	Reference
BSI – British Standards Institution (BS 8887-2:2009)	"A process of returning a used product to at least its original performance with a warranty that is equivalent to or better than that of a newly manufactured product."	Original or better performance; equivalent or superior warranty; industrial process.	(BSI, 2009)

ANSI / RIC – American National Standards Institute (ANSI/RIC001.1-2016; RIC001.2-2021)	"A comprehensive and rigorous industrial process by which a previously sold, leased, used, worn, or non-functional product or part is returned to a like-new or better-than-new condition, from both a quality and performance perspective, through a controlled, reproducible, and sustainable process."	Controlled and documented process; like-new or better condition; quality and performance verified.	(Remanufacturing Industries, 2016, 2021)
European Standard (EN 45553, draft)	"General method for assessing the ability to remanufacture energy-related products" — defines remanufacturing as an industrial process that restores used products to at least their original performance with verified conformity assessment.	Conformity and verification; environmental and quality assurance integration.	(European Committee for, 2022)

Among the existing formal definitions of remanufacturing, this thesis adopts the BSI definition (BS 8887-2:2009). This definition is preferred because it is widely recognized in both industry and academia, provides a clear and operational description of remanufacturing as an industrial process, and emphasizes two essential quality criteria: restoring the product to at least its original performance, and providing a warranty equivalent to or better than that of a new product.

Various practitioners can engage in remanufacturing. Lund (1984) identified three main types of practitioners: original equipment manufacturers (OEMs), independent (non-contract) remanufacturers, and contract remanufacturers. OEMs manufacture and sell both new and remanufactured versions of their own products. Independent remanufacturers, previously referred to as non-contract manufacturers, acquire products that they did not originally design, develop, or produce, and remanufacture them for commercial purposes. They operate independently of the OEM. In contrast, contract remanufacturers are authorized by the OEM to perform remanufacturing under license and are granted access to the necessary intellectual property rights.

Remanufacturing has been performed as a deliberate practice since the early 1940s, particularly in sectors such as the automotive industry (Ijomah, 2002). Over time, it has become increasingly commercialized across several industries, including HDOR manufacturing, aerospace, electronics, electrical equipment, and the domestic appliance sector (ERN, 2015; Guide Jr, 2000; Matsumoto & Ijomah, 2013). Early research identified remanufacturing as an economically advantageous process that extends product longevity and thereby reduces the volume of materials requiring in recycling or disposal in landfills (Lund, 1984). More recent studies position remanufacturing as a CE strategy that reduces material consumption and emissions while providing economic and social benefits (Lieder & Rashid, 2016; Matsumoto & Ijomah, 2013; Yang, 2020).

Implementing remanufacturing within the CE presents several challenges and encounters various barriers. These include difficulties in the effective collection of used products, the development of efficient remanufacturing processes, labour intensity, product variation and associated complexity, planning and scheduling issues, quality concerns, low customer awareness and acceptance of remanufactured products, as well. Despite these challenges, remanufacturing offers significant opportunities for OEMs by enabling access to new markets, supporting the development of innovative business models, fostering strategic differentiation, and enhancing competitiveness through value retention (Bansal et al., 2024; Kurilova-Palisaitiene et al., 2025; Shao et al., 2020).

2.3. Manufacturing strategy

The term strategy originates from the Greek word strategos, which refers to the art of planning and directing large-scale military operations (Cambridge University Press, n.d; Alex. Hill & Terry. Hill, 2012). In a business context, strategy encompasses both direction and implementation, addressing the questions of what to do and how to do it to reach the goals (Alex. Hill & Terry. Hill, 2012). Table 2 presents the characteristics commonly associated with the term in organizational and business settings.

Table 2: Characteristics of manufacturing strategy based on Wheelwright (1984)

Characteristics of Strategy	Definition
Time Horizon	MS involves long-term decisions regarding manufacturing capabilities, such as capacity, technology, process choice, and workforce development, whose implementation and outcomes unfold over several years.
Impact	The effects of manufacturing strategic decisions (e.g., investment in automation, facility layout changes, capability development) become evident only over time, and their long-term influence outweighs short-term operational adjustments.
Concentration of effort	MS requires focusing manufacturing resources and efforts on a limited set of prioritized competitive objectives (e.g., quality, cost, flexibility). This focus implicitly reduces attention to less critical objectives.
Pattern of decisions	MS is expressed through a pattern of consistent decisions across multiple areas, capacity, technology, supply chain, process design, workforce, rather than a single choice. These decisions must be aligned and reinforced over time.
Pervasiveness	MS influences the entire manufacturing organization, shaping daily operations and resource allocation. Strategic depth is achieved when employees at all levels act in ways that coherently support the MS.

The foundations of MS were established at Harvard during the 1940s and 1950s, when researchers examined various industries and observed that companies adopted different approaches to compete within their respective sectors (Voss, 1995). Skinner (1969) consolidated the previously fragmented MS concepts by emphasizing explicit linkages between manufacturing choices and corporate strategy, positioning MS as a competitive weapon. A well-formulated and effectively implemented MS can provide manufacturers with competitive advantages through the distinctiveness of their manufacturing functions (Hayes & Wheelwright, 1984; Slack & Lewis, 2024; Swamidass, 1986). Since then, the concept of MS has been further developed and refined by numerous scholars, who emphasize its role in aligning manufacturing capabilities with business strategy and in enhancing firms' competitive performance (Chatha & Butt, 2015; Hayes & Wheelwright, 1985; Miltenburg, 2008; Skinner, 2007; Slack & Lewis, 2024; Voss, 1995).

Hayes and Wheelwright (1984) Contributed to the development of the MS concept by emphasizing that MS should align manufacturing operations with the needs of the business strategy, ensuring consistency between organizational capabilities, policies, and sources of competitive advantage. They identified several major decision-making categories, such as capacity, facilities, technology, vertical integration, workforce, quality, production planning and control, materials management, and organizational structure, as key areas where manufacturing-related decisions are made. Several scholars note that MS is frequently described as a top-down approach, but it can also emerge through bottom-up initiatives and iterative alignment between operations and corporate strategy (Swamidass et al., 2001; Voss, 1995). In some organizations, this top-down approach is complemented by alternative mechanisms, including coherent patterns of actions, process improvement programs, and the pursuit of enhanced manufacturing capabilities (Swamidass, 1986; Swamidass et al., 2001).

Table 3: Definitions of manufacturing strategy literature

(Skinner, 1969, 2007)	As a competitive weapon, MS sets manufacturing policies designed to intensify performance among trade-offs among success criteria to comply with the manufacturing task formed by a corporate strategy. Top management is responsible for ensuring the coherence of MS, in which all manufacturing policies are designed as a whole to facilitate or lead the corporate strategy.
(Hayes & Wheelwright, 1984)	Decision patterns that, over time, enable a business unit to gain a desired manufacturing structure, infrastructure, and set of specific capabilities
(Swamidass, 1986; Swamidass et al., 2001)	MS comprises the development and deployment of manufacturing capabilities in alignment with the firm's goals and strategies, providing competitive advantage through low-cost manufacturing, high-quality production, manufacturing flexibility, etc, as well as evolving forms of MS process development.
(Alex. Hill & Terry. Hill, 2012; Hill, 1986)	MS as a coordinated approach to link corporate objectives, marketing strategies, and manufacturing structure and infrastructure on the assessment of order qualifying and order winning criteria of existing and future products
(Sarkis, 2001)	Manufacturing function efficiencies and management will be central to their environmental benign-ness. Integrating environmental concerns is a long-term, integrated plan that guides the design, operation, and improvement of manufacturing systems to achieve competitive advantage while minimizing environmental impact.

(Miltenburg, 2008)	Pattern underlying the sequence of decisions made by manufacturing over a long period of time for moving the company from where it is to where it wants to be
(Slack & Lewis, 2024)	Pattern of strategic decisions and actions that set the role, objectives and activities of operations, where it concerns the relative prioritisation of the operations function's objectives of cost, flexibility, quality, dependability, and speed with respect to the firm's competitive strategy by taking decisions in the areas of capacity, supply chain, technology, and organisation and information management

Table 3 presents selected definitions from the MS literature. Taken together these definitions illustrates the evolution of MS from a focus on top management responsibility, internal trade-offs, and competitive priorities toward broader considerations of capability development, strategic alignment, and sustainability. This synthesis forms the foundation for how MS is understood in this thesis. Over the years, MS has been reinforced through the integration of environmental considerations into manufacturing functions (Kulkarni et al., 2019; Sarkis, 2001; Slack & Lewis, 2024). Manufacturing organizations are increasingly expected to act responsibly by integrating environmental and social considerations into their strategic decision-making, going beyond traditional efficiency- and cost-driven priorities (Kulkarni et al., 2019; Sarkis, 2001; Slack & Lewis, 2024).

2.4. Circular economy

Turner and Pearce (1990) identified the need for an economy that is closed and circular, promoting growth within ecological limits, and conceptualized the term CE. With its roots in industrial ecology, where efficient use of resources and materials is emphasized, the CE concept gained prominence in the late 2000s within economic, business, and societal contexts. This development was influenced by the seminal work of McDonough and Braungart (2009) and the perspective of Dame Ellen MacArthur, founding EMF in 2010 (EMF, 2013). The CE has been recognized as a global economic model that aims to decouple economic development from the consumption of finite resources through restorative and regenerative industrial systems. It also addresses the challenges arising from the unprecedented growth of manufacturing industries that traditionally rely on the linear "take–make–dispose" economic model (EMF, 2013).

To create both economic and environmental value, certain CE strategies focus on retaining the value of materials, energy, and labour embedded in products and components. Figure 5 illustrates the 10R model, which categorises CE strategies based on their potential for value retention, from refuse and rethink to recycle and recover (Kirchherr et al., 2017a). These strategies, when supported by appropriate manufacturing approaches, are referred to as CM strategies (Abbasi et al., 2022; Kurilova-Palisaitiene et al., 2024; Mejía-Moncayo et al., 2023). CM strategies include remanufacturing, refurbishment, repair, and recycling. As described in the introduction, remanufacturing achieves the highest level of value retention by preserving products and components, thereby saving both materials and energy (EMF, 2013; Lund, 1984). In contrast, recycling involves breaking down products into raw materials for reuse, a process that typically requires greater energy and labour inputs than remanufacturing. Repair and refurbishment, meanwhile, restore products to a functional condition but do not extend their lifespan to the same degree as remanufacturing (EMF, 2013; Kirchherr et al., 2017b). CM strategies provide the operational and strategic foundation necessary to deliver CE strategies.

Circular Economy ↑

Smarter product use and manufacture	Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	Reduce	Make product use more intensive (e.g. by sharing product)
	Rethink	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
Extend lifespan of product and parts	Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
	Repair	Repair and maintenance of defective product so it can be used with its original function
	Refurbish	Restore an old product and bring it up to date
	Remanufacture	Restore an EOL product or its parts to a condition similar to or better than a new product, with the same function
	Repurpose	Use discarded product or its parts in a new product with a different function
Useful application of materials	Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	Recover	Incineration of material with energy recovery

Linear Economy

Figure 5: CE strategies 10R model

These CM strategies create opportunities for the CE across multiple dimensions. Economically and market-wise, they can contribute to improved resource efficiency, net material cost savings, and the creation of employment opportunities, although their contribution to economic growth is generally lower than that of traditional linear models (Matsumoto et al., 2016; Parker et al., 2015). Environmentally, they help reduce emissions and primary material consumption, preserve and enhance land productivity, and mitigate negative externalities such as climate change (EMF, 2013). CM strategies also offer production-related opportunities through improved productivity and operational efficiency (Kurilova-Palisaitiene et al., 2018; Reddy & Kumar, 2021). However, the adoption and advancement of CM strategies are often hindered by various barriers across these dimensions (Matsumoto et al., 2016; Silvius et al., 2021).

2.5. Dynamic capabilities framework

The adoption of remanufacturing presents several challenges arising from uncertainties related to core return timing, volume, quality, and product variations, as well as limited inventory availability (Bag et al., 2019; Guide Jr, 2000; Paraschos et al., 2024). As noted in the introduction, researchers have suggested that dynamic capabilities (DC) can enable organizations to effectively respond to such uncertainties and support the implementation of CE strategies (Chari et al., 2022; Khan et al., 2020b). These capabilities comprise complex bundles of skills and knowledge that can be either dynamic or static, enabling organizations to develop strategies that foster sustainable competitive advantage (Barney, 1991; Benner, 2009; Teece et al., 1997; Wernerfelt, 1984).

The DCV is an extension of the organization's resource-based view (RBV) theory (Barney, 1991; Eisenhardt & Martin, 2000; Teece et al., 1997). According to the RBV, organizations achieve competitive advantage by bundling and leveraging internal and external resources to develop valuable capabilities (Barney, 1991; Wernerfelt, 1984). Building on this foundation, the DCV emphasizes how organizations evolve and reconfigure their existing resource base to adapt to dynamic and uncertain environments (Bag et al., 2019; Chari et al., 2022). While the RBV focuses on selecting and utilizing existing resources, the DCV highlights the processes of developing, renewing, and acquiring resources to sustain competitiveness in changing contexts (Teece, 2007; Teece et al., 1997; Wernerfelt, 1984).

Although several conceptualizations of the DCV exist, the framework proposed by Teece et al. (1997) is the most widely adopted in literature. They define DC as the firm's ability to integrate, build, and reconfigure internal and external resources and capabilities to address a changing business environment, thereby sustaining a competitive advantage. The term *dynamic* refers to the firm's capacity to respond to changing environments driven by fluctuating market conditions and rapid technological innovation, while *capabilities* refer to the organization's abilities to sense, seize, and reconfigure resources, skills, and competencies to meet evolving environmental demands. These capabilities are embedded within the organizational structures and managerial processes that enable productive activities and the effective deployment of resources, knowledge, and skills (Teece et al., 1997; Wang & Ahmed, 2007). Collectively, these activities, processes, and skills form the microfoundations that underpin the dynamic capabilities of sensing, seizing, and reconfiguring (Teece, 2007).

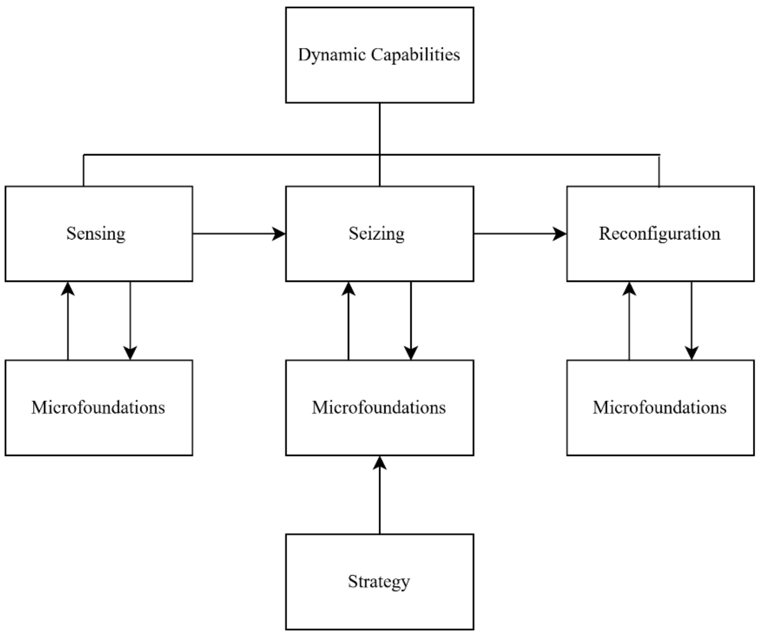

Figure 6: Dynamic capabilities view based on Teece et al. (1997, 2007, 2018).

Sensing capabilities enable organizations to identify and shape new opportunities through activities such as scanning, learning, creating, and interpreting information (Khan et al., 2020b; Teece, 2007). When managers sense opportunities or threats, they must determine how to translate them into new initiatives and developments deciding which technologies to acquire, which market segments to target, and how to anticipate responses from competitors, suppliers, and customers, while remaining attentive to technological and market changes (Teece, 2007). *Seizing* capabilities encompasses activities related to planning and mobilizing resources to implement newly identified opportunities (Khan et al., 2020b). *reconfiguration* capabilities, transform resources for sustainability in the dynamic business environment (Bag et al., 2019). Reconfiguration capability reconfigure and recombine existing and new resources, structures, and processes to realize identified opportunities (Helfat et al., 2010; Khan et al., 2020b; Teece, 2007). Collectively, these DC enable organizations to systematically address challenges by sensing opportunities and threats, making timely market-oriented decisions, and continuously adjusting their resource base (Barreto, 2010). Figure 6 shows how DC, underlying microfoundations, and strategy combined to create and refine organizational transformation (Teece, 2007, 2018; Teece et al., 1997).

Recent studies identified that DC contributes to the CE implementation (Chari et al., 2022; Khan et al., 2020a; Lopes et al., 2025; Walker et al., 2023). These works identified *sensing capabilities*, including market monitoring and technology scanning, idea generation and knowledge creation, external sensitivity, adopting holistic perspective, using sustainability oriented instruments, monitoring and recognizing sustainability trends, eco-friendly products and regulatory shifts*, seizing capabilities* such as strategic planning, business model development and redesign, and collaboration, stakeholder engagement, supporting sustainable and innovative culture, investing in recycling infrastructures, eco-design principles, switching to renewable energy sources as well as *reconfiguration capabilities*, including organizational restructuring, technological upgradation, knowledge integration, and best practices adaptation, trust building and communication, redesign value chains, ecosystem orchestration, leadership and change management (Chari et al., 2022; Khan et al., 2020a, 2020b; Lopes et al., 2025; Walker et al., 2023).

Many authors revealed that DCs are essential for SME's to identify and shape CE opportunities and transition to the CE (Khan et al., 2020a; Lopes et al., 2025; Putri et al., 2025). Literature emphasized that DCs strengthen the resilience supply chain for the CE (Bag et al., 2019; Chari et al., 2022), build positive relationships with alliance and change capabilities linking with data analytics capabilities (Bag & Rahman, 2021), create relational rents and a mutually supportive relationship between open innovation and a trade-off (Köhler et al., 2022).

Research exploring the relationship between remanufacturing and DCs remains limited. One of the earliest studies in this area is by Bag et al. (2019), who examined the role of DCs in remanufacturing and identified key factors influencing their development. The authors introduced the concept of dynamic remanufacturing capability (DRC), defined as "the ability to produce remanufactured parts as per market demand using existing resources and current capacity." (Bag et al., 2019. p. 856). Subsequently, Moroni et al. (2022) adopted this definition of DRC to investigate buyer–supplier relationships in connection with firms' eco-innovation practices, aiming to develop competitive strategies that integrate environmental values into reverse logistics performance. Their study further highlighted the significance of consumer perception, market structure, and regulatory support in determining the success of remanufacturing strategies.

3. METHODOLOGY

This chapter outlines the research process used in this thesis, including the research design, data collection, and data analysis procedures. The methodological choices are described separately for each study. The chapter also discusses the quality of the research.

3.1. Research process

The research presented in this thesis was conducted as part of two projects: CirkuTrä and Re:Furn. The CirkuTrä project aims to develop knowledge within the wood processing industry to enable circularity through reuse and remanufacturing. The project is funded by the Kamprad Family Foundation and carried out in collaboration between four universities, including Chalmers University of Technology.

The Re:Furn project seeks to enhance knowledge about the CE and remanufacturing within the Swedish public sector and furniture industry. It is funded by Vinnova, Formas, and the Swedish Energy Agency (Energimyndigheten). The project involves collaboration among Swedish universities, furniture manufacturers, government organizations, and non-profit organizations related to the wood and furniture industry. Based on these projects, Studies 1 and 2 were initiated in 2023. The research process and its timeline are illustrated in Figure 7.

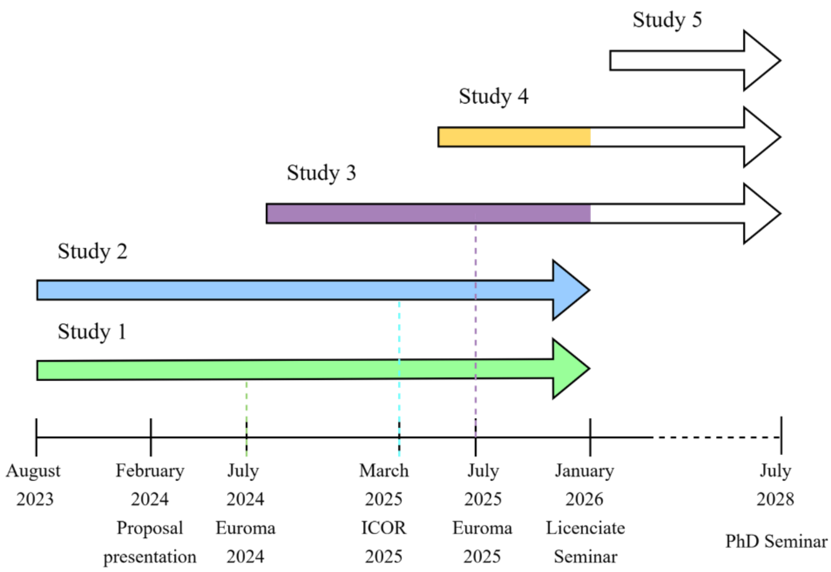

Figure 7: Research process since the beginning of the author's doctoral studies

Upon joining the CirkuTrä and Re:Furn projects in August 2023, my initial objective was to gain a comprehensive understanding of remanufacturing within the context of the CE. Specifically, I sought to explore the characteristics that position remanufacturing as a practice of competitive advantage for OEMs that implement such practices.

To address this objective, I conducted Study 1 using a structured literature review (SLR) approach. This methodology was selected because it is well-suited to addressing broad research questions, enabling a systematic synthesis of dispersed literature and the identification of dominant research views and research gaps (Booth et al., 2022). Through this approach, Study

1 examines remanufacturing from a MS perspective within the CE, as outlined in Section 3.1 of this dissertation.

As both research projects are centred on the wood and furniture industries, the empirical focus was subsequently directed toward remanufacturing practices among furniture OEMs, sometimes referred to as original manufacturers (OMs) in this dissertation. An initial review of the participating organisations' public material, including company websites, indicated a clear strategic intent to enhance sustainability and circularity. Moreover, these organisations had already undertaken remanufacturing initiatives, making them particularly relevant for in-depth empirical investigation.

Accordingly, Study 2 adopts a qualitative case study design to develop a contextualised understanding of remanufacturing within furniture manufacturing settings. This methodological choice enables an in-depth examination of how remanufacturing is implemented in practice, with particular attention to the opportunities it presents and the barriers encountered by OMs during its integration into existing manufacturing operations.

Together, Studies 1 and 2 constitute a complementary methodological approach. The structured literature review provides a broad and theory-driven understanding of how remanufacturing has been conceptualized from a strategic manufacturing perspective, but it is limited in its ability to capture organizational practices and contextual nuances. The qualitative case study addresses this limitation by offering in-depth, context-specific insights to understand remanufacturing adoption within OEMs' manufacturing operations.

In addition to Studies 1 and 2, further studies have been initiated along the overall research process. Study 3, which examines competitive priorities in the context of the CE and remanufacturing, and Study 4, which focuses on decision interactions in remanufacturing within production planning and control, are currently ongoing. A potential Study 5, aimed at empirically testing the conceptual framework developed in Study 2, is under discussion.

3.2. Study 1

3.2.1. Research design of study 1

Study 1 employed a systematic literature review methodology. Booth et al. (2022) emphasize that a systematic approach enhances clarity, validity, and auditability compared to a conventional review. They further note that the systematic literature review method combines the strengths of a critical review with an exhaustive search process, making it suitable for addressing broad research questions. In this study, the aim was to contribute to the understanding of the strategic perspective of remanufacturing. Therefore, the main search terms, "manufacturing strategy", "remanufacturing", and "circular economy", were utilized to extract the data. Based on the findings, this study developed a conceptual framework to support OEMs in adopting or advancing remanufacturing to enhance competitiveness.

This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009) to collect data, which helped to build methodological rigor. The study also followed a four-step content analysis process derived from Mayring

(2008). This approach enhances the replicability, transparency, and practical relevance of the findings. The steps of this process are presented in Table 4.

Table 4: SLR content analysis process steps

Process steps	Defining the steps
Material collection	Defining and delimiting the collection of materials based on specific criteria, where each paper serves as a unit of analysis.
Descriptive criteria	Establishing various criteria to analyze the collected materials.
Category selection	Identifying relevant categories and subcategories for analysis
Material evaluation	Analyzing and interpreting the research papers based on the established categories to develop a conceptual framework

3.2.2. Data collection of study 1

The data collection process followed the stages outlined in the PRISMA guidelines: identification, screening, eligibility, and inclusion. The literature search was conducted in the Scopus and Web of Science databases. The selected keywords and their synonyms were carefully chosen to ensure comprehensive coverage of relevant studies. Only peer-reviewed journal articles published in English up to and including 2024 were considered. This search resulted in 168 article hits. Using this time span, from the earliest available records to 2024, ensured a comprehensive overview of developments within remanufacturing, circular economy, and MS research. After removing duplicates, 128 articles remained for further review. During the initial screening, the titles, keywords, and abstracts were examined, narrowing the dataset to 104 articles. Subsequently, the author and one supervisor independently conducted a full-text assessment, resulting in a final selection of 61 articles for analysis. The full-text screening employed a blind review process to reduce potential bias.

3.2.3. Data analysis of study 1

Study 1 utilized content analysis to systematically review the articles (Mayring, 2019; Säfsten & Gustavsson, 2020). To conduct this analysis, a theory-based, predetermined categorization was employed. This categorization was based on the study by Kulkarni et al. (2019), which defines MS by considering the academic and industry views, as presented in Table 5.

According to Säfsten and Gustavsson (2020) well-defined theory-based categorization enhances the reliability of the coding process. The author used the software tool NVivo14 for the analysis process. Each article was coded by using open free codes, which were then aggregated into descriptive categories based on their recurrence.

Table 5: Analytical categories

Dimension	element	Description
Content	Competitive Priorities	Set of manufacturing objectives that represents the linkage with the market

	Distinctive competence	Identify and use resources, skills, and organisational characteristics that give it a competitive edge over its competitors
	Linkage with Business strategy	Critical part of the firms' strategy and consistent with well-coordinated business objectives designed within context
	Structural and Infrastructural decisions	Patterns of decision that led the company to develop manufacturing capabilities with chosen competitive priorities
Process	Strategy formulation process	Justifying structural and infrastructural decisions with chosen competitive priorities
	Decision Patterns and Resource deployments	Development and implementation of plans which affect the firm's choice, deployment, and utilisation of the firm's resources
	Operational plan and Improvement programmes	Aligning operational plans, action, and improvement programmes with chosen competitive priority
Context	Firm specific emerging notions	Vital linkage between the role of MS and all operational functions and the emergent paradigms to be proactive in developing future market opportunities by addressing the question of how firms can cope with changing environments
	Market and competitors	Ability of the firm to integrate, build, and reconfigure manufacturing tasks and resources, aligning with changing competitive structure, industrial competition and global customers' expectations

3.3. Study 2

3.3.1. Research design of study 2

Study 2 entails a multiple-case study design. The case study research design provides contextually rich data from bounded empirical world settings to investigate a focused phenomenon (Barratt et al., 2011; Eisenhardt, 1989; Voss et al., 2002). In this research, a multiple-case design was adopted to explore and better understand emerging, contemporary phenomena in practice (Barratt et al., 2011; Meredith, 1998). To examine the strategic perspective of remanufacturing, this study conceptualizes remanufacturing as the phenomenon of interest. According to Grünbaum (2007), a case study gives a meta-understanding of not only the case but also the unit of analysis. Dubé and Paré (2003) identify the unit of analysis as "critical if we want to understand how the case relates to a broader body of knowledge" (p. 610). In this study, remanufacturing represents the phenomenon, while the unit of analysis is the original furniture manufacturer that has adopted remanufacturing. Based on Patton (1990), the aim towards the end of the study is to articulate insights about, in this instance, "remanufacturing at the OMs," focusing on Swedish furniture industry, thereby highlighting the unique features of the cases, complying with the case study design method.

This study adopts a multiple-case study design rather than a single-case study in order to enable cross-case comparison and replication, thereby strengthening the robustness of the findings (Voss et al., 2002). Such designs rely on replication logic, involving either literal replication, where similar results are expected across cases, or theoretical replication, where predicted contrasting results arise for theoretically meaningful reasons (Yin, 2018). In line with this logic, the approach enables the identification of cross-case patterns, both similarities and theoretically expected differences of the findings, compared to focusing on a single instance.

3.3.2. Data collection of study 2

The participating companies were selected based on their interest in taking part in the CirkuTrä and Re:Furn projects. All participating firms were small or medium-sized enterprises (SMEs) operating in similar market segments, high-quality design furniture, primarily supplying furniture to public-sector or corporate customers, and having Swedish minimalistic design focus. These furniture manufacturers are located in the Småland region of Sweden. They are therefore comparable in terms of size, customer base, product focus, and geography. It is noteworthy that none of the companies included in this study are large multinational firms such as IKEA. In total, five furniture manufacturers participated.

The project team initially conducted a pre-study to develop a questionnaire. Based on the findings from this pre-study, an interview guide was created, incorporating the theoretical concepts of remanufacturing, MS, and the CE. Furthermore, three analytical categories, market aspect, production aspect, and sustainability aspect, were developed to facilitate data collection and improve understanding of remanufacturing practices within the case organizations. The project team conducted semi-structured interviews with the five case organizations and carried out on-site observations. Table 6 outlines the data collection methods used in each organization.

Table 6: Data collection methods from the organization.

Organization name	Empirical data collection	Other data collection
Alpha	On-site interview, 135 minutes with the organization's CEO, production manager, and sustainability manager.	Site visit, Website, Organization reports
Beta	On-site interview, 95 minutes with production manager, marketing manager, and sustainability manager.	Site visit, Website, Organization reports
Gamma	Two of the research team joined via Teams interview, and two researchers were on site and held 60 minutes interview	Site visit Website, Organization reports
Delta	On-site interview, 120 minutes with the organization's CEO.	Site visit, Website, Organization reports
Epsilon	Teams interview 60 minutes and onsite interview 60 minutes with the CEO	Site visit, Website, Organization reports

Organization Alpha

Alpha was founded in 1950 with the purpose of creating and crafting innovative designs that inspire creativity and simplify work life. Alpha remains a small-sized organization as of 2024, employing approximately 38 people and generating an annual turnover of around 91 million SEK. The company produces a wide variety of office furniture, primarily for workspaces, characterized by innovative and minimalist Scandinavian design. Its product range includes desks, tables, hybrid meeting tables with integrated technology, stools, chairs, and storage units, some equipped with RFID locks. The products are made from materials such as wood, plexiglass, veneer, aluminum, brass, leather, and wool fabric. Alpha engages in project-based remanufacturing, and its innovative designs support and facilitate this process.

Organization Beta

Beta was founded in 1992 and designs furniture and interior furnishings for creative meeting spaces and dynamic organizations. As of 2024, Beta employs 67 people and reports an annual turnover of 187 million SEK, positioning it as a medium-sized organization. The company's head office and production facilities are located in Tranås. Beta produces a wide variety of office furniture for workspaces and public areas, including sofas, tables, desks, stools, and chairs. The materials used include plywood, wood veneer, metal, laminate, linoleum, fabric, and leather. The company maintains a strong commitment to quality and Scandinavian design principles. Beta has also launched the Materia Reloved initiative, through which it remanufactures furniture for specific projects and labels these products with a dedicated mark to highlight their circular value.

Organization Gamma

Gamma was founded in 1800 and continues to preserve traditional production techniques to sustain the craftsmanship of solid wood furniture. The company's production facility is located in Diö, Älmhult Municipality, in the Småland region. Gamma employs approximately 20 people and reports an annual turnover of 26.47 million SEK. Gamma produces high-quality wooden furniture using only natural materials. Its product range includes armchairs, chairs, stools, sofas, tables, and vintage furniture for public, private, and corporate clients. The primary materials used are wood, leather, wool, and naturally tanned hide. The company employs bentwood and traditional handcrafting techniques in its designs. Gamma has also developed a take-back system to facilitate remanufacturing, allowing customers to return used products for restoration or reuse based on demand.

Organization Delta

Delta was founded in 1957 and focuses on Swedish craftsmanship, high quality, and careful material selection. The manufacturing plant is located in Mönsterås. As of 2024, the company employs 22 people and reports an annual turnover of 44 million SEK. Delta targets the contract and institutional furniture market, producing tables, chairs, stools, poufs, benches, and sofas. The materials used include wood, laminate, veneer, linoleum, fabric, and leather. Remanufacturing has become an integral part of the company's business strategy, and it has completed several remanufacturing projects for the public sector.

Organization Episilon

Epsilon was founded in 1893. Its headquarters and manufacturing facility are located in Epsilon, Österlen. As of 2024, it is a small-sized organization, employing around 28 people and generating an annual turnover of approximately 67 million SEK. Epsilon designs, produces, and markets high-quality furniture, primarily wooden chairs, armchairs, tables, sofas, and other interior furnishings for both public and private environments. The products are made from materials such as wood, laminate, aluminum, fabric, and leather. The company has completed several remanufacturing projects for public organizations and actively works toward achieving its Circular Vision 2030.

3.3.3. Data analysis of study 2

The interviews were thematically structured to explore the market, production, and sustainability aspects of the organizations' approach to remanufacturing. The author analysed the data to identify the opportunities and barriers of each aspect. First, the data were analysed using a within-case analysis to gain familiarity and a preliminary understanding (Eisenhardt, 1989). Then a cross-case analysis was performed to replicate and extend across individual cases (Eisenhardt, 1989; Yin, 2014).

Subsequently, the empirical findings were matched with existing theory. The RBV was initially considered; however, RBV alone was insufficient to fully explain the findings, particularly given the uncertainty associated with remanufacturing and the dynamic nature of the market context. As a result the DCV, was adopted, as it extends the resource-based perspective by emphasizing firms' abilities to adapt, integrate, and reconfigure capabilities in response to changing environments (Helfat et al., 2010; Moroni et al., 2022; Teece, 2007; Teece et al., 1997). Using abductive reasoning (Dubois & Gadde, 2002), the author intended to extend the theory to develop dynamic remanufacturing capabilities.

3.4. Quality of the research

Although various criteria can be used to assess the research quality, this thesis adopts the criteria of validity and reliability as key measures (Säfsten & Gustavsson, 2020; Yin, 2014). The concept of validity has a wide range of dimensions, such as construct validity, internal validity, and external validity. Validity refers to the extent to which the results accurately reflect what is intended to be measured (Säfsten & Gustavsson, 2020).

Construct Validity

Construct validity is a relevant concept for assessing the quality of the indirect measures (Säfsten & Gustavsson, 2020). Yin (2014) defines it as "identifying correct operational measures for the concepts being studied". The construct validity can be improved by utilizing a chain of evidence to ensure traceability of the data over time and not losing the evidence over time.

Study 1, which involved a systematic literature review, achieved construct validity by systematically collecting data in the searched domains using PRISMA guidelines. The inclusion and exclusion criteria were clearly defined, and the predetermined categories were selected by grounding the coding framework in established constructs.

Study 2 ensured construct validity by using multiple sources of evidence, including semi-structured interviews, site observations, organizational reports, and website content, following Yin’s (2014) triangulation strategy. The interview guide was thematically structured around the categories of market, production, and sustainability, which were derived from a pre-study and aligned with the study’s research questions. This ensures the data collection accuracy of the theoretical constructs under investigation.

Internal validity

Internal validity of the research concerns whether the performance of the study actually provides a basis for answering the research question or provides alternative explanations for the results, and pertains to the accuracy and consistency with which findings reflect the data (Säfsten & Gustavsson, 2020).

In Study 1, it was ensured through a rigorous multi-phase screening process aligned with PRISMA guidelines. Full texts were independently assessed by two reviewers using a blind review protocol to minimize bias. Discrepancies were resolved through consensus, and predefined inclusion and exclusion criteria were consistently applied. The reviewers' academic and industry-specific expertise further supported the accurate interpretation and selection of relevant studies.

In Study 2, the internal validity was supported through systematic cross-case analysis using content analysis techniques (Eisenhardt & Graebner, 2007), as well as by involving multiple researchers in the data collection and discussing interpretations to reduce individual bias. Interview findings were presented at Euroma24 conference, providing an opportunity for peer scrutiny and feedback.

External validity

External validity considers the ability to make statements regarding the scope and concerns the transferability of the results to see if they are valid for more people in other situations, or findings may be applicable beyond the reviewed sample.(Säfsten & Gustavsson, 2020).

Study 1 was strengthened by conducting a comprehensive search across two major databases namely Scopus and Web of Science. The study further includes peer-reviewed articles spanning all years up to 2024. This broad scope captured diverse industry contexts and time periods, enhancing the applicability of the findings across the studied scope.

The study 2 comply with external validity by conducting a multiple-case study across five furniture manufacturing organizations. This enables analytical generalization across different organizational contexts within the same industry.

Reliability

Reliability concerns the extent to which a measurement can be repeated by another person at a different time and could provide the same results (Säfsten & Gustavsson, 2020).

Reliability was ensured through a transparent and consistently applied method. The study followed a clearly documented protocol based on PRISMA, including predefined inclusion criteria and Mayring's content analysis steps, including coding categories. A blind review approach during full-text screening minimized subjectivity, while consistent application of the coding scheme supported analytical stability. These procedures created a replicable audit trail, enhancing the dependability of the findings.

In the study 2, reliability was ensured through the use of a standardized and collaboratively refined interview guide, careful documentation of procedures, and consistent data handling practices. All interviews were recorded, transcribed, and securely stored in the university's Teams folder, allowing for transparency and replicability of the research process.

4. SUMMARY OF THE APPENDED PAPERS

This chapter summarizes the two appended papers. First, the background and purpose will be introduced, followed by a summary of the findings from each paper.

4.1. Paper 1

4.1.1. Background and purpose

OEMs are increasingly encouraged to adopt and advance remanufacturing practices to reduce resource and energy consumption, as well as carbon emissions, through a transition towards a CE. A well-formulated and effectively implemented MS is considered a source of competitive advantage, as it enhances the distinctiveness of the manufacturing function. However, OEMs encounter significant challenges in adopting remanufacturing, and traditional MS approaches require adaptation to meet contemporary needs. The existing body of literature on this topic remains limited and fragmented, providing only partial insights into how MS influences OEMs' ability to adopt and integrate remanufacturing effectively into their operations. Accordingly, the purpose of this paper is to identify the characteristics of MS that facilitate remanufacturing within a CE. Therefore, the paper seeks to develop a theoretical framework for the concept of remanufacturing strategy (ReMS), positioned at the intersection of MS, remanufacturing, and the CE.

4.1.2. Findings

The results present a comprehensive SLR of the ReMS, structured around three main dimensions: context, content, and process. The review identifies the principal concepts within each dimension that contribute to the formulation of ReMS. Furthermore, the analysis highlights the main categories and subcategories that characterize ReMS, grounded in the literature on MS, remanufacturing, and the CE. Collectively, these findings provide a structured understanding of how ReMS can be conceptualized and developed to support OEMs in the effective integration of remanufacturing into their operations.

The context dimension facilitates an understanding of ReMS by examining how both internal and external environments influence the development and implementation. The main categories within this dimension include *firm-specific emerging notions*, characterized by the integration of new technologies, the development of technological structures and infrastructures, capability building, innovation in remanufacturing and disassembly, and data-driven decision-making. These aspects illustrate how firms adapt their internal capabilities and resources to support remanufacturing practices. The *market and competitors* category is characterized by factors such as customer acceptance and the competitive dynamics surrounding remanufacturing, highlighting the external market forces that shape strategic decisions. Finally, *government interventions*, characterized by policy and regulatory measures, also emerge as influential factors, reflecting the institutional pressures that drive or constrain the advancement of ReMS.

The content of the ReMS identifies the key decisions that collectively define a ReMS. These decisions are organized into four main categories, each reflecting a distinct strategic dimension. The first category, *linkage with business strategy*, highlights the strategic alignment between remanufacturing and the broader business objectives. It encompasses elements such as circular business model thinking, a strategic focus on take-back systems and closed-loop supply chains (CLSCs), key performance indicators (KPIs), and trade-offs, illustrating how remanufacturing is integrated into the overall strategic direction of the firm. The second category, *structural and infrastructural decisions*, captures the internal arrangements and supporting mechanisms necessary for effective implementation. This includes capacity strategy, organizational structure, innovation and technological changes, decision-making models, assessment tools, and CLSC configuration. The third category, *distinctive competencies*, emphasizes the sources of competitive advantage, particularly through product strategy and the development of dynamic remanufacturing capabilities. Finally, the *competitive priorities* category encompasses the performance dimensions that guide operational and strategic decisions, including cost, design, quality, innovation, flexibility, speed, and environmental sustainability. However, only one journal article explicitly examined competitive priorities, while the remaining studies implicitly addressed these performance objectives, contributing to competitive advantage.

The process dimension of ReMS facilitates decision-making activities related to how remanufacturing strategies are designed and implemented. This dimension comprises three main categories. The first, *decision patterns and resource deployment*, encompasses the use of data and information in process management, innovation and technology adoption, system design, CLSC strategy implementation, hybrid manufacturing planning, and trade-offs in strategy selection. These elements reflect how firms coordinate and allocate resources to balance operational efficiency with remanufacturing objectives. The second category, *operation planning and improvement programmes*, includes process control, improvement tools, and lean manufacturing practices, illustrating the role of continuous improvement in achieving process stability and efficiency. Finally, the *remanufacturing strategy formulation* category covers the implementation and assessment of KPIs, lifecycle strategy execution, integration of hybrid production strategies, consideration of third-party remanufacturing approaches, and the overall formulation of ReMS.

4.2. Paper 2

4.2.1. Background and purpose

Remanufacturing is a CM strategy, grounded in the principles of the CE, designed to optimize resource use, reduce emissions, and circulate products at their highest value. Despite clear economic and environmental benefits, OEMs face various barriers that hinder the adoption of remanufacturing. While some sectors have reached a mature stage in implementing remanufacturing, other promising sectors, such as the furniture industry, have yet to adopt and advance these practices. Even where opportunities exist, adoption is often constrained by multiple barriers and a lack of necessary capabilities. Dynamic capabilities are essential in facilitating CE-related transitions, enabling firms to identify opportunities, overcome barriers, and effectively adopt remanufacturing.

The purpose of this research is therefore to investigate the specific opportunities and barriers associated with remanufacturing among original furniture manufacturers in the context of Swedish furniture industry, and to understand how dynamic capabilities can support the adoption of remanufacturing toward a CE. The study aims to facilitate the development of remanufacturing within the furniture sector and address gaps in the existing literature by examining the unique context of the Swedish furniture industry, where remanufactured furniture is not yet widely available despite the industry's significant production capacity and growth potential.

4.2.2. Key findings

Identifying opportunities and barriers

The analysis identifies opportunities and barriers across three dimensions: market-related, production-related, and sustainability-related aspects. Within the *market dimension*, several opportunities emerge that support the adoption of remanufacturing among furniture OMs. These include growing sustainability-oriented customer demand, the need for effective communication and customer relationship building, and the strategic value of emphasizing quality, design, and flexibility as competitive priorities. Additional opportunities relate to reverse logistics as a mechanism for value capture, and the possibility of redeploying existing resources with minimal additional investment. From a supply-chain perspective, opportunities arise through access to high-quality materials, unique design components, and cost benefits from long-term supplier relationships. Moreover, partnerships and stakeholder collaborations, the integration of remanufacturing into existing business models, and the diversification of offerings and customer segments further strengthen the market potential for remanufacturing in the Swedish furniture sector.

Production-related opportunities refer to factors that can increase productivity and operational efficiency when adopting remanufacturing. Within the production dimension, several opportunities emerged, including scalability of production capacity with available resources, existing or developable remanufacturing process capabilities relevant to furniture remanufacturing, and enhanced knowledge creation and capability development through learning-by-doing, process refinement, and the accumulation of remanufacturing-specific expertise. Additional opportunities include strategic outsourcing when there are high production rates and supplier collaboration, the ability to reconfigure production planning and control for hybrid manufacturing and leveraging technological advancements and digitalization to support more efficient and traceable remanufacturing processes.

The *sustainability-related opportunities* highlight the potential for improved environmental performance through remanufacturing. At the core of these opportunities is the fundamental motivation for remanufacturing itself: reducing the consumption of virgin materials and lowering overall energy use compared to producing new products. Additional opportunities include using certification as a market differentiator, developing long-term sustainability strategies, adopting energy-efficient practices, such as renewable energy use and optimized reverse logistics, and increasing the use of locally sourced materials to minimize environmental impact.

The results also identified several barriers that hinder the widespread adoption of remanufacturing in the furniture industry across the three dimensions. The *market-related barriers* include the complexity of balancing design-driven branding with remanufacturing requirements, high product costs associated with certain design choices, and competition from low-cost new products. Additional barriers involve insufficient product traceability, limited consumer knowledge and awareness, and exposure to external risks such as supply chain disruptions.

The *production-related barriers* encompass a range of operational and technical challenges. These include product development issues, such as the absence of design rights and the use of materials not suitable for remanufacturing. Several remanufacturing operations remain time-consuming, for example, processes like lacquer removal, and both traditional manufacturing and remanufacturing are affected by a shortage of skilled labour. Further barriers arise from production planning uncertainties, insufficient lean implementation, and various technological challenges, including limited use of digital tools and frequent changes in service providers.

The *sustainability-related barriers* include the complexity of obtaining sustainability certifications and a knowledge gap in circular business model innovation, which limits firms' ability to fully integrate remanufacturing into long-term sustainability strategies.

Mapping the dynamic capabilities view on remanufacturing

After identifying the opportunities and barriers, the relevant DCs were mapped to understand how the DCV supports the adoption of remanufacturing. Within the *market-related dimension*, market monitoring was identified as a key sensing capability, enabling firms to detect customer demand trends, sustainability expectations, and competitive developments. The seizing capabilities include the firm's ability to effectively communicate the remanufacturability of products, build and leverage customer and supplier relationships, adapt or develop business models, and mobilize resources and collaborative networks to support remanufacturing. The reconfiguration capabilities relate to utilizing communication to facilitate organizational adjustments and enable the strategic reconfiguration of the business to integrate remanufacturing more fully into operations.

Within the *production-related dimension*, several dynamic capabilities were identified. Within the production-related dimension, the sensing capability is reflected in knowledge creation, which is underpinned by the firm's ability to understand process-related innovations and to gain information from returned cores. This knowledge enables firms to identify opportunities for improvement and enhance their remanufacturing processes. The seizing capabilities relates to the firm's ability to redeploy and relocate existing resources and operational capabilities to support remanufacturing activities. The reconfiguration capabilities involve integrating knowledge through a skilled workforce, collaborating with suppliers, and adopting best practices in production planning and control for hybrid manufacturing. Additionally, firms' ability to upgrade and adapt technological infrastructures is identified as a reconfiguration activity that enables operational adjustments necessary for remanufacturing and traditional manufacturing.

Within the *sustainability-related dimension*, several dynamic capabilities were identified. The sensing capability involves monitoring sustainability trends, underpinned by recognizing the need for sustainability-related certifications and understanding the importance of long-term sustainability goals. The reconfiguration capabilities are reflected in the firm's ability to adapt sustainability practices, such as shifting to energy-efficient and optimized logistics, adopting sustainable raw materials, and sourcing locally. Another important reconfiguration capability is the upgrading of structural and infrastructural systems, including the implementation of energy-efficient technologies and facilities to support sustainability-oriented remanufacturing. Notably, no explicit seizing capabilities were identified within this dimension.

The barriers identified across the market, production, and sustainability dimensions highlight areas where dynamic capabilities are underdeveloped or constrained. Market-related barriers, such as limited traceability, low consumer awareness, and the difficulty of balancing branding with remanufacturing pointing to gaps in sensing capabilities, as firms struggle to access and interpret information needed to recognize remanufacturing opportunities. Production-related barriers, which include unsuitable materials, time-consuming processes, skilled labour shortages, and planning uncertainties, reflect weaknesses in both seizing and reconfiguration capabilities, as firms are unable to mobilize resources or adjust operational routines effectively to support remanufacturing. Sustainability-related barriers, such as the complexity of certification processes and the knowledge gap in circular business model innovation, further indicate limited reconfiguring capabilities, preventing firms from aligning environmental goals with structural and strategic change. Together, these barriers reveal where capability development is needed to enable the successful adoption of remanufacturing in the furniture industry.

5. DISCUSSION ON KEY FINDINGS AND CONTRIBUTIONS

This chapter discusses the key findings from the two studies in relation to the overarching research questions. It further outlines the theoretical and managerial contributions generated by each study. The chapter concludes by synthesizing insights from both studies to offer a more integrated understanding of the remanufacturing phenomenon through the lens of the dynamic capabilities view.

5.1. Research question 1

RQ1: What are the characteristics of manufacturing strategies that facilitate remanufacturing at the OEMs?

The characteristics of MS that facilitate remanufacturing can be meaningfully interpreted through the three dimensions of context, content, and process, which have been utilized in characterizing MS by several literature (Kulkarni et al., 2019; Miltenburg, 2008; Slack & Lewis, 2024). These dimensions, along with their associated categories and subcategories, demonstrate that isolated strategic choices are insufficient to enable remanufacturing. Instead, remanufacturing is supported by a coherent configuration of contextual conditions, strategic content decisions, and process-oriented mechanisms for remanufacturing strategy formulation and implementation.

The context dimension is characterized by the main categories of firm-specific emerging notions, market and competitors, and government interventions, along with their respective subcategories. While the study followed the MS framework by Kulkarni et al. (2019) it identified government intervention as an additional category characterizing the context dimension of ReMS. Government intervention through policy and regulatory mechanisms emerges as a critical institutional driver, emphasizing the extent to which strategy is shaped by external environmental conditions. These findings reinforce the argument that policy alignment, such as extended producer responsibility (EPR) and product take-back legislation (Krystofik & Gaustad, 2018), incentive mechanisms (Gu et al., 2018; Li et al., 2024), government subsidies (Liu et al., 2024; Xie et al., 2022) and policies for green innovation adoption (Liu et al., 2024) is vital for promoting remanufacturing at the OEM level.

Firm-specific emerging notions, including I4.0 (Bag et al., 2021) and I5.0 (Mejía-Moncayo et al., 2023) technological integration contributes to remanufacturing profitability (Delpla et al., 2022), reduce uncertainty (Mejía-Moncayo et al., 2023), decrease waste and emissions while improving performance (Bag et al., 2021; Eldrandaly et al., 2022). These developments demonstrate how OEMs internally adapt to support remanufacturing. Such adaptation is actualized through the development of technological structures and infrastructures, as well as capability building (Bag et al., 2021; Chong et al., 2022; Karuppiah et al., 2023; Mejía-Moncayo et al., 2023; Paraschos et al., 2024), innovations in remanufacturing and the disassembly process (Aydin & Badurdeen, 2019; Chong et al., 2022; Hjorth & Chrysostomou, 2022; Sutherland et al., 2020; Tolio et al., 2017; Yang et al., 2018) and data-driven decision making (Acerbi et al., 2021; Chong et al., 2022; Ilgin & Gupta, 2011; Mejía-Moncayo et al., 2023).

Externally, the market and competitor category emphasizes the role of customer acceptance and competitive dynamics in determining the viability of remanufactured products. This reflects a market-driven view of strategy, in which demand uncertainty and perceived quality barriers (Karuppiah et al., 2023; Li et al., 2024) constrain the adoption of remanufacturing. Low consumer awareness and limited knowledge further hinder acceptance and uptake (Hariyani & Mishra, 2023; Karuppiah et al., 2023; Monyaki & Cilliers, 2023). Moreover, competition among OEMs and independent remanufacturers (Gu et al., 2018; Ma et al., 2024), as well as among contract remanufacturers and their interactions across CLSC (Mondal & Giri, 2020; Papachristos & Adamides, 2014) shapes the external environment in which strategic decisions are made. Thus, the context dimension suggests that the effectiveness of ReMS is contingent on both organizational readiness and the maturity of external institutional and market environments.

The content dimension comprises linkage with business strategy, structural and infrastructural decisions, distinctive competencies, and competitive priorities, along with their associated subcategories. Accordingly, the strategic alignment between remanufacturing and overall business strategy plays a central role in defining the content dimension. The linkage with business strategy, including circular business model thinking, take-back systems (Asif et al., 2012; Chen et al., 2019; Jayaraman et al., 2007; Krystofik & Gaustad, 2018), and CLSCs, and strategic prioritizations (Abbey & Guide, 2018; Jayaraman et al., 2007), KPIs for capturing CE performance (Asif et al., 2021) and trade-offs that balance economic and environmental considerations (Salehi et al., 2024), emphasizes that a ReMS should extend beyond efficiency-based thinking to incorporate environmental and lifecycle perspectives. This is consistent with earlier research (Hayes, 2006; Hayes & Wheelwright, 1984; Sarkis, 2001), which positions MS as an integrative mechanism that links operational capabilities to long-term strategic objectives.

The inclusion of structural and infrastructural decisions, such as capacity strategy (Jindal & Sangwan, 2014; Khakbaz & Tirkolaee, 2022; Papachristos & Adamides, 2014), process and technological innovation (Bag et al., 2021; Chong et al., 2022; Delpla et al., 2022; Eldrandaly et al., 2022), and organizational structural changes, including the centralization of manufacturing, remanufacturing, or core management activities (Li et al., 2024; Salehi et al., 2024), along with CLSC configurations involving information-sharing systems (Delavar et al., 2022), network structures (Karunakaran et al., 2024; Li et al., 2024), and conservative CLSC designs (Rashid et al., 2013) emphasize the need for adaptive and flexible systems that can manage the uncertainties inherent in reverse logistics and product recovery while supporting material conservation and energy efficiency.

Similarly, the identification of distinctive competencies emphasizes the importance of competitive positioning through product design and product line design (Abbey & Guide, 2018; Aydin & Badurdeen, 2019). It emphasize that OEMs engaging in remanufacturing must develop dynamic remanufacturing capabilities by leveraging existing resources and facility capacity (Bag et al., 2019), enhancing CLSC flexibility to cope with uncertainty (Bag et al., 2019; Jayaraman et al., 2007; Moroni-Cutovoi, 2021), and gaining process innovation that integrates best practices (Hariyani & Mishra, 2023). These requirements extend beyond traditional lean practices by incorporating sustainable and green manufacturing principles.

Although competitive priorities are not explicitly stated in reviewed articles, this study identified the need to incorporate novel competitive priorities, particularly design and environmental sustainability. Thus, the content of ReMS represents not merely an extension of MS but a reconfiguration of it, integrating circularity into structures and infrastructures, design-for-remanufacture, and sustainability as core competitive imperatives rather than peripheral concerns.

The process dimension of ReMS reveals how strategic intent is operationalized through decision-making, operational planning for both remanufacturing and manufacturing, and the continuous improvement of these activities to achieve effective ReMS formulation. Decision patterns and resource deployment, such as data-driven process management during the design stage (Acerbi et al., 2021), and long-term resource optimizations from lifecycle considerations (Asif et al., 2021), emphasize the need for hybrid planning. Hybrid manufacturing planning aimed at optimizing production capacity, output, CE strategies, maintenance, and emissions (Hajej et al., 2019; Jung et al., 2016; Khakbaz & Tirkolaee, 2022; Paraschos et al., 2024), along with trade-offs in strategy implementation that balance environmental sustainability, green innovation, and cost (Amaitik et al., 2023; Karunakaran et al., 2024; Zhang et al., 2019). Additionally, system design and CLSC strategy implementation (Feng et al., 2021; Salehi et al., 2024; Telegraphi & Bulgak, 2021) reflect the need for a more dynamic and iterative approach to MS than traditionally practiced.

Furthermore, the category of operation planning and improvement programmes, including process control and lean manufacturing (Hariyani & Mishra, 2023; Sasso et al., 2024; Schimanek et al., 2022), shows that conventional manufacturing efficiency tools remain relevant but must be adapted to accommodate reverse flows and disassembly operations. Finally, ReMS formulation, through KPI implementation (Aljamal et al., 2024), lifecycle strategy integration (Bradley et al., 2018), and third-party collaboration (Feng et al., 2021; Ma et al., 2024) demonstrates that remanufacturing success depends on the capacity to transform strategic objectives into measurable operational practices.

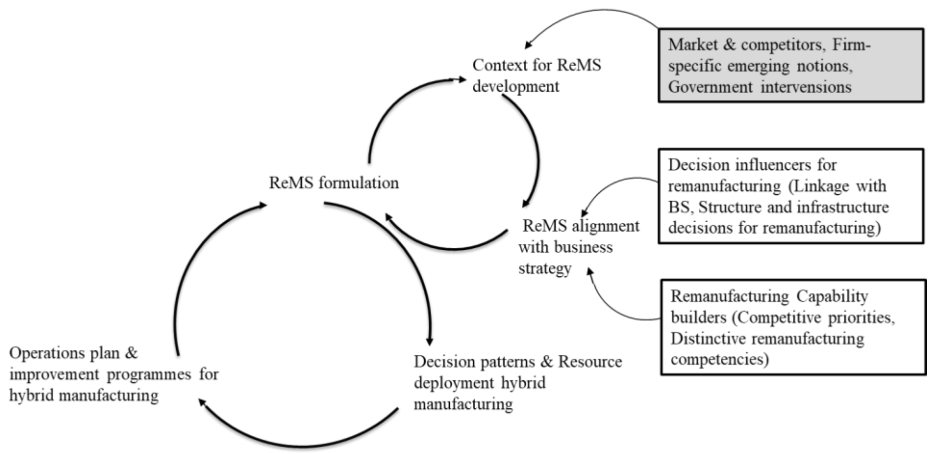

Figure 8: Remanufacturing strategy formulation

Collectively, the process dimension emphasizes that remanufacturing is a dynamic strategic process that requires cross-functional coordination, feedback mechanisms, and a long-term performance orientation, with interactions and interdependencies among its characteristics. Hence, the conceptual framework in Figure 8 is developed for the managerial implications.

5.2. Practical contribution of study 1

Figure 8 illustrates that ReMS is not a static or isolated set of choices. Instead, it is a dynamic, multidimensional process requiring alignment between internal capabilities and external institutional environments, the integration of circularity into core business and operational strategies, and continuous adaptation through data-driven and collaborative approaches. The framework provides managerial insights by showing that successful remanufacturing at OEMs depends on synergy between the context, content, and process dimensions, each comprising distinct categories and subcategories. It offers guidance for managers seeking to integrate remanufacturing into traditional manufacturing activities within the CE. The model is cyclical, emphasizing the continual adaptation and integration of contextual, content, and process dimensions.

A key managerial implication is the recognition that ReMS formulation is an evolving process. Managers need to build an organizational culture that is responsive to change, encouraging ongoing assessment and adjustment of strategies as contextual factors, such as market trends, regulatory developments, and technological advancements, shift over time. This approach helps ensure that remanufacturing initiatives remain aligned with both external pressures and internal capabilities. Managers should monitor external signals and incorporate them into strategic planning. For instance, new government policies or shifts in consumer preferences toward sustainability can serve as catalysts for adopting or intensifying remanufacturing efforts. Proactive engagement with these factors enables organizations to anticipate changes and strengthen their competitive position within the CE.

The content dimension serves as a bridge between overarching business objectives and the formulation of specific remanufacturing strategies. Managers are encouraged to integrate remanufacturing goals into broader business strategy rather than treating them as isolated initiatives. This requires aligning structural and infrastructural decisions, such as supply chain configuration and technology investments, with the organization's long-term vision for remanufacturing and competitiveness.

The framework also highlights the importance of developing distinctive competencies and competitive priorities, including flexibility, innovation, design, and environmental sustainability. Managers should invest in capability-building initiatives such as workforce training, technology adoption, and process innovation. These capabilities support the effective implementation of ReMS while also enhancing the organization's ability to respond to uncertainty and pursue emerging market opportunities.

Operational planning and improvement programs are essential for translating strategic intent into actionable outcomes. Managers should apply practices that combine lean manufacturing, CE principles, and green innovation to optimize resource use and reduce waste. The framework underscores the value of improvement tools and performance metrics (e.g., lifecycle-oriented KPIs) to monitor progress and promote continuous improvement. Addressing barriers such as resistance to change or technological constraints through targeted interventions is crucial for maintaining competitiveness.

Ultimately, the cyclical nature of the framework emphasizes the importance of feedback loops between context, content, and process. Managers should establish mechanisms for routinely reviewing performance data and adjusting strategies as external and internal conditions evolve. This iterative approach ensures that remanufacturing strategies remain effective over time.

5.3. Theoretical contribution of study 1

This research makes several key theoretical contributions to the fields of remanufacturing, MS, and the CE. By systematically analysing and synthesising existing literature, the study develops the concept of ReMS and provides a structured explanation of how the characteristics of MS can facilitate remanufacturing at OEMs.

The study contributes to remanufacturing literature by conceptualizing remanufacturing not only as an operational or technical activity but as a strategic approach. It demonstrates that successful remanufacturing requires a holistic strategic orientation, in which organizations adapt their existing MS to align with remanufacturing and CE objectives. The study also identifies that existing research largely focuses on context-related factors, such as technological paradigms and competitive dynamics, and content-related areas such as structural and infrastructural decisions and linkage with business strategy, as well as process-related aspects including decision patterns and resource deployment. However, gaps remain in the literature regarding competitive priorities within the content dimension and operational planning, improvement programmes, and remanufacturing strategy formulation within the process dimension.

By identifying the content, process, and context dimensions of ReMS, the study extends theoretical understanding of remanufacturing as a multidimensional strategic capability that integrates business strategy, manufacturing structures and infrastructures, competitive priorities, and dynamic resource configurations. This reconceptualization positions remanufacturing as a source of competitive advantage rather than an additional operational activity, thereby advancing theoretical contributions to remanufacturing research within operations management.

The ReMS framework provides a theoretically grounded extension of MS into the domain of circular manufacturing. The study also indicates that the traditional MS needs to be reconfigured to support CE and remanufacturing.

5.4. Research question 2

RQ2) How do capabilities facilitate remanufacturing at Swedish original furniture manufacturers?

This study identifies the opportunities and barriers associated with the adoption of remanufacturing among original furniture manufacturers in Sweden and examines how dynamic capabilities can support this transition. The findings reveal that although considerable market, production, and sustainability-related opportunities exist, firms still face barriers that restrict their ability to adopt remanufacturing practices. When viewed through the lens of the Dynamic Capabilities View (DCV), these opportunities and barriers reflect where sensing, seizing, and reconfiguring capabilities are present, underdeveloped, or entirely absent within the case companies.

The market-related findings show that Swedish furniture manufacturers experience increasing sustainability-oriented customer demand and are able to identify shifts in market trends, both of which represent market-related opportunities. These insights indicate a latent sensing capability, enabling firms to detect changes in customer expectations and sustainability trends that may motivate the development of remanufacturing capability. This aligns with findings by Khan et al. (2020a), who identify market monitoring as a microfoundation of sensing when transitioning to a CE.

The results further show that strategic value creation through communication, sales opportunities created through customer relationships, reallocation of resources and capabilities, and emerging collaboration opportunities reflect seizing capabilities during remanufacturing adoption. For instance, organizations must make rapid decisions based on incoming cores, requiring continual adjustments in structural and infrastructural resource allocation to align with business strategy. Redeploying existing resources aligns with Chari et al. (2022) and Lopes et al. (2025). However, while Chari et al. (2022) identify communication, and particularly data, as a sensing capability, the present study suggests communication of remanufacturability as a seizing capability, because firms here had already identified the opportunity and used communication to seize it. Communication also appears as a reconfiguration capability, as case organizations continually update, monitor, and improve communication to integrate remanufacturing into their business strategies.

Although sensing involves the ability to perceive external changes and identify remanufacturing opportunities, the market-related barriers demonstrated, limited consumer awareness, insufficient product traceability, and competition from low-cost manufacturers, signal weaknesses in both sensing and seizing capabilities. Firms struggle not only to identify and interpret relevant market signals but also to mobilize resources to communicate remanufacturability, differentiate themselves, and develop business models that capitalize on market potential. This indicates that although the sector perceives opportunities, it lacks sufficiently developed mechanisms to act on them, preventing the translation of sensed opportunities into strategic advantage.

The production-related results highlight opportunities in scalability, capability development, technological advancements, and improvements in production planning. These opportunities align with seizing and reconfiguration capabilities, which are the ability to redeploy and mobilize existing resources (seizing) (Chari et al., 2022; Lopes et al., 2025), and reconfiguration capabilities such as knowledge integration, supplier collaboration, and infrastructure upgrades (Chari et al., 2022; Khan et al., 2020a; Lopes et al., 2025; Walker et al., 2023). However, production barriers, including a lack of design rights, unsuitable materials, time-consuming operations, skilled labour shortages, and technological fragmentation, point to limitations in reconfiguration capabilities. These barriers suggest that although firms may be motivated to adapt their operations, they lack the structural capabilities necessary to reconfigure routines, materials, and technologies for efficient remanufacturing. Thus, the production dimension reveals a need for a more strategic approach to capability development: opportunities require strategic reconfiguration, but barriers constrain firms' ability to modify and align operational systems.

The sustainability-related dimension shows clear opportunities for environmental value creation through certification, long-term sustainability strategies, energy-efficient logistics, and local sourcing. These opportunities demonstrate the presence of sensing capabilities, where firms monitor sustainability trends and recognize the need for future-oriented sustainability commitments. Such sensing activities align with Walker et al. (2023), particularly in the adoption of sustainability instruments such as certifications and energy-efficient logistics structures, and commitment and support towards sustainability as a strategic view from top management. However, barriers related to certification complexity and knowledge gaps in circular business model innovation highlight an underdeveloped ability to translate CE insights into concrete action. Notably, the study did not identify explicit seizing capabilities within this dimension, suggesting that while firms understand sustainability expectations, they lack mechanisms to commit resources, redesign offerings, and leverage remanufacturability as a strategic advantage. Reconfiguration capabilities appear more active, particularly in structural and infrastructural upgrades, but these efforts remain fragmented rather than strategically coordinated.

These findings illustrate that DC in the Swedish furniture industry is partial and unevenly developed across the market, production, and sustainability dimensions. Firms demonstrate an emerging ability to sense opportunities and, to some extent, reconfigure operations, but they struggle to seize opportunities, particularly in relation to the sustainability and production-related dimensions. This imbalance limits their progress toward adopting remanufacturing as a strategic CM practice. The study contributes to the remanufacturing literature by showing that the barriers are not merely a lack of opportunities but an incomplete capability to act on them, resulting in a capability bottleneck that slows CE transitions.

Figure 9 shows the identified microfoundations specific to remanufacturing by linking opportunities to DCs

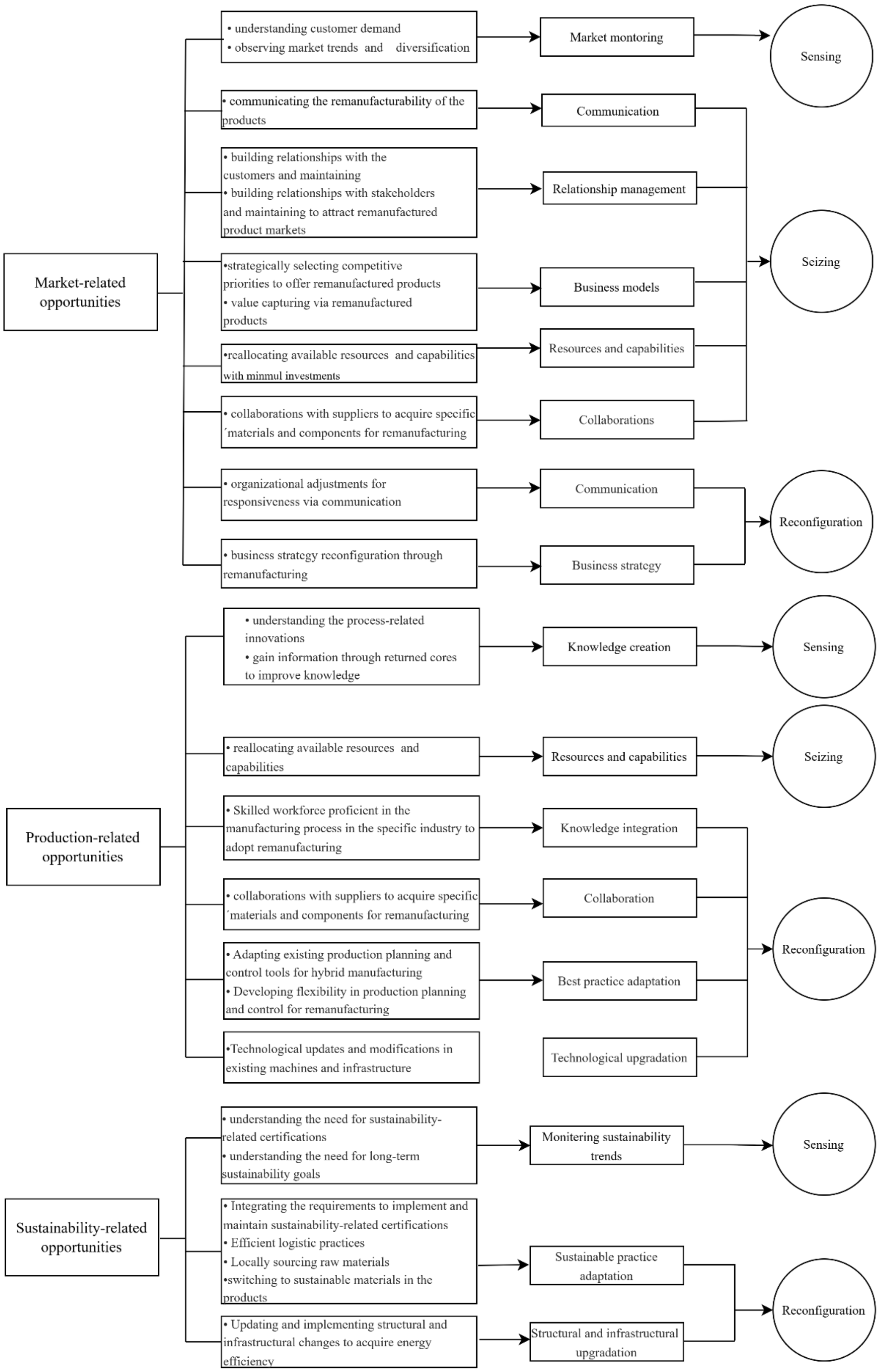

Figure 9: Opportunities aligned with dynamic remanufacturing capabilities

5.5. Practical contribution of study 2

For practitioners, the results emphasize that adopting remanufacturing requires more than technological solutions or sustainability commitments. Manufacturers must build integrated dynamic capabilities that allow them to sense market and sustainability signals, seize opportunities through business model adjustments, and reconfigure processes, labour resources, and technological infrastructures. Strengthening internal knowledge, improving product traceability, investing in skilled labour, and engaging in long-term supplier and stakeholder collaboration are essential steps toward building a robust remanufacturing capability base.

The findings show that remanufacturing in the Swedish furniture sector is both promising and challenging. While opportunities exist across the market, production, and sustainability dimensions, the identified barriers reveal critical capability gaps. Addressing these gaps through DRC development is essential for enabling a more mature and strategically embedded remanufacturing practice that supports the broader transition toward a CE.

5.6. Theoretical contribution of study 2

From a theoretical perspective, this study extends the application of DCV to the remanufacturing context by demonstrating how opportunities and barriers jointly shape capability development needs. It highlights that sensing, seizing, and reconfiguring should not be viewed as isolated capabilities but as interdependent processes that must be jointly developed to support CE transitions. In particular, the absence of strong seizing capabilities emphasizes the importance of business model innovation, strategic communication, and resource commitment areas often overlooked in operationally focused CE and remanufacturing research.

5.7. Synthesizing study 1 and 2

Across the two studies, this dissertation demonstrates that remanufacturing, both in the furniture industry and more broadly, is not merely a technical process, but a strategically embedded, capability-dependent transformation. Study 1 establishes this foundation by conceptualizing ReMS as a multidimensional strategic construct that integrates ReMS development with internal and external environmental changes; business strategy alignment with remanufacturing; the configuration of manufacturing structures, infrastructures, competitive priorities, and capabilities; and remanufacturing strategy formulation supported by dynamic resource configurations and improvement programmes for hybrid manufacturing planning. Study 1 argues that traditional MS must be reconfigured to support CE ambitions and remanufacturing activities. This positions remanufacturing as a strategic capability and a potential source of competitive advantage, rather than an isolated operational initiative.

Study 2 extends these insights by examining how DCs (sensing, seizing, and reconfiguring) shape firms' ability to adopt and develop remanufacturing in practice. The study identifies concrete opportunities (e.g., sustainability-oriented customer demand, evolving market expectations, and environmental alignment) that reflect active or emerging sensing capabilities. At the same time, several barriers (e.g., limited production readiness, knowledge gaps, profitability uncertainties, and system-level challenges) highlight where seizing and reconfiguring capabilities remain underdeveloped. In doing so, Study 2 empirically illustrates how dynamic capabilities condition the effectiveness of the strategic elements proposed in Study 1.

Synthetically, Study 1 provides the strategic view, the ReMS framework, while Study 2 reveals the capability mechanisms required to operationalize that view. Together, the studies show that achieving remanufacturing at scale requires both:

Strategic alignment and reconfiguration of MS, supported by the development of DCs; and

Dynamic capabilities that enable firms to:

- Sense firm-specific emerging notions in the context dimension, such as CE opportunities, technological advancements, and regulatory changes;
- Seize opportunities related to business potential in the content dimension of ReMS; and
- Reconfigure resources and capabilities in the process dimension to support remanufacturing strategy formulation and continuous improvement programmes.

Thus, the combined findings emphasize that remanufacturing adoption in the furniture industry depends on the interplay between the strategic intent of remanufacturing and the organizational capabilities that enable such intent to be realized. This integrated perspective advances current remanufacturing research by demonstrating that strategic orientation and dynamic capabilities require co-evolution for firms to successfully transition toward circular manufacturing.

6. CONCLUSION

The purpose of this dissertation is to develop knowledge about the strategic perspective of remanufacturing as a circular manufacturing strategy for OEMs. This purpose is addressed through two complementary studies. Study 1 develops conceptual insights into remanufacturing from a manufacturing strategy perspective and introduces the concept of Remanufacturing Strategy (ReMS), extending traditional MS toward a more circular and adaptive paradigm. It proposes a conceptual framework that identifies MS characteristics facilitating remanufacturing, considering the context, content, and process dimensions for formulating a ReMS.

Study 2 provides empirical insights from Swedish furniture OEMs by identifying the opportunities and barriers associated with remanufacturing and examining how dynamic capabilities support the realization of remanufacturing opportunities. The study also highlights capability gaps that hinder remanufacturing implementation and need to be addressed to overcome these barriers.

The two studies advance understanding of the strategic perspective of remanufacturing and contribute to both remanufacturing research and manufacturing strategy literature within a CE context. The findings also provide practical insights for OEMs on strategically integrating remanufacturing within existing manufacturing operations.

6.1. Limitations

While this thesis provides new insights into how remanufacturing is understood, strategized, and enabled within the furniture industry, several limitations should be acknowledged.

First, the SLR in Study 1 is based on publications retrieved from two major databases: Scopus and Web of Science. Although these databases are widely used and cover a broad range of high-quality academic journals, relying solely on them may have excluded relevant publications indexed elsewhere or found in grey literature. Consequently, the scope of the reviewed literature may not fully capture all scholarly perspectives on remanufacturing and MS.

Second, the empirical foundation of this thesis is based primarily on qualitative case studies of Swedish original furniture manufacturers. This narrow geographical and sectoral focus strengthens contextual depth but limits the breadth of generalizability. Furniture manufacturers in Sweden operate within a comparatively mature sustainability discourse, strong institutional pressures, and well-established environmental regulations. Firms in other countries or industries may experience different market dynamics, capability requirements, or strategic constraints, which could influence the transferability of the findings.

Third, the research examines remanufacturing at a particular moment in the strategic development of the participating firms. Because remanufacturing is an emerging and evolving practice within the furniture industry, some identified opportunities, barriers, or capability configurations may change over time. Although the dynamic capabilities lens provides a theoretical basis for understanding such evolution, the empirical design does not allow for longitudinal validation of how capabilities are developed, deployed, or reconfigured in practice.

Fourth, the empirical analysis in Study 2 is based on five furniture manufacturing organizations. While this number falls within the commonly accepted range for theoretical replication in multiple case study research (4–6 cases), Yin (2018) notes that including 6–10 cases can provide more compelling support for analytic generalization. Therefore, although the cases offer meaningful insights into capability development and strategic alignment, a larger set of cases could further strengthen the robustness and explanatory power of the findings.

Finally, the thesis focuses on OEM-level perspectives and does not extensively capture the viewpoints of other actors in the remanufacturing ecosystem, such as suppliers, logistics partners, customers, or recycling actors. Remanufacturing is inherently inter-organizational and requires coordination across product lifecycles. A broader multi-actor perspective could therefore enrich the understanding of capability formation, value creation, and strategic alignment in remanufacturing.

Despite these limitations, the thesis offers a robust and empirically grounded contribution to the understanding of the strategic perspective of remanufacturing and capability development within the furniture industry.

6.2. Future research

Study 1 highlights a clear gap in the literature regarding the identification of competitive priorities relevant to remanufacturing. Future research will therefore aim to further develop and clarify the set of competitive priorities necessary for remanufacturing within a CE context, particularly in the Swedish furniture industry. This work will continue to employ a case study research design, with a stronger emphasis on the business strategy perspective to deepen the understanding of remanufacturing as a strategic phenomenon.

As the empirical data in this thesis were collected at a particular moment in time, future research will also extend toward examining how dynamic capabilities evolve as firms progress in their remanufacturing adoption. A longitudinal approach will allow for a richer understanding of how sensing, seizing, and reconfiguring capabilities develop and interact over time.

Moreover, the empirical component of this dissertation is limited to five furniture manufacturing organizations. Future research will seek to expand the number of cases to strengthen the robustness and analytical generalizability of the findings.

Finally, Study 1 revealed a gap in the literature related to the process dimension, including decision-making in operations and planning activities during remanufacturing strategy formulation. Future research will therefore investigate decision-making processes and operational choices within remanufacturing, contributing to a more comprehensive understanding of how remanufacturing strategies are developed and implemented in practice.

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