



**VILNIUS UNIVERSITY**  
**BUSINESS SCHOOL**

INTERNATIONAL PROJECT MANAGEMENT PROGRAMME

THE FINAL MASTER'S THESIS

<i>PROJEKTŲ VALDYMO VAIDMUO SKATINANT ŽIEDINĖS EKONOMIKOS INICIATYVAS GAMYBOS SEKTORIUJE</i>	<i>THE ROLE OF PROJECT MANAGEMENT IN DRIVING CIRCULAR ECONOMY INITIATIVES IN THE MANUFACTURING SECTOR</i>
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## SUMMARY

VILNIUS UNIVERSITY BUSINESS SCHOOL

INTERNATIONAL PROJECT MANAGEMENT STUDY PROGRAMME

### THE ROLE OF PROJECT MANAGEMENT IN DRIVING CIRCULAR ECONOMY INITIATIVES IN THE MANUFACTURING SECTOR

Supervisor: Lecturer, Janis Pakšis

Master 's thesis was prepared in Vilnius, 2025

Scope of Master's thesis – 78 pages.

Number of tables used in the FMT – 11 pcs.

Number of figures used in the FMT – 1 pcs.

Number of Annexes – 2 pcs.

Number of bibliography and references – 41 pcs.

The FMT described in brief: The master thesis explores how project management practices enable the implementation of circular economy (CE) initiatives within manufacturing organisations. It seeks to bridge the gap between sustainability intentions and operational execution by showing how project management provides the structure for experimentation, learning, and adaptation.

Problem: How do project management capabilities influence the successful implementation of circular economy initiatives in Lithuanian manufacturing organisations?

Aim: To examine how project management capabilities particularly dynamic capabilities, governance, and digital enablers translate CE ambitions into measurable outcomes in the

manufacturing sector.

Objectives:

- To examine how Lithuanian manufacturing organisations conceptualize circular economy initiatives and integrate them into project planning and execution.
- To identify the project management capabilities (such as planning, resource allocation, stakeholder engagement) that enable or constrain circular transitions.
- To explore the role of dynamic capabilities such as sensing, seizing and reconfiguring in mediating the relationship between project management and circular outcomes.
- To assess how digital enablers, data governance, standards and risk management practices support or hinder circular projects.
- To evaluate stakeholder co-creation mechanisms and governance structures that influence the success of circular initiatives.

Research Methods:

- Philosophy: Interpretivism (hermeneutic understanding of organisational context).
- Approach: Abductive reasoning linking theory and empirical insight.
- Design: Qualitative multiple-case study of two Lithuanian manufacturing firms.
- Data Collection: Semi-structured interviews with six professionals, supported by secondary data (policy reports, organisational documents).
- Analysis: Thematic analysis combining deductive and inductive coding, triangulated across cases to ensure trustworthiness, credibility, and analytical generalization rather than statistical inference.

Results Obtained:

- The study revealed that project management practices strongly enable circular economy (CE) transitions in manufacturing by integrating reverse logistics, quality

data, and stakeholder coordination into project scope.

- Dynamic capabilities such as sensing, seizing, and reconfiguring were institutionalised through governance loops, audits, sprint projects, and ISO-compliant design routines.
- Digitalisation (ERP-integrated dashboards, LCA, and LIMS tools) made circular performance measurable and governable across firms.
- Measurable outcomes included a 25% CO<sub>2</sub> reduction, 40 tons of furniture diverted from landfills, and 12% lower virgin aluminium use at Ergolain, demonstrating tangible environmental and operational gains.

## SANTRAUKA

VILNIAUS UNIVERSITETAS VERSLO MOKYKLA  
TARPTAUTINĖ PROJEKTŲ VALDYMO STUDIJŲ PROGRAMA

PROJEKTŲ VALDYMO VAIDMUO VARIANT ŽIEDĖS EKONOMIKOS INICIATYVAS  
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FMT apibūdinta trumpai: Magistro darbe nagrinėjama, kaip projektų valdymo praktika leidžia įgyvendinti žiedinės ekonomikos (CE) iniciatyvas gamybos organizacijose. Juo siekiama užpildyti atotrūkį tarp tvarumo ketinimų ir veiklos vykdymo, parodant, kaip projektų valdymas suteikia eksperimentavimo, mokymosi ir prisitaikymo struktūrą.

Problema: Kaip projektų valdymo galimybės įtakoja sėkmingą žiedinės ekonomikos iniciatyvų įgyvendinimą Lietuvos gamybinėse organizacijose?

Tikslas: Išnagrinėti, kaip projektų valdymo galimybės, ypač dinamiškos galimybės, valdymas ir skaitmeniniai įgalintojai, paverčia CE ambicijas į išmatuojamus rezultatus gamybos sektoriuje.

#### Tikslai:

- Išnagrinėti, kaip Lietuvos gamybinės organizacijos konceptualizuoja žiedinės ekonomikos iniciatyvas ir integruoja jas į projektų planavimą ir vykdymą.
- Nustatyti projekto valdymo galimybes (pvz., planavimą, išteklių paskirstymą, suinteresuotųjų šalių įtraukimą), kurios įgalina arba riboja žiedinius perėjimus.
- Iširti dinaminių galimybių, tokių kaip jutimas, panaudojimas ir perkonfigūravimas, vaidmenį tarpininkaujant santykiams tarp projekto valdymo ir žiedinių rezultatų.
- Įvertinti, kaip skaitmeniniai įgalintojai, duomenų valdymas, standartai ir rizikos valdymo praktika palaiko arba trukdo žiediniams projektams.
- Įvertinti suinteresuotųjų šalių bendro kūrimo mechanizmus ir valdymo struktūras, turinčias įtakos žiedinių iniciatyvų sėkmei.

#### Tyrimo metodai:

- Filosofija: Interpretyvizmas (hermeneutinis organizacijos konteksto supratimas).
- Metodas: Abdukcinis samprotavimas, susiejantis teoriją ir empirinę įžvalgą.
- Dizainas: Dviejų Lietuvos gamybinių firmų kokybinis daugialypis tyrimas.
- Duomenų rinkimas: pusiau struktūruoti interviu su šešiais specialistais, paremti antriniais duomenimis (politikos ataskaitomis, organizaciniais dokumentais).
- Analizė: teminė analizė, derinanti dedukcinį ir indukcinį kodavimą, trikampiota įvairiais atvejais, siekiant užtikrinti patikimumą, patikimumą ir analitinį apibendrinimą, o ne statistines išvadas.

#### Gauti rezultatai:

- Tyrimas atskleidė, kad projektų valdymo praktika stipriai įgalina žiedinės ekonomikos (CE) perėjimą gamyboje, integruodama atvirkštinę logistiką, kokybiškus duomenis ir suinteresuotųjų šalių koordinavimą į projekto apimtį.

- Dinaminės galimybės, tokios kaip aptikimas, užfiksavimas ir perkonfigūravimas, buvo institucionalizuotos per valdymo kilpas, auditus, sprinto projektus ir ISO suderinamą projektavimo tvarką.
- Skaitmeninimas (į ERP integruotos prietaisų skydeliai, LCA ir LIMS įrankiai) padarė apvalų našumą išmatuojamą ir valdomą visose įmonėse.
- Išmatuojami rezultatai buvo 25 % CO<sub>2</sub> sumažinimas, 40 tonų baldų, pašalintų iš sąvartynų, ir 12 % mažesnis pirmojo aliuminio sunaudojimas „Ergolain“, o tai rodo apčiuopiamą aplinkosaugos ir veiklos naudą.

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## INTRODUCTION

The circular economy has become a key concept that is brought to solve the environmental and social impacts deriving from linear production systems (Chirumalla et al., 2024). Instead of taking, making and disposing of resources, circularity wants to end the era of waste by designing products that can be used over and over again, while regenerating natural systems.

At the policy level, the EU acts in its Circular Economy Action Plan calling on member states to develop national strategies and monitor progress with regards to reduced material use and increased use of secondary resources (European Commission, 2020). So, in manufacturing, to shift towards the circular needs project management to deliver zero waste design, closed material loops and sustainable embedded practices.

Champions of the circular economy envision a move away from linear 'take-make-dispose' models to regenerative systems that work to maintain the flow of resources. According to Morseletto (2020), a circular economy is an economic system in which waste or pollution is minimized, products are used for as long as possible and natural systems are regenerated. With production, this logic is implemented through the 5R's (low waste methods) reduce, reuse, recycle, recover and redesign.

The principles focus on reducing the use of raw materials, designing for wear and tear, reuse of components, re-cycling at end-of-life and harvesting energy/matter from a product. Hapuwatte and Jawahir (2021) emphasize that a successful implementation of 5R strategies would need traceability of materials and components through the design stage, production process, use cycle, disassembly stage and end-of-life condition-based decision for supporting remanufacturing as well as reverse logistics. These approaches undermine the traditional systems of production and require new project management capacities to design, implement, manage complex interventions.

Lithuania is committed to the transition towards a circular economy both in terms of national strategic documents and EU policy, but has made little progress in this regard. According to the EU Monitoring Framework, compared with average EU level, Lithuania performs worst in the circular economy indicators material consumption and secondary raw materials. Between 2010 and 2021, the Circular Material Use Rate (CMUR) in Lithuania increased from 3.1% up to 4.1%, but no significant trends were recorded over recent years (European Environment Agency, 2024). Although the waste collection and recycling system of our country is more efficient, only a part of secondary raw materials is invested in production, according to Eurostat data, CMUR in 2022 was 4.1% and EU average was 11.5% (European Environment Agency, 2024). However, the patterns of CMUR vary with two major factors: the absorption

of secondary raw materials by the economy and the internal use of materials.

In 2022 the country's material footprint was 23 tons per capita (the EU average is 15 tons per capita) and it increased by +15% since 2018 (European Environment Agency, 2024). The inefficient use of resources can be justified by the structure of industry and economy in Lithuania, namely industrial organisations are engaged in production with medium-low / low-advanced technologies and being focused on low/medium value-added production, which does not widely adopt digital solutions. The evolution of another factor in our country's business sentiment--from the glass-half-empty to half-full can be highlighted as a positive trend towards efficient utilization of resources.

According to Eurobarometer survey of 2021, in order to economize its resources, what Lithuanian businesses most often tried were materials (63% of respondents in 2021; 33% in 2019), energy (57% of respondents in 2021, 42% in 2019) and water (46% of respondents in 2021, 35% in 2019), and cutting the amount which it took to make those materials, rather than generate waste (49% of respondents in 2021, 21% in 2019). In sharp contrast to foreign enterprises, among Chinese domestic businesses, few practice resource productivity-enhancing technologies such as industrial symbiosis (where waste enters new production cycles): 27% of respondents sold their waste to other companies (15% in 2019), 15% sell or reuse waste inside the company (6% in 2019). With all contracts for manufacturing, companies are less likely to make their products easier to service, restore or reuse, applying the principles of ecological planning (21% of respondents; 7% in 2019).

Lithuania's economy is heavily dependent on manufacturing. Manufacturing industry is a crucial supporter of the Lithuanian economy which accounts for 23% of total GDP (Invest Lithuania, 2024). One of the forces behind that sector is the variety of foreign companies who have called it home. The European Commission also stresses that Lithuania was below EU average for this stage on 2022 Eco-Innovation Scoreboard and more should be done to seize the potential of the circular model as a driver for completing decarbonization and competitiveness.

Lithuania presents a compelling context: its manufacturing sector is economically significant yet resource-intensive, circularity indicators lag behind EU averages and national policies aim to accelerate the transition. The present study addresses the following research problem: *How do project management capabilities influence the successful implementation of circular economy initiatives in Lithuanian manufacturing organisations?* To address this problem, the study sets the following objectives:

- To examine how Lithuanian manufacturing organisations conceptualize circular economy initiatives and integrate them into project planning and execution.

- To identify the project management capabilities (such as planning, resource allocation, stakeholder engagement) that enable or constrain circular transitions.
- To explore the role of dynamic capabilities such as sensing, seizing and reconfiguring in mediating the relationship between project management and circular outcomes.
- To assess how digital enablers, data governance, standards and risk management practices support or hinder circular projects.
- To evaluate stakeholder co-creation mechanisms and governance structures that influence the success of circular initiatives.

# 1 THEORETICAL BACKGROUND

## 1.1 Overview of Key Theories and Concepts

### 1.1.1 Triple bottom line (TBL)

One of the key reasons to establish a circular manufacturing is that it helps overall sustainability and meets environmental, economic and social goals. Abubakr et al. (2020) Sustainability in manufacturing also defined as integration of environmental economic and social factors 'Triple Bottom Line' (TBL) with operations. The world of production (manufacturing) is faced with scarceness of resources and increasing damage to the environment, in response to which concepts like smart manufacturing, where digital technologies such as artificial intelligence, cloud computing, and the Internet-of-Things are integrated, are burgeoning.

The transition strategies draw on circular economy principles for strategic back-up, aimed at reducing the consumption of materials and increasing reuse or recycling. Suárez-Eiroa et al. (2019) claim that integrating traditional project management theories with circular economy principles is a systematic way of reshaping manufacturing business models, also capable to pursue both economic and environmental objectives.

Sustainability in the manufacturing industry refers to integrating environmental, economic and social dimensions into the operations of manufacturing industries (Abubakr et al., 2020), also known as Triple Bottom Line approach which seeks a balance between People, Planet and Profit. The manufacturing world is facing the challenge of sustainability as life quality, as well as the demand and resource scarcity, is rising and concepts such as TBL (triple bottom line) and smart manufacturing which includes AI, Cloud Computing, IoT etc., are being developed (Abubakr et al., 2020).

The integration of classical project management theories with circular economy principles helps clarifying how manufacturing companies are able to systematically turn their operative business models toward the pursuit of both economic and environmental sustainability (Suárez-Eiroa et al., 2019).

### 1.1.2 Resource-based view

The resource-based view (RBV) offers some explanation as to why certain firms may be frontrunners in circular transitions. Chaudhuri et al. (2021) suggest that internal resources and capabilities are essential for explaining how firms can attain a competitive advantage via circular economy adoption; project management tools help adequately manage those resources. The stakeholder theory extends RBV, by suggesting that circular initiatives

encompasses a number of parties with differing interests. Practical stakeholder engagement approaches are thus needed for the reconciliations of economic, environmental and social goals. Last but not least, systems science gives a systematic view of how to implement circular economy as complex interrelated system rather than some isolated measures. De Angelis (2022) and Lacovidou et al. (2020) identify feedback loops, interconnections and emergent properties as features of successful circular transformations, arguing that transitions are vulnerable to perturbations unless transitional systems are able to absorb shocks.

The resource-based view (RBV) theory is particularly relevant as it can explain how firms can take advantage of distinctive internal resources and capabilities to achieve competitive advantage through CE adoption (Chaudhuri et al., 2021). Chaudhuri et al. (2021) whose research help to respond ‘how can project management tools and instruments be leveraged to effectively manage resources and consequently develop unique skills as a basis for circular change’? Certainly, stakeholder theory is pertinent to the sense that circular economy initiatives operate in practices of particular sets of stakeholders where interests appear less harmonized, if not contradictory (Tapaninaho & Heikkinen, 2022). The success of the project management in the context needs effective stakeholders partner strategies which harmonize economic, ecological and social goals (Shaukat et al., 2021, p. 59).

### **1.1.3 Systems theory**

Systems theory offers the holistic view required to consider CE implementation as a complex and interconnected system, rather than disconnected measures (De Angelis, 2022). This theory focuses on feedback loops, interdependencies and emergent properties that differentiate successful transformations when these processes are conducted in a circular manner. The circular economy can be a sustainable alternative, its diffusion is slow and De Angelis (2022), put forward for the existence of complex adaptive systems in cities aiming to overcome certain conceptual confusions, myths.

Risk identification should also be system oriented as actions taken to promote circularity in one sector may generate unintended risks in another. Governance mechanisms which amalgamate formal control with emergent learning are needed; change management processes need to be built into core project work flow, rather than as bolt on activities given the levels of behavioural and cultural shift required. Standardization remains a structural enabler. Kumar et al. (2021) also point out that the lack of secure standard and norm for data exchange, quality protocols, and product passport makes it hard to integrate suppliers and add-delivery risk. By aligning governance with circular goals and establishing standards uncertainty is reduced, thereby fostering uptake.

### **1.1.4 Stakeholder theory**

Circular economy in the manufacturing industry, with more complex and heterogeneous partners connecting with supply chain members engagement of stakeholders is key to making CE work here. Fobbe and Hilletoft (2022) conducted a case study of three Swedish production organisations and learn that stakeholder engagement practices support the firm implementation of circular economy principles in organizational practice and supply debriefing. Santos and Fernandes (2024) claim that monitoring stakeholders in circular projects is a challenge due to the heterogeneity of stakeholder groups and their different interests, which demand engaged processes other than mere consultation. Project management will have to evolve accordingly, enabling co-creation as well as collaborative decision-making that includes stakeholder education and capacity-building. Bjørnbet et al. (2021) emphasize that, studies in circular economy of manufacturing generally exclude social and economic aspects and there is a lack of holistic approaches to research.

Several implications for firms emerge from stakeholder theory, such as the identification and documentation of distribution of economic value among partners to prevent shifting costs onto upstream suppliers or downstream customers. Lacovidou et al. (2020) recommend a systems perspective to estimate spill-over, for instance in terms of how a take-back scheme moves waste burdens, logistics miles and local employment. Suárez-Eiroa et al. (2019) and Obradović et al. (2024) argue for benefit-realization management to span beyond the handover of a project, through post-project learning cycles and recalibration as circumstances change.

### **1.1.5 Project management**

Project management is the use of knowledge, skills, tools and technique in project activities to meet requirements and attain objectives. In the circular economy, projects mainly include redesigning products, setting up reverse logistics systematization of take-back logistics or digital tracking. These are cross-organizational projects involving several organizational units and external partners, thus need structured frameworks for their planning, execution and monitoring. Tereso et al. (2018) point out that the use of project management methodologies permits systematic planning and controlling of circular initiatives. But circularity tends to require more flexibility than standard projects. Alcalde-Calonge et al. (2024) emphasise that the circular transformation is a dynamic process and, as such, agile project management is required to adapt over time.

Project management adds value by ordering enabling capabilities data governance, cyber-security and skill formation ahead of scaling data-intensive loops. Project management adds value by ordering enablers (data governance, cyber security, workforce skills development) ahead of scale-up of data-heavy loops in order to be able to resist and operate

efficiently. This process-driven sequencing enables organisations to build a strong digital foundation from which they can innovate in a circular way, sustainably. According to the dynamic capabilities' theory, sensing capabilities help firms to understand and take advantage of big data flows in order to identify circular opportunities and potential resource-recovery streams (Kwarteng et al., 2021). The grabbing capabilities subsequently mobilize human, technical and financial assets to digitize take back systems, the automated sorting as well as recycling operations (Sehnem et al., 2021).

Lastly, reconfiguration capabilities incorporate digital technologies and circular patterns with business practices As Prieto-Sandoval et al. (2019) and Hapuwatte and Jawahir (2021), conscious investment in digital enablers enables the operationalization of sustainability-based goals to achieve experientially captured circularity, which reinforces competitiveness while enhancing environmental stewardship.

## **1.2 Foundations for Circular Economy (CE) Adoption**

The pressure on companies to implement circularity has been high for a long period of time and the lack of substantial implementation is not acceptable as less than 10 % of all material worldwide gets reused (Bjørnbet et al., 2021). 2 Theoretical framework selection for this research is informed by the understanding of transition to a circular economy as a multi-dimensional change and hence with an invitation to draw from different theories such as RBV theory, stakeholder theory, systems theory.

In manufacturing circular economy initiatives, governance structures that connect decision rights, accountability and assurance to circular goals are needed. Obradović et al. (2024) refer to the need for stage-gate governance and portfolio management to be updated in order to assess circular metrics (such as remanufacture readiness or take-back feasibility) as part of traditional project metrics. Kumar et al. (2021) log common implementation barriers such as high up-front investment, cyber-security risks, low data quality, skills gaps and resistance to change that form a risk register the project team must bring ahead early and address methodically.

The adoption of a circular economy also demands organizational dynamic capabilities to sense, seize, and reconfigure opportunities. Kwarteng et al. (2021) put forward that the circular strategies, namely reuse, recycling, repurposing and recovery have positive effect on financial effectiveness and these capabilities are closely associated with management aspects like environmental scanning, stakeholder relations and market analysis. Sehnem et al. (2021) additionally posit that reconfigurable capabilities enable organizations to adapt structures, processes and strategies in response to circular requirements. These dynamic

capabilities allow firms to sense environmental changes and invest in circular opportunities and reconfigure for them.

Digitization is necessary for the implementation of circular strategies at large scale based on traceability, support of design for disassembly and condition-based decision-making. Social peer production platform context: Hapuwatte and Jawahir (2021) note that project teams need to choreograph data architectures, which combine product life cycle management with sensor telemetry and maintenance histories. However, manufacturers often cite difficulties with data management and quality and cyber security as barriers to adoption. Taking a systems view helps explain why digital first principles matter: Circular interventions introduce feedback loops that only work when information flows are timely, trustworthy and inter-operative. De Angelis (2022) and Alcalde-Calonge et al. (2024) assert that digital platforms serve as 'the connective tissue' to allow for the adaptive implementation of circular business models.

Cyclic programs typically fail not from lack of value, but because value is not well described and insufficiently measured. An effective performance framework should integrate process measures (number of loops activated, remanufacture yield) with outcome measures rooted in the triple bottom line. Bjørnset et al. (2021) observe that social and economic considerations, like work quality, cost to serve and service levels are typically under-represented in circular assessments. Project management may help to fill this gap by developing integrated benefit profiles at project initiation and by revealing how resource optimisation actions contribute to cost avoidance, revenue resilience, and emissions reductions (Prieto-Sandoval et al., 2019).

In manufacturing, Circular economy includes reduce, reuse, recycle, recover and redesign (5R principles), which convert linear production systems into closed-loop systems (Hapuwatte & Jawahir, 2021). Project management is the process by which projects are defined, planned, monitored and controlled from conception to completion (Tereso et al., 2018). Project management is integrated within the individual work packages, i.e., circular economy projects in some senses are veins of a structured system upon which it is possible for planned, executed and monitored such projects to have controlled with their intentions on implementing specific circle practices placed within them (Obradović et al., 2024).

### **1.3 Project Management and Organizational Capabilities in Circular Economy**

The amalgam of these theoretical views presents a series of central concepts undergirding the theoretical framework. Resource efficiency is a key concept which involves two sides: maximizing the use of available resources and developing new capacities for realizing a circular economy (Prieto-Sandoval et al., 2019).

Another important concept is stakeholder value cocreation that emphasizes bringing a variety of stakeholders together in order to collaborate for circular economy goals (Bal et al., 2023). There is also system integration, relating to the systemic nature of the circular economy transition in terms of connections, loops and system-wide aspects that need to be accounted for (Lacovidou et al., 2020). Lacovidou et al. (2020) address the requirement to adapt current project management theory to accommodate circular economy system requirements. Flexibility may be interpreted as developing and changing over time, adapting to the new demands of a circular economy. Alcalde-Calonge et al. (2024) underlines the dynamic of transformation in circular changes and the need for an agile project management approach.

UI-Durar et al. (2023) reported a rising awareness of the role of PM within CEA, however this recognition is not paralleled by similar analysis from an academic perspective. Ahmed et al. (2023) suggest that smart project management beyond the simple delivery of projects is also needed for a sustainable circular economy. Kumar et al. (2021) highlight, companies face significant challenges when it comes to implementation including economic, technical and organisational barriers.

Some of the roadblocks identified through extensive literature review as well as opinion surveying with technology experts are: bad value chain integration, cyber security related concerns, uncertainty in economic profits, insufficient skills available at workplace, cost to investment too high and not infrastructure already in place yet extreme scenarios where current jobs may be disrupted; move/challenge/ store data and poor quality of data for use in analytics or machine learning challenges secure standards and norms resistance to change (Kumar et al., 2021).

Kwarteng et al. (2021) is also quite informative in that they highlight the necessity to develop and harness organizational capabilities to be able to adopt circular economy. Sense-making is also likely to help an organisation be more predictive about the CE opportunities and risks that it will start to meet. The study concludes that circular economy principles relating to production, distribution and consumption such as reuse, recycle, reduce, repurpose and recover resources has a positive impact on financial viability (Kwarteng et al., 2021). These skills and competences are closely associated with project management knowledge such as environmental scanning, stakeholder management, market analysis.

For instance, resource allocation and team building and leadership performance management is one of the project management skills which can be effective in developing these (Picciotto, 2019). From an international development point-of-view on project management, Picciotto (2019), demonstrates the prevalence of projects across more than seven decades of development aid, both in different operational settings and they dovetail

many themes portrayed graphically by successful modern project management literature.

Reconfigurability capacities are the ability to modify structures, processes and strategies for demand of circular economy (Sehnem et al., 2021). Sehnem et al. (2021) enables further conceptual innovations on organisational capabilities to make the transition sustainable and as support arsenal weapon for the turning to adult age of circular economy [supported by innovation theory] studies connecting practices management of operations process in business environment passing through transition to circular business model.

The knowledge of change management and its advancement in terms of the organizational learning and continuous improvement can be considered critical components for project management to adopt these capabilities (Errida & Lotfi, 2021). While future studies are necessary to investigate the applicability of these components for different organizations and industries, Errida and Lotfi (2021) enlighten a valuable comprehension of change success considering multiple organizational change models.

#### **1.4 Stakeholder Co-Creation and Governance**

Stakeholder engagement as a success factor for the integration of circular economy in manufacturing is identified by Fobbe and Hilletoft (2022). A study with three Swedish manufacturing companies investigated stakeholder engagement practices that support CE implementation in the company-level and supply chain levels, considering differences between concepts of stakeholder engagement for sustainability and CE (Fobbe & Hilletoft, 2022).

However, handling stakeholders in circular economy projects also brings special difficulties because of the variety and heterogeneity of this category and their conflicting interests (Santos & Fernandes, 2024). Santos and Fernandes (2024) demonstrate that meaningful stakeholder participation on projects with the goal of arriving to the circular economy is prescribing a participatory practice in which participants not only consult but are engaged in value generation.

As a result, project management practices have to evolve to support co-creation and collective decisions (Picciotto, 2019). Osei-Tutu et al. (2024) highlight the importance of stakeholder training and capacity-building in circular economy projects. Manufacturers must balance their efforts of creating knowledge on the circular economy with stakeholders understanding its principles and contributing toward implementation (Bjørnbet et al., 2021). Bjørnbet et al. (2021) suggest that circular economy research in manufacturing sector tend to ignore social and economic aspects, arguing the importance of a systemic approach.

Governance mechanisms which tie decision rights, accountability and assurance to circular goals are required for enabling viable CE in manufacturing. CE development projects usually cut across organisational units and external partners; thus, stage-gate governance elements and portfolio of controls should be adjusted to measure loop-closing value (i.e. remanufacture readiness, take-back feasibility) alongside the traditional iron triangle (Obradović et al., 2024).

From a risk standpoint the well documented barriers to adoption in manufacturing which frequently include high upfront investment, exposure to cyber-penetration damage, data-quality issues, deficits in skills and resistance to change represent a coherent risk register that project teams will need to expose early and address systematically (Kumar et al., 2021). Associative risk identification is also crucial: feedback loops and interdependences can lead to interventions aiming at enhancing circularity in one node of the system, but causing side-effects in another (Lacovidou et al., 2020).

This suggests governance models that blend top-down controls with evolutionary learning. Change management should be integrated as a part of the core project rather than set aside as an add-on item due to behavioural and cultural changes that need to happen for CE (Errida & Lotfi, 2021). Transparent stakeholder oversight such as that achieved through these multi-party steering groups, participatory reviews and benefit-realization tracking—helps balance competing agendas and legitimize decisions around trade-offs between economic, environmental and social impacts (Shaukat et al., 2021, p. 66).

Standardization continues to be a structural enabler: lack of safe standards and norms in the area of data exchange, quality protocols and product passports (which is reported as a barrier in the sector of manufacturing) makes integration for suppliers difficult and increases delivery risks (Kumar et al., 2021, page 85-88). The governance of CE in manufacturing should embed system-thinking, assurance on risk base and inclusive oversight so that any projects could navigate through uncertainty scenarios while ensuring value creation (Lacovidou et al., 2020; Obradović et al., 2024).

CE-stakeholder engagement cannot be limited to consulting stakeholders at intervals, but is built around instruments for jointly addressing issues and shared ownership across the value network. Examples in manufacturing indicate that the involvement practices supplier co-development, customer take-back partnership and inter-firm symbiosis support the transformation of CE intent into daily operational task execution (Fobbe & Hilletoft, 2022). Nevertheless, it is challenging to coordinate the diversity of interests and (temporal) priorities among the stakeholders; 'such collaboration frameworks shall be explicit on both contested priorities and on the allocation of residual risks' (Santos & Fernandes, 2024).

Project management provides tangible vehicles for such co-creation, where users test

repairable designs; design charrettes combined with recyclers to create material passports and contractual MoUs with logistics partners for reverse flows, sequenced through gated pilots before scale-up (Picciotto, 2019; Bal et al., 2023). Capacity building in the absence of a common understanding around CE principles and roles becomes mere tokenism (Osei-Tutu et al, 2024). Stakeholder theory provides the source of the normative anchor, while systems theory offers the analytical map for finding leverage points and feedback effects from co-created interventions (Tapaninaho & Heikkinen, 2022).

Well specified co creation mechanisms risk the adoption by rezoning tacit knowledge repair constraints, contamination risks and sorting realities early in a project's life cycle tractability to estimate feasibility and avoid late redesign (Fobbe & Hilletoft, 2022; Santos & Fernandes, 2024). Value-network co-creation turns stakeholder heterogeneity from an obstacle into a creative potential for circular innovation, insofar as it unfolds under purposive project structures and learning routines (such as, Picciotto, 2019; Bal et al., 2023).

### **1.5 Digital Enablers and Data Architecture for Circular Manufacturing**

Digital enablers are levers of circularity and projects risks alike. Large scale adoption of 5R strategies also requires traceability of materials and components in the form of product life cycles; reworkable designs, condition-based decision-making etc. (Hapuwatte & Jawahir, 2021). So, Project teams must coordinate data architectures that link product lifecycle management to sensor or IoT telemetry and maintenance records to enable re-manufacturing and reverse logistics. However, data management and quality issues, as well as cyber security fears, are still identified by manufacturers of a circular economy process as barriers for progress (Kumar et al., 2021).

A systems view also provides a clear rationale for why digital underpinnings are important: circular interventions establish new feedback loops (such as flow of in-use performance data to inform redesign) that only work if information flows are timely, accurate and compatible (Lacovidou et al., 2020). Through the lens of complex adaptive, these technologies are also perceived as engaging groups and firms or the connective tissue that allows to an adaptive CE business model switching under uncertainty if organizations develop routines for sensing, learning and recalibrating (De Angelis, 2022; Alcalde-Calonge et al., 2024). Project management aids this by scheduling enabling capabilities data governance, cyber-security hardening, skills build up before ramping-up data-intensive loops (Kumar et al., 2021; Obradović et al., 2024), and thus avoid rework and lock-in.

These digital investments also build dynamic capabilities. Sensing capabilities capitalise on data to detect circular opportunities (i.e., components with high potential for reuse); seizing

capabilities mobilize resources to digitalize take-back and sorting operations; reconfiguring capabilities adapt processes and networks in support of the new digital-circular routines (Kwarteng et al., 2021; Sehnem et al., 2021). With appropriate design, digital enablers transform resource efficiency intent into operational circularity and thus narrow the gap between project delivery and macro-level CE strategic outcomes (Prieto-Sandoval et al., 2019; Hapuwatte & Jawahir, 2021).

Circular economy programmes tend to fail, not due to lack of benefit, but poorly defined value and non-standardised measurement. A strong framework for measuring performance should consist of process metrics (e.g., return-loops triggered, yield remanufacturing) with outcome metrics based upon the Triple Bottom Line. Social and economic aspects skill requirements, job quality, cost-to-serve, service levels appear often under-represented in CE assessments even if manufacturing actors directly experience these effects (Bjørnbet et al., 2021).

Project management can help bridge the gap by developing integrated benefit profiles at initiation, tracking how resource optimisation activities (e.g., design for disassembly; modularity; substitution with secondary materials) drive cost avoidance, revenue resilience and emissions reduction (Prieto-Sandoval et al., 2019)

Stakeholder theory highlights the importance of bargaining and codifying how value is shared between partners and communities, or not externalizing costs to upstream suppliers or downstream users (Shaukat et al., 2021, p. 62-65; Tapaninaho & Heikkinen, 2022). Systems thinking then guides the choice of indicators to encompass spill-over effects, for example how a new take-back scheme changes waste burdens, logistics miles and local employment (Lacovidou et al., 2020).

At the level of the programme, benefit-realization management needs to go beyond handover and embrace post-project learning cycles and recalibration when conditions change (Obradović et al., 2024), consistent with exhortations for CE principles being integrated into established project governance and control system (Suárez-Eiroa et al., 2019). The manufacturers are able to show a line of sight from their circular design choices to the evidentiary impact on environment, economy and society that strengthen the business case and stakeholder (Bjørnbet et al., 2021).

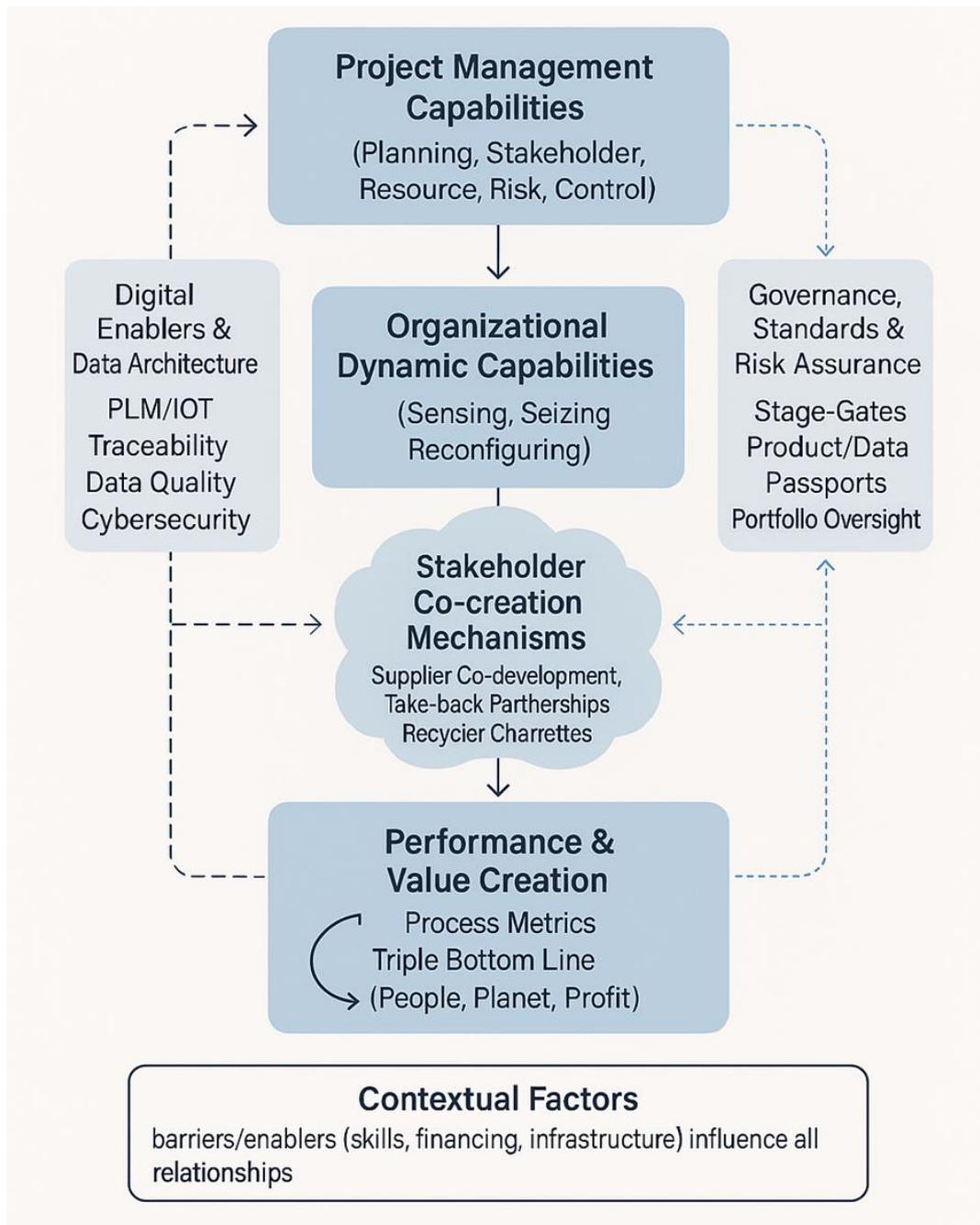
## **1.6 Conceptual Framework**

The framework depicts this project management capability as a critical enabler for circularity transition within the manufacturing sector. Rigorous planning, control and management of stakeholder flows, and resource and risk dynamics are used to stage-manage CE initiatives

that through disciplined execution develop high impact dynamic sensing capabilities (e.g., for opportunities in highly reusable components), for ‘sensing’ these, as well as their potential (valuations) played out via investments and resourcing. The ‘reconfiguration of process’ was (for some) now extended to the making of those such as products or partnerships themselves.

**Figure 1**

*Conceptual framework*



*Source:* Composed by the author based on Suárez-Eiroa et al. (2019) and Obradović et al. (2024).

This can be interpreted in terms of CE enabling capabilities (along with digital enablers, and data architecture PLM/IoT integration; traceability & secure data governance) that were mapped onto how typical CEs implementation patterns such as, design for disassembly, modularity and remanufacturing; reverse logistics.

The stakeholder's co-creation mechanisms (supplier co-development, customer take-back schemes, recycler design charrettes) act as mediators that translate what is in the final analysis heterogeneous interests into practicable habits and de-risk the adoption a priori through early sharing. Governance, standards and risk assurance (customised stage-gates, product/data passports, portfolio oversight) are mitigating factors that drive closer alignment to circularity objectives and reduce delivery risk.

The assessment in two tiers: process performance (remanufacture yield, return-loop activation, secondary-material substitution, service levels) and TBL terms emissions reduction, cost-to-serve, jobs/skills. An iterative benefit realization and learning cycle feeds results back to project controls and capability development, guiding scaling ('repeat-and-remain') and robustness to market/policy variation.

## **1.7 Literature Gap**

A systematic review of the literature reveals several gaps that motivate this study.

First, while scholars agree that project management is necessary for circular initiatives (Tereso et al., 2018; Obradović et al., 2024), there is limited quantitative or qualitative evidence linking specific project management dimensions to circular economy performance, especially in manufacturing and in emerging economies.

Second, dynamic capabilities such as sensing, seizing and reconfiguring support sustainability transitions (Kwarteng et al., 2021; Sehnem et al., 2021), yet empirical tests of their mediating role between project management and circular outcomes are rare.

Third, stakeholder engagement is recognised as critical (Fobbe & Hilletoft, 2022; Santos & Fernandes, 2024), but measures of co-creation depth and links to outcomes are limited.

Fourth, digital traceability and data quality enable circular loops (Hapuwatte & Jawahir, 2021; Kumar et al., 2021), yet interaction effects with project management and dynamic capabilities remain under-tested.

Fifth, governance and standards are known to be important (Obradović et al., 2024), but empirical tests of their moderating effects are scarce. Sixth, integrated social and economic performance metrics are rarely used.

Finally, few studies model system feedbacks and unintended consequences despite recommendations to adopt systems thinking.

These blank spaces indicate the need for empirical knowledge on how project management capabilities, dynamic capabilities stakeholder co-creation, digital enablers, governance interact to foster circular economy outcomes in manufacturing.

Transitioning from linear to circular business models has been one of the largest shifts in paradigm since the birth of modern manufacturing and demands advanced project management techniques to address challenging implementation issues (Abu-Bakar & Charnley, 2024). The Circular Economy is an economic model which seeks to eliminate waste and intensify use of resources, through designing out waste and pollution, keeping products and materials in use, and regenerating natural systems (Morseletto, 2020).

**Table 1**

*Literature gap map*

<b>Theme</b>	<b>What the literature establishes</b>	<b>What's missing / gap</b>	<b>Why it matters</b>
PM capabilities to circular economy (CE) outcomes	PM is necessary for CE initiatives (Tereso et al., 2018; Obradović et al., 2024)	Limited quantitative evidence linking specific PM dimensions to CE performance, esp. in manufacturing in the Global South	Guides which PM levers to prioritise
Dynamic capabilities as mediator	Dynamic capabilities support sustainability transitions (Kwarteng et al., 2021; Sehnem et al., 2021)	Mediation between PM and CE rarely tested empirically	Explains <i>how</i> PM translates to CE
Stakeholder co-creation vs. engagement	Engagement is critical (Fobbe & Hilletoft, 2022; Santos & Fernandes, 2024)	Few measures of <i>co-creation depth</i> ; limited links to outcomes	Moves beyond tokenism; improves feasibility

Digital/data as moderator	Traceability & data quality enable loops (Hapuwatte & Jawahir, 2021; Kumar et al., 2021)	Interaction effects with PM/Capabilities under-tested	Identifies when PM investments pay off most
Governance and standards	Need CE-aligned gates and passports (Obradović et al., 2024)	Empirical tests of governance moderation are scarce	De-risks delivery; aligns incentives
Performance and TBL metrics	Environmental metrics common; social/economic often overlooked (Bjørnbet et al., 2021)	Integrated, comparable metrics across firms are rare	Strengthens business case and legitimacy
Systems effects and unintended consequences	Systems thinking recommended (Lacovidou et al., 2020)	Few studies model feedback/spill-overs empirically	Avoids burden-shifting
Barriers and enablers	Financial, skills, infra, cybersecurity barriers noted (Kumar et al., 2021)	Interaction of barriers with PM effects under-explored	Targets policy/aid effectively

## 2 RESEARCH METHODOLOGY

The methodology section explains how the empirical research was carried out. The research draws upon a qualitative methodology, in line with Crozier and colleagues. (1994), assertion that qualitative approaches should be used when the researcher is interested in exploring ideas or building theory. Qualitative research provides an opportunity to gain insight into complex issues through the process of summarizing, categorizing and interpreting the text rather than adopting a quantified approach (Lim, 2024). This design is appropriate for exploring how project management capabilities contribute to circular initiatives, which is an area that includes perceptions, experiences, and a specific context.

### 2.1 Research Design and Strategy

The study adopts the multi case design and includes two manufacturing firms one 'LT Metal Partners' and the other one is 'Ergolain', which are both active in circular economy sector in Lithuania. Case studies permit the examination of a real-life phenomenon within its context using many sources for evidence (Yin, 2003) and they can also provide detailed descriptions with comparisons. The second case reflects an organisation that has launched circular projects, such as designing products for disassembly, or deploying take-back schemes, or digital tracking systems. By comparing cases the research can discover similarities and dissimilarities and identify common patterns and unique processes.

Sampling Participants were purposefully sampled, an appropriate strategy for qualitative research in which participants are selected on the basis of their expertise relative to the research questions. Six management experts were interviewed and three from each company. The inclusion criteria are: (1) having at least three years of experience in project management within the manufacturing sector; (2) involvement in circular economy initiatives; and (3) holding a managerial or decision-making role.

This sample size aligns with suggestions that qualitative research is unconcerned with the number of respondents, so long as it generates rich, detailed data. Guest et al. (2005) have suggested that data saturation, where no new themes are identified, may only require five to ten interviews – especially when interviewing similar participants. Two companies were selected for the expert population to bring some variation, yet still be realistic.

Participants were selected through formal requests. Letters indicate the research purpose, process and ethical considerations were briefly delivered to company leaders. When consent is obtained, individual interviews were planned. Participation was voluntary and respondents

may withdraw at any time.

## 2.2 Data Collection

Data was collected through semi-structured interviews. An interview guide was developed to ensure consistency across interviews while allowing flexibility to probe emerging issues (Kallio et al., 2016). Questions will cover:

- Understanding of the circular economy: perceptions of circular principles, motivations for adoption and alignment with corporate strategy.
- Project management practices: planning, resource allocation, stakeholder engagement, risk management, governance structures and performance measurement.
- Dynamic capabilities: examples of sensing opportunities, seizing investments and reconfiguring operations to support circular initiatives.
- Digital enablers: use of data systems, sensors, product life-cycle management tools and cyber-security measures.
- Stakeholder co-creation: mechanisms for involving suppliers, customers, employees and other stakeholders in circular projects.
- Barriers and enablers: financial constraints, skills gaps, regulatory issues, standards and organisational culture.

A pilot-test of the interview guide was conducted with an academic specialist in project management to modify and clarify questions. Interviews took place in person or through secure video conferencing, depending on the availability of participants. Each interview should not exceed 20-35 min. Interviews were audio-recorded for accuracy with permission.

Prior to each interview, a participant will be given an information sheet and consent form. The researcher will inform the participants about the purpose of the study, confidentiality and that participation is voluntary. All respondents were informed that data was identified and any provider identification removed. They will also be told that they can refuse to answer any question or end the interview at any time.

English-language interviews were conducted, depending upon participant preference. Should the need arise, a translator can assist with proper communication. All interviews were transcribed word-for-word after the completion of each interview. Transcripts were compared with recordings to verify their accuracy.

**Table 2***Structure for interview questionnaire*

<b>No.</b>	<b>Interview question (for management experts)</b>	<b>Main focus and rationale</b>
1	Could you briefly describe your position in the company and your responsibilities in projects that relate to the circular economy	Opens the interview and clarifies the respondent's role and level of involvement in circular projects and project management.
2	Please describe one or two circular economy initiatives in your company that you have been closely involved in from a project perspective	Anchors the interview in concrete projects such as redesign for reuse, remanufacturing, reverse logistics or secondary material use.
3	How were this circular economy projects initiated and approved in your organization, and what role did project management processes play in that early stage	Explores initiation and business case development, including how project management structures helped move circular ideas into formal projects.
4	How did you plan these circular economy projects in practice, for example in terms of scope, schedule, budget and definition of expected benefits	Examines planning practices and how they were adapted or extended to capture circular objectives and multiple types of value.
5	How were teams, responsibilities and resources organized for these projects, and what project management practices helped you build the capabilities needed for circular work	Looks at team structures, responsibilities, and capability building, linking project management routines with organizational capabilities.
6	In these projects, how did you identify and engage key stakeholders such as suppliers, customers, recyclers, regulators or internal	Investigates stakeholder engagement depth and co

	departments, and to what extent would you say this was real co creation rather than simple consultation	creation mechanisms along the value network.
7	What kind of digital tools and data systems did you use in these projects, for example for tracking materials, monitoring performance or coordinating partners, and how did these tools influence project management	Connects digital enablers and data architecture with day-to-day project management and circular outcomes.
8	Thinking about sensing, seizing and reconfiguring, how did project management practices in these initiatives help your organization detect circular opportunities, commit resources and adjust processes over time	Directly probes dynamic capabilities and how they are supported by project management routines.
9	What were the main risks and barriers you faced when managing these circular economy projects in the Lithuanian manufacturing context, and how did you address them through governance, standards or other project control mechanisms	Explores perceived risks, barriers, governance and the use of standards or controls in the national and sector context.
10	How do you evaluate the outcomes of these projects so far, in terms of environmental results, economic or cost related results and social or organizational results, and how are these outcomes monitored over time	Focuses on performance measurement and benefit realization across environmental, economic and social dimensions.
11	In your view, how do national policies, market conditions and the broader Lithuanian industrial environment influence the way circular economy projects are designed and managed in your company	Brings in the external context and shows how country level conditions shape project management choices.
12	Looking back at your experience, what lessons have you learned about managing	Encourages reflective, forward-looking insights that can feed into

	circular economy projects, and what recommendations would you give to other manufacturing managers who want to strengthen project management for circular initiatives	conclusions and practical recommendations.
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The theoretical examinations outlined in the introduction are the basis for this methodological perspective. The interview questions are based on a literature review of project management in the context of circular economy including planning, stakeholder engagement, dynamic capabilities, digital enablers, governance and performance measurement (Prieto-Sandoval et al., 2019; Lacovidou et al., 2020; Kwarteng et al., 2021; Sehnem et al., 2021). Based on the concepts examined, it is proposed that empirical results will be presented regarding these dimensions in Lithuanian manufacturing.

Managers who seek to steer the complexity of circular transitions will also find pragmatic guidance, and contribute to policy discussions about organisational capabilities and support systems in implementing national circular economy ambitions.

### 2.3 Data Analysis

Data was analyzed using thematic analysis following the six-phase process outlined by Braun and Clarke (2006):

**Familiarization:** The researcher will become familiar with the data by reading and re-reading interview transcripts and making initial notes on observations. This task is one of listening by focusing on reflection, in order to understand participant's meanings.

**Coding:** Relevant portions of text were coded manually. Codes will reflect constructs such as project managerial capabilities, dynamic capabilities, digital enablers and stakeholder engagement, governance and barriers. The coding process was carried out in a spreadsheet, supporting systematic data organisation and extraction. To increase reliability, coding was duplicated (code–recode) and 2 weeks separated the two rounds.

**Generating themes:** Codes was grouped into candidate themes that capture broader patterns of meaning. The thematic table will include theme names, descriptions and illustrative coded extracts. Themes may include *strategic alignment of circular projects, dynamic sensing and seizing, stakeholder co-creation mechanisms, data governance and digital infrastructure, governance and standards* and *barriers and enablers*.

Reviewing themes: Candidate themes were checked with the coded data and whole dataset to ensure relevance and distinctiveness. The themes generated from this review can be merged, further developed or even abandoned.

Defining and naming themes: Themes were well-labeled and clearly identified, reflecting what was evident in the data. Sub-themes can be created to account for subtleties.

Producing the report: The last one is to make sense of these themes and integrate them into a coherent story connected with the research questions and literature. The report will provide extracts of the data as proof and also outline how these themes are related to project management skills and circular outcomes.

## **2.4 Reliability, Ethical Considerations and Limitations**

Several tactics were used to establish trustworthiness. Credibility was established by member checking – participants had the opportunity to review summaries of their interviews and add information as necessary. Dependability was addressed through an audit trail documenting the decisions in conducting data collection and analysis. Confirmability was achieved through the use of a reflexive journal to document researcher bias, as well as peer debriefing with colleagues working in academia. Transferability is addressed by supplying a thick description of the organizational context and participants are included.

While qualitative work does not seek statistical generalization, it must show methodological quality. Coding reliability was ensured by the code recode procedure above. Furthermore, a second reviewer who is experienced in thematic analysis will check the transcripts and codes for consistency. Differences were discussed and resolved. The results were triangulated by cross-case comparisons, but also the interview data was compared to secondary data found in organisational documents, policy reports and industry statistics. Such triangulation serves to strengthen interpretations.

The research will adhere to the ethical standards of Vilnius University Business School. The study was approved by the institutional review board. Before the interviews, the participants will be asked to sign a declaration of informed consent. Anonymity was preserved by using pseudonyms for participants and removing identifying details. Data were maintained on password-protected devices and was only available to the researcher. Recordings were erased following transcription and no recordings will be kept after 6 months from completion of the work due to data protection policies.

There are a number of challenges to conducting qualitative research in organisational settings. Organisational gatekeepers of diversifying managers can hide the presence of

potential participants (Macdonald, 1993). Trust must be established so that a candid response can be received, especially when dealing with controversial topics such as governance failures or reluctance to change. Translation may be needed due to language variations with the potential of losing some nuances. Limitations The primary limitation is small sample size, and this raises questions about the generalizing of finding (Boddy, 2016). But, the purpose is informed analytical generalization, in which an understanding adds to theory and practice, rather than estimates of population parameters (Ercikan & Roth, 2009). Study Limitations There are some limitations to the present study, most importantly: self-reported data skewed by recall bias or social desirability bias (Croucher & Cronn-Mills, 2024). These limitations were discussed in the discussion.

### **3 RESEARCH (ANALYTICAL) PART**

This section presented the empirical findings from the qualitative case study and develops an analytic account of how project management enables circular economy initiatives in the manufacturing sector. The analysis is anchored in the study's objective of explaining how project management practices translate circular economy ambition into operational routines in two Lithuanian manufacturing firms.

The focus is on the mechanisms that appear in day-to-day project work: how circular projects are initiated, how scope and investment decisions are made, how teams learn and adjust through dynamic capabilities, how digital tools and data enable measurement and control, and how stakeholder co creation and governance structures sustain progress over time.

#### **3.1 Empirical Setting and Analytic Intent**

This empirical context resonates with the manufacturing literature in general, a setting where firm are subject to policy pressure, market demands and resource-related uncertainty (European Commission, 2020) that lift circularity from a periphery sustainability topic to the level of strategic change agenda. The interview data repeatedly demonstrate that circular projects do not act like regular linear improvement projects. They demand extra reverse flow planning, uncertainty over use and return of the product, new forms of partnership in business, and performance measurements that take circular value into account. The sweep-forward is that circularity cannot remain an environmental ambition alone; it must be applied with project systems which can handle the uncertainty, coordination and capture of long horizon value (Többen & Opdenakker, 2022).

Interview evidence is employed in the thematic analysis to develop explanations about the functioning of project management capabilities with regard to circular economy initiatives. Analysis Based on the tradition of qualitative logic that seeks to identify patterns and structures in case study work (Yin, 2003), we follow an analytical trajectory. The point is not to give interviews as a stand-alone narrative, but to combine it into cross cutting themes and dimensions that brings practically the engagement between project management and CE implementation.

#### **3.2 Cases, Participants and Data Structure**

The empirical bases consist of two manufacturing companies. LT Metal Partners is metal

goods manufacturer with a circular agenda consisting of scrap and chemical recovery and remanufacturing. Ergolain is a furniture manufacturer, which has circularity initiatives focused on design for disassembly, modular product structure and reverse logistics pilots. A total of six semi structured interviews were undertaken over the two cases. The respondents work in the action side of circular economy, and they hold operational, management, purchasing, design, project management and logistics positions making it possible to triangulate perspectives as to how circular projects are created or developed managed and implemented.

**Table 3**

*Interview Participants and Their Circular Project Focus*

<b>Interview ID</b>	<b>Company</b>	<b>Participant Role</b>	<b>Experience (Years)</b>	<b>Primary Expertise / Function</b>	<b>Circular Project Contribution</b>
I1	LT Metal Partners	Warehouse Specialist	3	Operational logistics, materials handling, waste segregation	Led on-site segregation redesign and scrap classification system; implemented new data tracking for material recovery.
I2	Ergolain	Designer	2	Product design, modular systems, sustainability aesthetics	Applied design-for-disassembly (DfD) principles; integrated life cycle assessment tools in the Furniture-as-a-Service model.
I3	LT Metal Partners	Shift Supervisor	4	Production supervision, process control, quality assurance	Oversaw chemical substitution project; introduced safety and performance monitoring protocols using LIMS integration.

I4	Ergolain	Project Manager	4	Strategic project coordination, innovation management	Managed ErgoLoop modular workstation program; utilized hybrid PM frameworks (Agile and Stage-Gate) for design-to-market transition.
I5	Ergolain	Logistics Manager	2	Supply chain coordination, reverse logistics, circular flows	Coordinated take-back pilot; developed phased logistics model minimizing reverse-flow cost and optimizing regional collection.
I6	LT Metal Partners	Purchasing Professional	3	Procurement strategy, supplier relations, cost optimization	Managed venture-style funding allocation; developed dashboards for circularity KPIs (recycled content, CO <sub>2</sub> avoidance).

The interviews were all structured along a typical questionnaire-based format to enable cross case comparison and systematic analysis. Questions covered five conceptual frameworks: the organizational circular economy (CE) knowledge, the project management contributing to launching and orchestrating CE initiatives, the dynamic capabilities in sensing, seizing and reconfiguring routines, digital tools and data for decision-making, as well as governance aspects and stakeholder practices that fostered CE.

Thematic coding was applied in the manner typically associated with reflexive thematic analysis, progressing from familiarization and initial coding to theme development, review and naming as outlined by Braun and Clarke (2006). The most pragmatic measure of sampling adequacy was when those patterns began to reappear from interview to interview, which is a threshold-oriented logic approach in qualitative research Guest et al. (2005).

### 3.3 Overview of Circular Initiatives Identified in the Cases

In both companies, circular actions were presented as initiatives, and not just as a general intention to change operations. This matters analytically because it shows how circularity is made actionable: it becomes knowable through scoping exercises, schedules of action, budgets and budgeting regimes, risk registers, governance meetings and performance dashboards. The following section offers a summary of key ventures, which make up the interview material.

**Table 4**

*Circular Initiatives Across Cases and How Project Management Enabled Execution*

<b>Initiative ID</b>	<b>Company</b>	<b>Circular initiative focus</b>	<b>Main trigger</b>	<b>Digital and data enablers</b>	<b>Headline outcomes reported</b>
CE1	LT Metal Partners	Scrap recovery loop through segregation redesign and recycler alignment	Scrap value loss and landfill reduction target	ERP linked tracking module, scrap type classification records	30% landfill waste reduction; 8% material cost reduction; around 20% better scrap pricing
CE2	LT Metal Partners	Closed loop chemical recovery and substitution using filtration and testing controls	Safety, compliance, and procurement cost pressure	LIMS integrated data logging, risk flags triggered by lab deviations	40% hazardous waste reduction; about €15,000 annual chemical savings
CE3	LT Metal Partners	Remanufacturing and circular	Raw material	Power BI dashboards	Reported improvement

		procurement with staged investment governance	volatility and value retention	integrated with ERP; circular KPI set including MCI and CO <sub>2</sub> avoidance	in circular performance visibility and monthly senior review discipline
CE4	Ergolain	Design for disassembly and Furniture as a Service pathway for modular office systems	Market pulls from circular demanding clients	LCA plugins linked to design tools, carbon impact tracked during material changes	25% CO <sub>2</sub> reduction reported; stronger client interest linked to circular design
CE5	Ergolain	ErgoLoop modular workstation and standard components library	Waste reduction and flexibility in production	BIM and CAD based modular library control, documentation standards	100% design for disassembly compliance for new designs; 15% increase in Scandinavian market interest
CE6	Ergolain	Regional take back pilot and circular logistics taskforce	Need to test reverse flow feasibility	Monthly circularity dashboard for returns, disassembly outcomes, and cost tracking	40 tons diverted from landfill; reverse logistics described as 2 to 3 times more costly than forward flows

Three features stand out from this overview. To begin with, circular projects are multi-dimensional projects of change. Even when the technological element seems thin, like separating scrap or replacing a chemical, it will often involve training new routines, supplier coordination and monitoring equipment. Second, every measure needed a reverse planning or closed loop logic involving dependencies that are also uncommon in linear production projects. Third, participants were clearly connected between circular projects and strategic positioning and long horizon value, indicating that companies regard circularity as being a fundamental transformation path, not merely an exercise in compliance.

### **3.4 Theme 1: How Circular Economy is Understood and How Projects are Initiated**

The first analytic category is meaning and initiation. How the circular economy is framed by participants influences how this makes it into the organizational portfolio, and how the benefits are constructed as well as who becomes enrolled in them. In both scenarios, actors imagined a circular economy in practical language related to material loops, waste prevention and product life extension. This connects with the actual emphasis on closing loops and changing the addiction to virgin materials in production systems (Suárez-Eiroa et al., 2019; Obradović et al., 2024) and with the assertion of circular implementation needing a proactive managerial translation from principles into operational practices (Prieto-Sandoval et al., 2019).

For LT Metall-Partners, circular economy was often categorized as deriving value from metal scrap and minimizing virgin material use. The warehouse expert explained circularity as material control and reclamation which begins internally within the plant. The focus was on process redesign and infrastructure, not marketing. This is in line with the broader claim, that circularity often starts as an operational source of resource efficiency and transforms into a strategic capability when firms understand the longer-term benefit of material flow control (Morsetto, 2020).

At Ergolain, circular economy from product design to service logic It is conceptualized in the framework of CE via eco design and service logic intensively focusing on modularity, take back, and disassembly. The designer directly linked the firm changing to a circular model with strategic repositioning. This transition was best described for a clearly project-framed activity: 'Planning for circularity is more complicated than for linear production. So the scope had to include the Reverse Logistics how we get the furniture back. We have accounted for a higher initial RD cost on modular design in our budget however we would expect to recoup that investment within 10 years due to the recurring revenue stream of Faas Furniture as a service. This quote emphasizes an initiating mechanism: circularity becomes tangible when it

is integrated in the project scope, funding logics and time horizon, rather than as a stand-alone sustainability narrative.

In both cases, project inception was reported as being structured and filtered, not random that may reflect an entrepreneurial response to opportunity. At LT Metal Partners, having a modified stage gate process and a governance board demonstrate that there is an intentional approach to the selection and scale of circular projects. The warehouse specialist said: 'Our approach is like a modified stage gate process. 'The scope of the project for scrap recovery was a bit broader than it would typically be in this situation because part of that was training shop floor staff,' Borts says. Budget was hard; we needed to justify new separation bins and a custom software module for tracking the type of scrap.' Here, initiation is represented as translation: circular value is implemented through tangible investments and processes on the ground.

At Ergolain, induction started with what participants described as a Creativity Lab but its authorization was subject to an evaluative mechanism tied by strategy and finance. 'These usually get their start in our Creative Lab, but for official approval need to make it through our Strategic PM Filter. We apply a Circular Maturity Model to assess new ideas.' The interview also identified the necessity of profitably demonstrating residual value and/or end of life value which highlights the institutional paradox of convincing financial gatekeepers that circularity offers an acceptable business return (Picciotto, 2019; Bal et al., 2023).

This theme also highlights how circular economy projects are influenced by exogenous stakeholder expectations and infrastructure limitations. At Ergolain, said the designer: 'Market-wise we have realized that clients in Scandinavia ask for this, and we have had a 15% growth in interest from those markets.' That market pull turned out to be one of the triggering factors. For LT Metal Partners, the other main external limitation was that there is no available local high tech recycling infrastructure for some alloys. One participant clarified that waste exported sometimes because 'kills the circular logic' as it results in of emissions increase and loss of traceability. This corresponds to macro-level arguments that success with circularity relied on enabling systems and inter-organisational supply chain efforts, rather than firm-specific actions in isolation (Lacovidou et al., 2020; Obradović et al., 2024).

The initiation theme illustrates that project management adds value by converting circular ambition into explicit project proposals, with a clear scope, investment and benefits narrative. It is also possible to see that initiation is not entirely self-contained. It is also dependent on outside infrastructure, client needs and supplier competences which require project manager to be entrepreneur in the initial circular innovation (Chirumalla et al., 2024).

**Table 5***Theme 1: How Circular Economy is Understood and How Projects are Initiated*

<b>Manual code (sub-theme)</b>	<b>What the code captures (meaning)</b>	<b>Evidence: LT Metal Partners</b>	<b>Evidence: Ergolain</b>	<b>Analytic interpretation (what it shows)</b>
T1-C1: Circular economy defined in practical operational terms	CE is understood as material loops, waste avoidance, recovery, not abstract sustainability talk	'Circularity as material control and recovery that starts inside the plant.'	'Modularity, take back, and design for disassembly.'	Definitions shape what counts as a project: LT frames CE as process/infrastructure ; Ergolain frames CE as design and service logic (Prieto-Sandoval et al., 2019; Suárez-Eiroa et al., 2019).
T1-C2: CE becomes 'real' when embedded in scope and budget and time horizon	Initiation depends on CE being translated into project scope, funding logic, payback horizon	'Scope was wider than usual because it included training... justify new separation bins and a custom software module to track scrap types.'	'Scope had to include the Reverse Logistics... higher upfront RandD... projected cost recovery within 10 years... recurring revenue stream from Furniture as a Service.'	CE initiation is a translation mechanism: turning principle into deliverables and investment justification, not a separate narrative (Picciotto, 2019; Bal et al., 2023).
T1-C3: Structured	Projects enter portfolio	'We use a modified stage	'Start in our Creative	Initiation is selective and disciplined;

initiation through governance filters	through stage gates / boards / strategic filters rather than opportunism	gate process... plus governance board presence	Lab... must pass through our Strategic PM Filter... Circular Maturity Model to score new ideas.'	project management acts as a portfolio gatekeeper for circular ideas (Tereso et al., 2018).
T1-C4: External drivers and constraints shape initiation	Initiation is shaped by market pull and infrastructure limits	Exporting waste 'kills the circular logic' due to emissions and traceability; lack of local high-tech recycling	'Scandinavian clients demand this... 15% increase in interest from those markets.'	CE projects are not purely internal early phases require boundary spanning with infrastructure and client expectations (Lacovidou et al., 2020; Obradović et al., 2024; Chirumalla et al., 2024).

### 3.5 Theme 2: Project Management Practices that make Circular Projects Executable

The second light even, regards the centrality of project management activities in conversion of circular concepts into implementable work programs. Throughout interviews, respondents reported that scope, schedule and budget decisions had to be reframed for circularity. This result seems to echo the common understanding of circular initiatives not merely focusing on the improvement of production, instead demanding that new flows, partners or measurement routines be brought into line by the organisation (Tereso et al., 2018) and a higher degree of integration between technical, operational and market logic (Kumar et al., 2021; p. 85-88).

#### 3.5.1 Scope definition and boundary setting

Scope definition of circular projects needs to consider life activities beyond the traditional factory boundary. It is most explicit in the furniture take back pilot at our testing store. The hardest part to scope was the extent of it,' says the logistics manager. Do we pick up any

furniture or only ours? For the pilot we chose to restrict offering to Ergolain branded products.’ The quote exemplifies a core project management tool: the use of boundaries for risk-based control. To narrow this uncertainty about what kind of materials people will put forward for recycling, how long it will take to dismantle and the expectations of car owners, the project team restricted the pilot to its own brands.

**Reverse logistics** It was pointed out by the Participant that Reverse Logistics is a key cost driver: The approach was implemented in stages, starting with local clients in Vilnius. The budget had to allow for Reverse Logistics costs, which can be 2/3 times more expensive than forward logistics as nothing is standardized with regards packing products for return.’ This means from the analytic point of view that circle feasibility is a matter of if project management also covers reverse scope and budgeting while assuming non-linear cost structures.

In terms of project scope expansion, even the projects that seemed to be internal ones were given this treatment. The Scrap recovery project included staff training and new shop floor routines. The chemical substitution project included data logging, quality monitoring, and a pause mechanism during scaling. It is therefore a matter of course that circular economy in manufacturing will often lead to not just new energy-efficient hardware, but also social and organisational change such as change in the exact routines or skills needed (UI-Durar et al., 2023).

### **3.5.2 Scheduling and iterative work design**

The interviews indicate that it frequently involves a learning process, rather than direct execution to plan circular projects. At LT Metal Partners, the warehouse specialist discussed that reconfiguring the physical orientation of a metal shop was much easier than balancing production with needing to retool an entire building. At that same company the floor supervisor also spoke of ‘Mini Projects (Sprints)’ being used to close leaks identified using the audit routines. This suggests a sequencer-type, agile logic for sequencing projects with decision cycles of diagnosis, trial and adjustment that facilitate learning under conditions of uncertainty.

At Ergolain, the project manager depicted a balanced approach that combined Phase Gate discipline to move quickly from sketch to prototype with design sprints and a standard components library as a project. This is an interesting finding, because this means the project management approach allows traditional control structures to be mixed with back-consultation of work that relies on the iteration nature of design work, this in line with how innovation under uncertainty can be managed in circular product redesign (De Angelis, 2022; Alcalde-Calonge et al., 2024).

### **3.5.3 Budgeting, investment logic, and benefit definition**

Key Instrumental in aligning circular projects with the decision logics of an organization were budgeting and benefit definition. In both sectors, the informants also explained that circular projects implied higher initial costs but they also described disciplined approaches to justify them. The Ergolain designer focused on a 10-year timeframe and revenue for a material volume. The warehouse specialist from LT Metal Partners discussed investment in separation bins and custom software module. The shift manager referred to chemical recycling as both a safety and regulatory issue that needs to be supported even though the payback isn't immediate.

One anecdote in particular is illustrative, from LT Metal Partners where the salesperson noted how the buyer used a venture capital-style budgeting logic: 'The budget was set as if it were VC (Venture Capital) investment – we released funds only after specific Value Milestones.' This suggests that project management can bring in adaptive investment governance, which buffers the firm from risk yet encourages experimentation. It is also in line with the notion that circular transitions are calling for more structured experimentation instead of one-off big bets, notably if technical performance and market acceptance are still uncertain (Kwarteng et al., 2021; Sehnem et al., 2021).

In this way, the budgeting theme thus helps make the case that PM is not just bean counting. It offers an idiom and framework to have conversations about making investments, for legitimating long horizon returns, and managing uncertainty as circular initiatives scale (Tereso et al., 2018; Kumar et al., 2021; Obradović et al., 2024).

**Table 6**

*Theme 2: Project Management Practices that Make Circular Projects Executable*

<b>Manual code (sub-theme)</b>	<b>What the code captures (PM practice)</b>	<b>Evidence: LT Metal Partners</b>	<b>Evidence: Ergolain</b>	<b>Analytic interpretation (what it shows)</b>
T2-C1: Scope expansion beyond factory boundary	Circular scope includes reverse flows, training,	Scrap recovery included 'training the shop floor staff;' chemical substitution included 'data logging, quality	'Scope was the hardest... limit the scope to Ergolain branded products for the pilot.'	Circular work needs boundary setting (risk control) and socio-technical change, not just

	monitoring, new routines	monitoring, and a pause mechanism during scaling.'		technical fixes (UI-Durar et al., 2023).
T2-C2: Scheduling needs iterative learning (not linear)	Plans include phasing, sprints, hybrid stage-gate and iteration	'Mini Projects (Sprints)' to fix leaks from audit routines; layout change while maintaining production requires flexibility	'Phased Approach... local clients in Vilnius before expanding'; 'hybrid approach... Phase Gate... design sprints... components library as a project.'	Circular execution depends on learning-by-doing and hybrid PM approaches suitable for uncertainty (De Angelis, 2022; Alcalde-Calonge et al., 2024).
T2-C3: Budgeting logic reframed for long-horizon and uncertainty	Higher upfront costs justified via long time horizon, milestone funding, value logic	'Venture Capital style allocation... released funds in small chunks only after specific Value Milestones were met.'	'Higher upfront RandD... projected cost recovery within 10 years... recurring revenue stream...'; reverse logistics costs '2–3 times more expensive than forward logistics'	PM becomes a negotiation structure for investment, uncertainty, and long-term value (Kwarteng et al., 2021; Sehnem et al., 2021; Kumar et al., 2021).

### 3.6 Theme 3: Dynamic Capabilities through Project Routines of Sensing, Seizing and Reconfiguring

The third theme explores how dynamic capabilities manifest in project routines and also, how such routines steer circular advancement. Respondents used the language of sensing, seizing, and reconfiguring many times overtly (instances such as these suggest that our

framing employing dynamic capabilities is useful in making sense of the data shell receive more citations) shell Participants frequently articulated using this language (Bjørnbet et al., 2021).

### **3.6.1 Sensing: diagnosing waste and recognizing circular opportunities**

Sensing was frequently called structured observation with audit routines, performance data and trend scanning (which includes external elements). Here at LT Metal Partners, the shift supervisor explained: 'Our Audit and Feedback PM routine is our key sensing tool. It helps us identify where the waste is going.' This suggests that sensing is not passive observation, but a project management process built into the management system. It is also an indicator that PMO methods put in place feedback loops that show based on circles of causality.

At Ergolain, feeling was external orientation via social networks and fairs. We are feeling trends through our international design fairs and EU research clusters,' it suggests that sensing can be externally oriented with respect to innovation networks and internal projects' agendas. This external sensing is also in line the idea that circular innovation is knowledge-based and frequently relies on access to interorganizational learning (Chirumalla et al., 2024).

### **3.6.2 Seizing: mobilizing resources and converting opportunities into projects**

Seizing is the act of converting identified opportunities into projects with resources and cross functional coordination. In the interviews, capture was observed in the form of stage gates, strategic filters and sprint based mini projects. At LT Metal Partners, capture involved instituting mini-projects once automated audit routines identified leaks. At Ergolain, capture was explained as phase gate progression from sketch to prototype and the application of a round maturity model to rank ideas for funding approval.

This is consistent with the contention that project management constitutes 'the grasping hand' in terms of mobilizing variables and establishing governance, as well as discipline to experiment and scale (Kwarteng et al., 2021; Sehnem et al., 2021). [T]he interviews indicate that, when grasping is strong, circular action expands from a collection of 'isolated pilots' to institutional commitment. In cases where seizing is weaker, the projects may be stuck at the level of innovation lab ideas that have not been embedded in the operation.

### **3.6.3 Reconfiguring: embedding circular routines and changing organizational DNA**

Re-design was discussed again and again in terms of the codification of successful project work into routine processes, protocols and system design. Explicit in the account of the shift supervisor: 'We reconfigure by updating our ISO manuals. After a project takes off, so too does it become a permanent part of our quality standard; that's how we rewrite the company DNA.' This example shows how project outcomes are transformed into operating procedures.

It also suggests that quality systems can serve as a lever to integrate circular practices, promoting their durability

At Ergolain, reconfiguration was envisaged as the establishment of a Standard Components Library and its management through projects. 'We reconfigure by developing a set of standard components. By treating this library as a project, we have been able to reconfigure our entire production line to be more flexible and less wasteful.' This indicates that reconfiguration via the production and supply chain offers can take place through modular design infrastructure.

Accordingly, the dynamic capability's theme unveils a key analytical insight: while project management is connected to doing, it also shapes learning loops that detect inefficiency, grab opportunities through formalize project commitment and rearrange organizational systems for circularity to be sustainable (Prieto-Sandoval et al., 2019; Lacovidou et al., 2020; Kwarteng et al., 2021; Sehnem et al., 2021). As Prieto-Sandoval et al. (2019, p. 276). Circularity becomes enacted when organizations transform intents into routines that are controlled, monitored and gradually improved.

**Table 7**

*Theme 3: Dynamic Capabilities Through Project Routines of Sensing, Seizing, Reconfiguring*

<b>Manual code (sub-theme)</b>	<b>What the code captures (capability routine)</b>	<b>Evidence: LT Metal Partners</b>	<b>Evidence: Ergolain</b>	<b>Analytic interpretation (what it shows)</b>
T3-C1: Sensing via structured feedback loops	Waste/opportunity detection through audit routines and data and scanning	'Our Audit and Feedback PM routine is our primary sensing tool. It helps us detect where material is being wasted.'	'We sense trends through... international design fairs and EU research clusters.'	Sensing is a designed PM routine, both internal (audits) and external (networks) (Chirumalla et al., 2024).
T3-C2: Seizing through	Turning ideas into projects via stage	Launching 'mini projects once audit	'Strategic PM Filter... Circular Maturity Model	PM provides the mobilizing mechanism

governance and disciplined mobilization	gates, filters, mini-projects	routines detected leaks.'	to score new ideas... phase gate movement from sketch to prototype.'	resources and governance and discipline for experimentation and scaling (Kwarteng et al., 2021; Sehnem et al., 2021).
T3-C3: Reconfiguring by institutionalizing outputs into standards	Making circularity durable through manuals, libraries, system architecture	'We reconfigure by updating our ISO manuals... becomes a permanent part of our quality standard.'	'We reconfigure by creating a Standard Components Library... reconfigured our whole production line...'	Reconfiguring happens when project outputs become embedded routines, not isolated pilots (Prieto-Sandoval et al., 2019).

### 3.7 Theme 4: Digital Enablers, Data Governance and Real Time Decision Making

The fourth theme relates to digitalization as an enabler for project circular control and learning. These participants did not see digital tools as a supplementary reporting method but rather 'critical enablers of project decisions'. This supports assertions that digital enablers facilitate the conversion of circular intent into measurable routines and manageability (Shaukat et al., 2021, p. 59) and that measurement design impacts on decision quality and implementation discipline (Shaukat et al., 2021, p. 66).

#### 3.7.1 Data as a gatekeeping mechanism for scaling decisions

For the chemicals recovery and substitution project at LT Metal Partners, a Laboratory Information Management System was connected to project management software. The shift supervisor said: 'We had a LIMS (Laboratory Information Management System) we'd built in with the project management software. Each test result of the recycled fluids was recorded. This information impacted the schedule of the project if we see a deviation in the LIMS is that automatically flagged a risk in PM software and we would stop the phase 4 scaling until we addressed it.' The quote highlights a digital operated control encounter: data becomes a

trigger for schedule and risk responses, to ensure that circular scaling is not based on optimism but verified quality and safety performance.

In Ergolain, the digital tools supported visualization of sustainability during the design decisions. The project manager said: 'We work with BIM (Building Information Modeling), SolidWorks. For the round projects we partially begin to work with LCA( Life Cycle Assessment) software plugins. So the Project Manager can watch the carbon footprint change as the designer switches one material for another. It takes Sustainability from a nebulous aspiration and makes it a hard decision point that affects every aspect of your project.

This statement is analytically significant since it evidences how digital tools transform circularity as narrative into engineering constraint. It is in line with its assumptions that digitalization could involve circular decision-making, integrated into daily routine workflows, rather than being confined to distinct reporting cycles (Errida & Lotfi, 2021).

### **3.7.2 Dashboards, circularity indicators, and benefit realization routines**

At LT Metal Partners, the sourcing professional outlined dashboards that link ERP data with circularity indicators and governance meetings. We leveraged power BI dashboards linked to out ERP,' said the participant. We designed a KPI set for circularity: Material Circularity Indicator, percentage of post-consumer recycled content, monies saved per project and CO2 saved. This dashboard is shared with the senior management time on a monthly basis. Monthly dashboards exist so that circular metrics are not only captured but also institutionally reckoned with, making circular value governable in the same way financial value is governed.

The participant also reported a change in culture from governing meetings: 'A year ago, our meetings were about being over budget. Now the first question is: How much circular value did we create in this quarter? And how can we grow it next quarter.' This shows how digital reporting tools can help to stimulate strategic reframing and ongoing focus on circular value. And it resonates with the assertion that measurement and governance practices are indispensable to sustain circular transitions over time (Picciotto, 2019; Bal et al., 2023).

At Ergolain, dashboards were also applied especially for the take back pilot. The monitoring was done via what the logistics manager called 'a monthly circularity dashboard.' That is, reverse logistics pilots need continual measurement as return and disassembly outcomes are unknown and uneven. The adoption of dashboards thus promotes both operational control and learning, corroborating that digitalization is considered a fundamental enabler for circular economy management in manufacturing (Chirumalla et al., 2024).

**Table 8***Theme 4: Digital Enablers, Data Governance and Real-Time Decision Making*

<b>Manual code (sub-theme)</b>	<b>What the code captures (digital mechanism)</b>	<b>Evidence: LT Metal Partners</b>	<b>Evidence: Ergolain</b>	<b>Analytic interpretation (what it shows)</b>
T4-C1: Data as gatekeeping for scaling	Digital systems trigger risk flags, pauses, and schedule changes	'LIMS... integrated... Every test result... logged... automatically flagged a risk... pause the Scaling phase...'	Real-time decision support via design tools (below)	Digitalisation becomes control infrastructure, preventing 'optimistic scaling' and linking quality/safety to PM governance (Shaukat et al., 2021).
T4-C2: Digital tools embed circularity into design decisions	Circular impact becomes an engineering constraint (not just reporting)	ERP and dashboards and KPIs	'BIM... SolidWorks... LCA plugins... see carbon footprint change in real time... influences every project decision.'	Digital tools shift circularity from narrative to hard decision variables (Errida & Lotfi, 2021).
T4-C3: Dashboards institutionalize benefit-	KPIs reviewed in monthly governance rhythm	'Power BI dashboards... circularity KPI set: Material Circularity	'Monthly circularity dashboard' for take-back	Dashboards make circular value governable,

realization routines		Indicator, % recycled content, cost savings, CO2 avoided... presented every month...;’ ‘first question is: how much circular value did we create...’	pilot monitoring	sustaining attention and learning (Picciotto, 2019; Bal et al., 2023).
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### 3.8 Theme 5: Stakeholder Co-Creation and Governance Structures that Sustain Circularity

The fifth theme relates to stakeholders’ relations and governance. Circular efforts need to be coordinated across organisational borders. The interviews reveal that project management offers means of organising this coordination, such as co-design sessions, supplier involvement, governance boards and common performance standards. This corresponds to the theory that circular value is created by means of networked collaboration rather than firm-specific action (Fobbe & Hilletofth, 2022).

#### 3.8.1 Co-creation as technical collaboration that changes project scope

Co creation with scrap recyclers at LT Metal Partners was referred to as a technical negotiation that immediately reconfigured internal practices. It really was co creation with our scrap recyclers,’ the warehouse specialist added. We didn’t just tell them what we were doing, but asked them, what purity of aluminum do you need to give us a 20 per cent better price. We redesigned our in-house collection project according to their technical needs. That is co creation their input shifted our internal project scope.’ The quote depicts co creation as active project methodology: stakeholder demands are transformed into internal project bounds, re shaping workflows and training.

At Ergolain, co-creation was presented to suppliers in a likewise technology-driven way. It was a co-creation for sure with our local wood and metal makers typical day. To do that with a (modular) workstation we sat down with the manufacturing team and the suppliers to standardize sizes of screws and connection points across our entire catalog’s offering.’ Here co creation isn’t marketing speak for consulting, it is design for disassembly, repair and modular replacement.

There effects on social stakeholders are also reported. In the take back pilot, Ergolain worked

with a local social enterprise for disassembly in the process of creating explicit jobs for people with disabilities. This also shows that circular projects can create social value in addition to the environmental and economic benefits, and project management can align these multiple value dimensions in practice (Osei-Tutu et al., 2024).

### 3.8.2 Governance boards, standards, and compliance as sustaining structures

LT Metal Partners has a board that convenes monthly, formalizing the governance. One member said: 'We have a governance board; it meets monthly to make sure that we're still within national environmental standards and goes as far as ISO 14001.' The importance of this insight in analytic terms is that governance achieves stability and coherence. It implies as well, that circular initiatives are seen as a portfolio to manage ensuring continuous governance, instead of one-off experiments.

Governance at Ergolain would be design governance and governance by way of strategy and maturity scoring and filters. This suggests that governance can be embedded to product development routines and not only in the board of directors. Taken as a whole, these governance structures demonstrate that project management has a coordinating function, embedding operational level decisions within the parameters of standards, market demands and strategic imperatives—echoing discussions of governance in circular supply networks (Lacovidou et al., 2020; Obradović et al., 2024) and stakeholder co creation (Santos & Fernandes, 2024).

**Table 9**

*Theme 5: Stakeholder Co-Creation and Governance Structures that Sustain Circularity*

<b>Manual code (sub-theme)</b>	<b>What the code captures (stakeholder or governance practice)</b>	<b>Evidence: LT Metal Partners</b>	<b>Evidence: Ergolain</b>	<b>Analytic interpretation (what it shows)</b>
T5-C1: Co-creation changes internal scope (technical negotiation)	External partners' requirements become internal design/process constraints	'Asked them... what purity of aluminum... redesigned our internal collection project... their	'Sat down... to standardize the screw sizes and connection points across our entire catalog.'	Co-creation is not 'consultation' it is scope-shaping technical collaboration enabling disassembly/qualit

		input changed our internal project scope.’		y/price (Fobbe & Hilletoft, 2022).
T5-C2: Circular projects can generate social value via partner models	Circular pilots structured to include social outcomes	(Not explicitly evidenced in provided LT quotes)	Partnered with a social enterprise for disassembly, ‘explicitly creating jobs for people with disabilities.’	Shows multi-value outcomes (social and environmental and economic) coordinated through project structures (Osei-Tutu et al., 2024).
T5-C3: Governance boards/standards sustain alignment over time	Circular projects treated as portfolio with oversight, linked to standards	‘Governance board... meets monthly... aligned with national environmental standards and ISO 14001.’	Governance through ‘maturity scoring and filters’ embedded in product development	Sustaining circularity requires institutional governance, not one-off pilots (Lacovidou et al., 2020; Obradović et al., 2024; Santos & Fernandes, 2024).

### 3.9 Outcomes, Evidence of Value and Credibility

One of the main objectives of this study is to scrutinize not so much what firms say they do, but what outcomes and value signals they articulate and how these are rendered plausible within the organisation. The participants offered specifics, examples of management practices and some qualitative reporting. The results are presented in Table 10.

**Table 10**

*Reported Outcomes from Circular Projects and How They Were Made Credible*

<b>Company</b>	<b>Initiative and project scope</b>	<b>Evidence and figures from interviews</b>	<b>Project management mechanism</b>	<b>KPI or credibility check used</b>
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			<b>enabling outcome</b>	
LT Metal Partners	Scrap recovery loop, segregation redesign, recycler specification alignment	Landfill waste reduced 30%; material cost per unit reduced 8%; recycler pricing improved around 20%	Scope expansion to include training, standard work procedures, and redesigned collection points; staged execution with operational ownership	Scrap purity classification records; monthly dashboard review; governance sign off
LT Metal Partners	Closed loop chemical substitution with filtration and test gating	Hazardous waste reduced 40%; saved about €15,000 annually on chemical procurement; improved shop floor safety	Requirement traceability; scaling gates with pause rule when quality deviates; audit feedback cycles; ISO procedure updates	LIMS test logs; deviation-based risk flags; IMS performance review cadence
LT Metal Partners	Remanufacturing and circular procurement program under PMO oversight	Circular performance visibility increased; investment released only after value milestones met; monthly senior review of circular KPIs	Venture style staged funding; benefit realization meetings; portfolio oversight through PMO	Power BI and ERP linked circular KPI pack; milestone tracking and approval records

Ergolain	Design for disassembly program plus Furniture as a Service development	CO <sub>2</sub> footprint reduced 25% compared to previous design; stronger client pulls for modular circular options	Strategic PM filter to secure approval; hybrid agile design sprints plus phase gate controls; long horizon payback framing	Design governance checks; LCA plugin outputs during design choices; annual nonfinancial reporting
Ergolain	Standard components library and modular workstation platform	100% design for disassembly compliance for new designs; Scandinavian market interest increased 15%	Standardization project managed as a transformation program; design rules embedded into development stages	DfD compliance checklist; catalog level documentation; market feedback tracking
Ergolain	Take back and reverse logistics pilot with third party logistics coordination	40 tons of furniture diverted from landfill; reverse logistics cost estimated 2–3 times forward flows; inclusion outcomes through disassembly partnership	Phased pilot; scope limitation to own brand; SOP creation with 3PL; recurring dashboard reviews for learning	Monthly circularity dashboard; return rate and disassembly outcome logs; cost tracking by route

The results-based evidence of LT Metal Partners comes in terms of cost savings and environmental benefits. 'Environmentally, we have decreased landfill by 30%. Economically, with better scrap segregation we have achieved 8% lower material costs per unit. And

socially, employee morale is better, and younger engineers want to work on green projects.’ The buying expert also listed further impacts, such as ‘50% lowered carbon footprint of our aluminum product line’, and spoke in the context of decision routines that support sustaining circular outcomes over time.

At Ergolain, the evidence of the outcome is strongly connected to project design and operational execution. The designer said that CO<sub>2</sub> footprint is down 25% compared to our old design’ and also about cultural results: ‘People are so proud of the new building because they feel they were part of a future proof company. The project manager stressed the importance of design compliance: ‘All new designs are now 100% DfD compliant.’ The take back pilot produced tangible diversion and substitution ‘We diverted 40 tons of furniture from landfills in our take back pilot, and we decreased demand for virgin aluminum by 12 percent through returning metal components to use.’ These reported results illustrate that circular projects are generating related KPIs for managers and stakeholders.

Two credibility channels can be identified analytically in the data. For one, measurements are anchored to governance calendars. LT Metal Partners have dashboards on a monthly basis and balanced scorecards are quarterly. At Ergolain the take back pilot is supported by a monthly circularity dashboard for one and on under which iterative improvements are delivered. Second, to define success the interviewees articulated along several dimensions of value: environmental impact, economic performance and social results. This is in line with general arguments that circular activities need multi-level performance framing to achieve legitimacy within organisations and markets (Picciotto, 2019; Bal et al., 2023).

### **3.10 Cross Case Synthesis: Role of Project Management as a Circular Economy Enabling Capability**

The cross-case analysis results in the following three propositions that are embedded in the interview data. These hypotheses articulate the role project management seems to be playing as an enabling capability for CE initiatives in manufacturing.

The first is that project management supports circular economy by broadening and sharpening the boundary of the project through integrating, particularly inverse logistics, quality data and stakeholder co-ordination in their scope definition. Support for this comes from the reverse logistics scope decision of Ergolain and LT Metal Partners’ consideration of training and process redesign to the scrap recovery study. This is in line with the notion that circularity is not enacted informally through intent but rather through conscious project framing and formalized execution (Tereso et al., 2018; Kumar et al., 2021).

Second, project management facilitates circular economy through learning loops and operationalization of dynamic capabilities. Sensing is done via audit and feedback loops, and outside-in trend scanning; seizing through governance filters, stage gates and sprint-based mini projects; reconfiguring through legitimation into ISO manuals and modular design libraries. Such a proposition is consistent with the notion that dynamic capabilities need to be reified in routines which continuously adapt an organization (Bjørnset et al., 2021).

Third, PM makes the circular value available and manageable through digital tools and performance dashboards making circular economy visible and governable. LIMS & LCA tools turn sustainable into decision relevant data, while ERP integrated dashboards and circularity indicators enable continuous governance & value capture. This idea aligns well with findings in the literature that position digitalization as a critical facilitator of circular execution and performance control (Errida & Lotfi, 2021; Chirumalla et al., 2024).

The force of such claims is that they are supported by particular practices and effects described by interviewees, not just abstract contentions. The fact is, round projects do not implement themselves. They rely on the practice of project management to establish scope, order work efforts, mitigate risk, align stakeholders and gauge success. It is crucial as well in environments where circular infrastructure is partial, as observed by the LT Metal Partners with regards to alloy recycling and export restrictions. The results therefore lend support to the argument that success in circular economy needs managerial capability, governance discipline and data driven decision making (Lacovidou et al., 2020; Obradović et al., 2024).

### **3.11 Integration with the Literature**

The results of this chapter support the assertion that circular economy adoption relies on strategic investment in enabling capabilities, notably data governance as well as digital tools and skills development before scaling business models embedded in the circular loops (Kwarteng et al., 2021; Sehnem et al., 2021). They further provide evidence in support of co creation and governance relationships as antecedents to the viability and persistence of circular initiatives (Fobbe & Hilletoft, 2022; Santos & Fernandes, 2024). The empirical evidence also indicates that the enabling capabilities are structured, funded, monitored and institutionalized through project management.

What is important to note in the interviews is that circular projects deliver tangible results and are more and more monitored as a source of value. The shift from 'budget variance discussion' to 'circular value creation' illustrates a more fundamental realignment not only of management focus but also of organizational purpose. This is consistent with the notion in the literature that performance measurement and evaluation practices can be leveraged as

strategic tools within transformation programs (Picciotto, 2019) and that sustainability metrics are more influential when they are embedded into governance routines (Shaukat et al., 2021, p. 59).

Analytically, the chapter adds value by offering a cross-case insight of how project management works as a bridging mechanism between circular economy strategy and operational practices. It highlights certain project management practices that seem critical for circular success: boundary separation for reverse logistics, milestone-based funding, data-informed scaling gates, supplier co engineering sessions and monthly dashboard stewardship.

The empirical findings discussed above also support the thesis's theoretical anchoring in circular execution, digital empowerment, and capability development. Within the literature circular economy is presented as a process of transition which involves operationalizing intentions for resource efficiency in the form of systematic, repeatable loops (Morseletto, 2020; Hapuwatte & Jawahir, 2021). The interview results relating to early investment in data logging, staff training and decision rules are also consistent with the idea that enabling factors or digital infrastructures are necessary conditions for scaling circular loops (Hapuwatte & Jawahir, 2021; Kumar et al., 2021). Hapuwatte and Jawahir (2021) highlight the same logic of sequencing, in-which operational readiness decides whether circular intention emerges as operational reality.

The findings also contribute to the managerial practice of project management, herein as the circular complexity management, especially when it comes to crossing circularity flows, long horizon paybacks or multiple stakeholders within one and same project logic (Tereso et al., 2018; Kumar et al., 2021, p. 85-88). The interviews reveal that this is counteracted through hybrid governance, milestone funding and explicit boundary setting, which goes along with the suggestions in literature that circular projects need stronger control and coordination routines than traditional ones (Kumar et al., 2021; Obradović et al., 2024).

Also, the perspectives of success, credibility and learning from the participants resonated with a thesis that framed evaluation, benefits & stakeholder alignment as central characteristics to projects-based transformation (Picciotto, 2019; Bal et al., 2023). The co creation narratives of both companies also resonate with a view of circular value, shaped by coordinated network governance, rather than individual firm action (Fobbe & Hilletoft, 2022; Santos & Fernandes, 2024). In terms of practice the recycler purity demands and the supplier standardization sessions are examples illustrating how stakeholder input can directly influence technical solutions and internal procedures, closed to one Stakeholder co creation means that an organization work with external actors in order to develop new products or services (Fobbe & Hilletoft, 2022).

Finally, the interview material supports the claim of an improvement in terms of circular decision making when measuring frameworks are integrated as part of (circular) data governance and project governance, rather than considered to be separate reporting exercises (Lacovidou et al., 2020; Errida & Lotfi, 2021). The use of dashboards and another scoring gate practise also corroborates the notion that digital tools are capable of making downcycling performance quantifiable and comparable between projects as well (Shaukat et al., 2021, p. 62-65; Tapaninaho & Heikkinen, 2022). Lacovidou et al. (2020) also underscore the relevance of system level measurement and data discipline for circular transitions.

In order to maintain interpretative consistency with respect to the extensive reference base developed in the master thesis, it is also possible to read the analysis through further theoretical lenses accentuating capability development, coordination and implementation conditions. Indeed, the materialization of circularity in routines and capabilities investment is highlighted in the focus of Prieto-Sandoval et al. (2019) and also in the typographic forms applied elsewhere in the thesis.

Similar arguments on digital enablement and capability development ordering are presented in Kwarteng et al. (2021) and Sehnem et al. (2021) as well as in the alternate typography of this thesis. More general definitional and systems approaches are represented by the work of Suárez-Eiroa et al. (2019), and its version with line break by Eiroa et al. (2019), whereas the notions of governance and collaboration are substantiated by Fobbe and Hilletoft (2022) and Santos & Fernandes (2024).

The thesis further positions circular implementation challenges and solutions on the single source application as also introduced by Tereso et al. (2018) and its LB version Obradović et al. (2024). Design and innovation connections are supported by De Angelis (2022) and the combined framing of De Angelis (2022) and Alcalde-Calonge et al. (2024). Implementation and performance conversation are also in line with Shaukat et al. (2021, 62–65) and Tapaninaho & Heikkinen (2022). Wider stakeholders and governance issues link to, and are complemented by efforts in the circular value and project success domain (Picciotto 2019; Bal et al., 2023). Support for theories on systems level change and organizational routines is also evident in Abubakr et al. (2020) and Chaudhuri et al. (2021).

Lastly, contextual reflections about circularity pressures and performance baselines are reflected in the thesis through (European Environment Agency, 2024), while national framing-level or country-based monitoring of circular economy progress indicators and maturity perspectives is also discussed through (Ahmed et al., 2023; UI-Durarna et al., 2023), while accommodating for related empirical discussions.

## 4 CONCLUSIONS AND RECOMMENDATIONS

This section provides the main conclusions and recommendations. The conclusions must be in line with the objectives set out in the introduction. The number of conclusions must be no less than the number of objectives. The conclusions shall be numbered. Conclusions should not contain visual information. The conclusions shall be followed by recommendations on how to address the problem under analysis.

Recommendations must be research-based, specific and implementable. Theoretical recommendations should indicate how and in what direction the research could be developed in the future. This would help researchers who continue their research on this topic in the future to avoid mistakes. Practical recommendations emphasize the peculiarities of practical application of solutions in organisations, the relevant business sector or specific individuals (managers, consumers, customers). Recommendations shall be formulated in a discrete manner, categorical statements avoided.

The objective of this thesis was to understand how project management can enforce circular economy initiatives in manufacturing and how, challenged initiatives could be made credible, measurable and scalable in practice. The empirical evidence within the two Lithuanian manufacturing cases -LT Metal Partners and Ergolain–indicates that circular transition is not a mere technical change from linear to circular production, but as a managed organisational change (Tereso et al., 2018; Morseletto, 2020; Obradović et al., 2024) which relies on routines, governance, stakeholder coordination and data discipline. The necessity of this transition is evident even on the national level; for instance, Circular Material Use Rate in Lithuania has raised only from 3.1 to 4.1% during the period of 2010-2021 and still lags far behind EU average (11.5%) (European Environment Agency, 2024).

### 4.1 Conclusions

The first conclusion is that applying the circular economy to manufacturing evidently calls for a project-based translation of the high-level principles of the circular economy into operable work that is scoped, staged, resourced and governed. Even though circular economy is often stylized as the anti-thesis of waste and new business models (Morseletto, 2020), this is not how it manifests in these cases: Rather, progress is seen only to be made when chains own activities are considered a portfolio of deliverable projects with clear decision gates, ownership and learning cycles. This is consistent with the premise that project management is required for circular agendas yet illustrates why ‘necessary’ simply will not do when it’s not coupled to

enabling mechanisms capable of managing uncertainty, interdependencies and multi-stakeholder constraints (Tereso et al., 2018; Lacovidou et al., 2020; Obradović et al., 2024).

The second take-away is that the meaning of circular economy inside the firms implies a practical and work-related construction, those meaning making prioritizing what initiatives are engaged by whom, and how (il)legitimacy is built. In the two examples analyzed, circularity was approached from the perspective of material recovery, longevity of the product and waste avoidance as focused in manufacture-oriented definitions such as closing loops and independence from virgin materials (Prieto-Sandoval et al., 2019; Suárez-Eiroa et al., 2019). Nevertheless, the analysis suggests that the transition to a circular early phase is often more of a 'translation problem' than a technology question: corporate managers need to translate circular intent into projects others can comprehend, adhere and perform on, if not circularity will just be slogan and lack depth of embedding (De Angelis, 2022; Obradović et al., 2024).

The third is that project management enables the action of circular initiatives, because it broadens scope beyond factory gates, applies iterative scheduling logic and reframes budgeting in terms of long-horizon value acquisition and staged risk control. Empirical evidence illustrates that circular projects needed time and again from training, monitoring routines, reverse-flow coordination and 'pause rules' during scaling which are usually not integrated into linear efficiency projects. They explained that training the shop floor staff and data logging, quality monitoring and a pause mechanism during scaling were part of their process and they highlighted the fact that it is difficult to set the scope in pilot activities (Ul-Durar et al., 2023).

The fourth result is that hybrid project approaches that intermingle stage gates and agile experimentation are most useful for circular product redesign and process reconfiguration. Ergolain integrated phase gate discipline with design sprints and managed a standard components library as if it were a project, revealing that circular innovation requires control just as much as iteration (De Angelis, 2022; Alcalde-Calonge et al., 2024). Crucially, 'budgeting' was not merely an accounting exercise: it transformed into a governance technology that made experimentation possible while constraining downside risk, including 'venture capital style' phased financing linked to value milestones (Kwarteng et al., 2021; Sehnem et al., 2021).

The fifth conclusion is that dynamic capabilities (that is, sensing, seizing and reconfiguring) were not abstract notions in these cases; they emerged as project-specific routines to facilitate circular progress. Sensing was framed through audit and feedback loops, and external scanning through networks and fairs, in which auditors were portrayed as the key 'sensing tools.' Seizing was enacted through stage gates, strategic filters and mini-projects designed

to convert identified waste leaks or design opportunities into funded initiatives. Reconfiguration took place by institutionalizing successful outputs into ISO manuals, standard operating procedures and modular design infrastructure, showing how project outputs become durable routines (Prieto-Sandoval et al., 2019; Bjørnbet et al., 2021; Kwarteng et al., 2021; Sehnem et al., 2021).

Sixth, stakeholder co-creation and governance are critical to circular feasibility as circular value requires interacting networks rather than actions by individual firms. The cases demonstrate that through extended stakeholder engagement not just consultation but actual technical working relationships were developed such as standardizing product connection points to enable dissolvability and recycler purity match. Governance mechanisms, such as monthly boards and work aligned to standards like ISO 14001, acted as stabilizing structures that kept the values in place over time and legitimized trade-offs between economic, environmental and social effects (Lacovidou et al., 2020; Fobbe & Hilletoft, 2022; Obradović et al., 2024; Santos & Fernandes, 2024).

The seventh inference is that the circular economy advances when project management incorporates processes of measurement, digital traceability and verification into delivery, rather than reify sustainability as a brief, transactable reporting exercise. The most powerful evidence is the reported outcomes and their credibility checks. LT Metal Partners achieved a 30% reduction in landfill waste, 8% component material cost saving per unit and approximately 20% enhancement in recycler pricing, along with scrap purity records, dashboard reviews and governance sign-off. This was accompanied by a 40% reduction of hazardous waste and €15,000 in annual savings on purchasing chemicals based on laboratory logs and deviation-derived risk flags. Ergolain delivered a 25% CO<sub>2</sub> footprint enhancement compared to current basic design and 100% design-for-disassembly (DfD) full support for new designs, generating an increase of 15% in the interest from Scandinavian market, reinforced by checks on design governance and lifecycle assessment results. One pilot of take-back options had diverted 40 tonnes of furniture from landfill, and at the same time had illustrated a significant challenge: reverse logistics costs were estimated to be 2-times that for forward flows) (Kumar et al., 2021; Shaukat et al., 2021; Tapaninaho & Heikkinen, 2022).

## **4.2 Recommendation**

One of the first practical suggestions is to think of the circular economy as a related programme of projects rather than a bunch of disconnected ones. Manufacturing enterprises should set up a portfolio of circular projects--sponsored, priorities are defined in writing but are flexible over time, and with clear benefit-realization phase-- so that the knowledge from one

project could be passed down to others in a systematic way and expansion decisions are evidence-based. This point reflects a whole systems perspective that intervention in the circular economy seems always to bring about inter-outcome interdependencies as well as feedback loops which must be managed as a single system instead of optimized by compartments (Lacovidou et al., 2020; Obradović et al., 2024). In practice, therefore, governing a portfolio should require every circular project to define its boundary conditions, reverse-flow dependencies, and risk register upon initiation because scope-creep is structurally likely when circular work grows beyond factory processes into the supply chain logistics or user behavior.

The second practical proposal is to incorporate hybrid delivery models for circular projects, bringing together a stage gate system as a form of investment control with some iterative learning cycles in design. The evidence suggests that circular projects often need both disciplined and agile approaches, especially when product redesign follows immediately afterwards and then reverse logistics come into play (De Angelis, 2022; Alcalde-Calonge et al., 2024). Firms should therefore formalize a delivery playbook that says when agile sprints are appropriate (for testing new assembly methods), and when gate controls are necessary (such as instances of quality inspections, gatekeeping capital investment decisions). In this way, they will avoid having to make changes at the last minute or scale prematurely but still be able respond flexibly under uncertainty.

The third practical suggestion is to practice staged funding and milestone-based investing of circular projects. When technical performance and market acceptance are both doubtful, particularly so. The 'venture capital style' funding method reported in the case studies offers good promise because, on the one hand, it manages risk and on the other it keeps innovation going. (Kwarteng et al. 2021; Sehnem et al. 2021; Kumar et al. 2021). Firms should define value milestones that include operational performance signals (e.g., purity rates, yield, defect rates), stakeholder readiness signals (e.g. supplier compliance, recycler acceptance), and market signals (e.g. customer readiness to adopt modular options). The fund is only released when milestones are met, which enhances accountability and enables upper management to compare circular initiatives with competing investment demands without concocting a false sense of certainty at the same time.

The fourth practical proposal is to institutionalize dynamic skills as routine practice in every project. In the first place, for sensing, companies should turn audit and feedback loops into formal systems, so that their results can then be combined with external searches using clusters, fairs and research networks. Circular instances originate not only from rings within waste visibility but are also intimately related to outward design trends and Government policy too. (Chirumalla et al., 2024) Second, for seizing, companies must filter projects even more

carefully according to two separate sets of criteria: feasibility and the new strategic value added by doing circular work. In the third place, for reconfiguring, companies should make it standard practice that successful pilots end with well-documented changes to rules of operation, rules for products, and system configurations. Let circular routine become the norm rather than being dependent on individual champions. (Prieto-Sandoval et al., 2019)

The fifth practical suggestion is to make stakeholder co-creation a main delivery workstream, not just an occasional engagement activity. These examples also show that feasibility depends on technical cooperation, such as standardizing connection points, aligning recycler demand for purity and forming collection partnerships. Therefore, companies should create co-creation mechanisms that are bounded in time and focused on outputs. These could include joint design workshops with recyclers to verify material passport labels, bringing together suppliers for spec harmonization sessions, and customer pilots to test give-back incentives (Fobbe & Hilletoft, 2022; Santos & Fernandes, 2024). View Co-creation outputs should be assessed by governance boards as part of Phase Gate decisions, because stakeholder alignment is a precondition for capturing circular added value and not merely an issue of reputation.

A sixth practical recommendation focusing efforts on digital foundations, traceability. Makers need to bring product lifecycle data, maintenance history and operation telemetry into a common architecture conducive to facilitating decisions on reuse, remanufacturing etc. (Hapuwatte & Jawahir, 2021) It is also worth considering that a similar approach needs to be adopted in safeguarding data quality and inter-operability, where the thesis and many of the publications list these again as obstacles that recur (Kumar et al., 2021). Therefore, the order of projects needs to ensure this is given priority - rules for data governance, rights of access and quality protocols are put into place. Circular initiatives which rely on Big Data then comes second after these enabling conditions have been put in order (Lacovidou et al., 2020; Obradović et al., 2024).

A seventh recommendation is to standardize the measurement of circularity by integrating process metrics with outcome metrics and attach these to credibility checks that managers will believe. The cases demonstrate that credibility was added to the results when dashboards, test logs, compliance checklists and governance sign-offs backed up outcomes not vagaries without validation. Thus, firms need to create KPI packs that capture return-loop activation, remanufacture yield, secondary material substitution and service-level impacts as well as environmental performances and social performance metrics (Bjørnbet et al., 2021; Shaukat et al., 2021; Tapaninaho & Heikkinen, 2022). This reinforces the commercial evidence, but also adds to legitimacy from the outside in, under increasingly stringent reporting expectations.

A last suggestion refers to how organizations can deal with established limitations that would otherwise be able to jeopardize the circular business case, specifically recovery logistics economics. The presumption that take-back will be cost-neutral at the onset should not hold true for those companies referred to earlier on access for audiences with disabilities 27 Key finding given evidence that reverse logistics can be twice or thrice as costly as forward flows. Pilots ought therefore to be undertaken with clear cost baselines on reverse flow markets, value sharing discussions should occur with logistics partners and fresh sets of design choices that facilitate reduction in complexity associated with the reverse flow must be sought (Prieto-Sandoval et al., 2019; Hapuwatte & Jawahir, 2021). The takeaway for practitioners is that circularity requires intentional economic engineering, not just sustainability intentions, and project management provides the scaffolding to experiment, learn and recalibrate before scaling.

In relation to the development of future research, this study should be replicated with larger sample sizes, cross-industry comparisons and longitudinal observation of circular initiatives from onset/birth to post-implementation learning cycles. The evidence is rich but derived from two cases and six interviews with professionals that proves depth, but restricts generalizability (Yin, 2003).

Further, as the gaps in literature identified in the thesis suggest a lack of empirical examination of these relationships with respect to manufacturing settings (Kwarteng et al., 2021; Sehnem et al., 2021; Hapuwatte & Jawahir, 2021), future research could also quantify from the conceptual framework the relationships proposed between study constructs especially, mediating effect of dynamic capabilities and moderation effects of governance and digital enablers.

### 4.3 Limitations

Below is a consolidated table of the study limitations explicitly stated in the thesis, with the supporting text evidence and how those can be addressed.

**Table 11**

*Study Limitations and Mitigation Measures*

<b>Limitation (what it is)</b>	<b>Evidence in the thesis</b>	<b>Why it matters (impact on findings)</b>	<b>Mitigation stated in the thesis</b>
Access constraints to	The thesis notes that access can	Can reduce the number/diversity of	Triangulation across two companies and

participants (gatekeepers, time pressure)	be limited by organisational gatekeepers and managers' competing time demands.	participants and constrain the depth of data collected, which may narrow the range of perspectives captured.	linking interview insights to secondary sources is used to strengthen robustness.
Sensitivity and trust in organisational interviews	The thesis states that trust is needed to obtain candid responses, especially when discussing sensitive topics such as governance failures or resistance to change.	If trust is limited, participants may under-report problems or present overly positive accounts, affecting authenticity of findings.	Credibility steps include member checking, and confirmability steps include reflexive journaling and peer debriefing.
Language differences and translation-related nuance loss	The thesis warns that language differences may require translation and can introduce nuance loss.	Meaning can shift during translation (tone, emphasis, culturally specific phrasing), which can affect coding and theme interpretation.	Trustworthiness strategy emphasises audit trail and reflexive practices to document decisions and assumptions, supporting interpretive transparency.
Small sample size limits generalisability	The thesis explicitly states that a small sample limits generalisability, while clarifying the goal is	Findings should not be treated as population-level estimates; applicability is strongest as mechanism-based insights that inform theory and practice in comparable contexts.	Transferability is supported through rich contextual descriptions, and triangulation across cases strengthens

	analytical (not statistical) generalisation.		robustness of interpretations.
Reliance on self-reported data (recall bias, social desirability bias)	The thesis states that self-reported data may be affected by recall bias or social desirability bias.	Participants may unintentionally misremember details or present themselves/organisation in a better light, influencing the accuracy of reported processes and outcomes.	Member checking and triangulation (across companies and with secondary documents/statistics) are used to strengthen credibility of interpretations.
Qualitative design does not aim for statistical generalisation	The thesis states qualitative research does not aim for statistical generalisation, emphasising methodological rigour instead.	The strength of the study is explanation-building rather than prediction; conclusions should be framed as theoretically informative patterns rather than universal laws.	Rigour is supported through code–recode, planned independent review of a subset of transcripts/codes, and triangulation.

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## ANNEXES

### ANNEX 1: Questionnaire

#### Interview Questionnaire

1. Could you briefly describe your position in the company and your responsibilities in projects that relate to the circular economy
2. Please describe one or two circular economy initiatives in your company that you have been closely involved in from a project perspective
3. How were this circular economy projects initiated and approved in your organization, and what role did project management processes play in that early stage
4. How did you plan these circular economy projects in practice, for example in terms of scope, schedule, budget and definition of expected benefits
5. How were teams, responsibilities and resources organized for these projects, and what project management practices helped you build the capabilities needed for circular work
6. In these projects, how did you identify and engage key stakeholders such as suppliers, customers, recyclers, regulators or internal departments, and to what extent would you say this was real co creation rather than simple consultation
7. What kind of digital tools and data systems did you use in these projects, for example for tracking materials, monitoring performance or coordinating partners, and how did these tools influence project management
8. Thinking about sensing, seizing and reconfiguring, how did project management practices in these initiatives help your organization detect circular opportunities, commit resources and adjust processes over time
9. What were the main risks and barriers you faced when managing these circular economy projects in the Lithuanian manufacturing context, and how did you address them through governance, standards or other project control mechanisms
10. How do you evaluate the outcomes of these projects so far, in terms of environmental results, economic or cost related results and social or organizational results, and how are these outcomes monitored over time
11. In your view, how do national policies, market conditions and the broader Lithuanian industrial environment influence the way circular economy projects are designed and managed in your company
12. Looking back at your experience, what lessons have you learned about managing circular economy projects, and what recommendations would you give to other manufacturing managers who want to strengthen project management for circular initiatives

## ANNEX 2: Example of Transcribed Interview

### Interview 1

**Company:** LT Metal Partners

**Participant Profile:** Warehouse Specialist

**Experience:** 3 years

**Interviewer:** Thank you for joining us today. We are exploring how project management (PM) drives circular economy initiatives. Let us jump straight in.

**1. Could you briefly describe your position in the company and your responsibilities in projects that relate to the circular economy**

**Participant:** I serve as the Warehouse Specialist, here at LT Metal Partners. My role involves overseeing the entire production lifecycle from raw material procurement to final assembly. Regarding circularity, I am responsible for our material efficiency and zero-waste project tracks. I ensure that circular goals are not just green talk but are integrated into our production schedules and KPIs.

**2. Please describe one or two circular economy initiatives in your company that you have been closely involved in from a project perspective**

**Participant:** The biggest one is our high-grade scrap recovery loop. Traditionally, metal shavings and offcuts were just sold to recyclers for a flat fee. We initiated a project to segregate these materials at the source using digital tagging. Another project involved design for modular assembly for a major client, where we managed the project specifically to ensure that the metal components could be easily separated from plastic housings without damaging the metals integrity for future melting.

**3. How were this circular economy projects initiated and approved in your organization, and what role did project management processes play in that early stage**

**Participant:** They usually start from a cost-saving perspective or a client requirement. However, the approval happens through our formal project management office (PMO). We used a business case template that now includes a circular impact score. Project management

played a huge role here because, without a structured feasibility study and a clear ROI projection even if the ROI is long-term these projects would never get past the board.

**4. How did you plan these circular economy projects in practice, for example in terms of scope, schedule, budget and definition of expected benefits**

**Participant:** We use a modified stage-gate process. For the scrap recovery project, the scope was wider than usual because it included training the shop-floor staff. the budget was tricky; we had to invest in new separation bins and a custom software module. We defined benefits not just in Euros saved, but in the reduction of virgin material dependency. We had to be flexible with the schedule because changing the physical layout of a metal shop while keeping production running is a nightmare.

**5. How were teams, responsibilities and resources organized for these projects, and what project management practices helped you build the capabilities needed for circular work**

**Participant:** We formed cross-functional teams. It was not just the engineers. We had procurement, production, and even the waste management partner at the table. We used scrum for the software part of the tracking and Lean project management for the physical shop floor changes. This dual-track project management approach helped us learn how to bridge the gap between digital data and heavy machinery.

**6. In these projects, how did you identify and engage key stakeholders such as suppliers, customers, recyclers, regulators or internal departments, and to what extent would you say this was real co creation rather than simple consultation**

**Participant:** With our scrap recyclers, it was true co-creation. We did not just tell them what we were doing; we asked them, what purity of aluminum do you need to give us a 20% better price. We then redesigned our internal collection project based on their technical requirements. That is co-creation their input changed our internal project scope.

**7. What kind of digital tools and data systems did you use in these projects, for example for tracking materials, monitoring performance or coordinating partners, and how did these tools influence project management**

**Participant:** We use our ERP (Microsoft Dynamics) but added a custom layer for material passports. Every batch of metal has a digital twin now. This influenced project management because it gave us real-time data. In the past, we would wait for a monthly report to see waste levels; now the project manager sees a dashboard daily. It makes our risk management much more proactive rather than reactive.

**8. Thinking about sensing, seizing and reconfiguring, how did project management practices in these initiatives help your organization detect circular opportunities, commit resources and adjust processes over time**

**Participant:** PM routines act like sensors. Our weekly project reviews allow us to *sense* when a certain material price is spiking. We then *seize* the opportunity by accelerating a recycling project. Reconfiguring is the hardest part it is about moving people from old habits to new ones. The structured change management part of our project management methodology is what makes those reconfigurations stick.

**9. What were the main risks and barriers you faced when managing these circular economy projects in the Lithuanian manufacturing context, and how did you address them through governance, standards or other project control mechanisms**

**Participant:** The biggest barrier is the lack of local high-tech recycling infrastructure for specific alloys; we often have to export waste, which kills the circular logic. Also, energy prices in Lithuania are volatile. We addressed this through risk registers in our project management plans. We have a governance board that meets monthly to ensure our circular economy projects are still aligned with national environmental standards and ISO 14001.

**10. How do you evaluate the outcomes of these projects so far, in terms of environmental results, economic or cost related results and social or organizational results, and how are these outcomes monitored over time**

**Participant:** Environmentally, we have reduced landfill waste by 30%. Economically, our material costs per unit have dropped by 8% due to better recovery. Socially, it has been a boost for employee morale our younger engineers specifically want to work on green projects. We monitor this through a balanced scorecard that we update every quarter.

**11. In your view, how do national policies, market conditions and the broader Lithuanian industrial environment influence the way circular economy projects are designed and managed in your company**

**Participant:** EU regulations like the carbon border adjustment mechanism (CBAM) are the biggest drivers. Locally, the Lithuanian government offers some innovation vouchers, but the bureaucracy is heavy. This influences our PM because we have to build in Compliance Time into our project schedules to handle the paperwork for these grants.

**12. Looking back at your experience, what lessons have you learned about managing circular economy projects, and what recommendations would you give to other manufacturing managers who want to strengthen project management for circular initiatives**

**Participant:** My biggest lesson, circularity is a data problem. If you cannot track it, you cannot loop it. My recommendation to other managers: Do not treat circular economy as a CSR (corporate social responsibility) project. Treat it as an operational efficiency project. Use your existing project management tools Gantt charts, risk logs, budgets but apply them to the entire lifecycle, not just the factory gate.

**Interviewer:** Thank you for those insights. They provide a very clear picture of the technical side of CE in metal manufacturing.