Thesis

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Driving a better future: The role of startups in circular ecosystem innovation

An exploratory case study of startups' influence on circular ecosystems

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The concept of the Circular Economy is drawing increasing attention by practitioners and researchers alike. This is driven by the necessity to reduce excessive emissions caused by linear value chains and the need to cope with increasing resource scarcity. Yet, established companies are struggling to introduce circular business models. Recent literature suggests that circularity may only be realized across organizations and within collaborative settings, implying an ecosystem perspective on the context of circular business model innovation. Startups have been widely neglected as potential drivers towards Circular Ecosystems. This study exploratively considers startups' role in Circular Ecosystem Innovation (CEI) by employing qualitative methods, involving a multiple case study. Findings reveal a set of six ecosystem roles for startups in driving CEI, of which three are newly introduced to the literature: (1) *Vertical Digitizer*, (2) *Horizontal Digitizer,* and (3) *Indirect Orchestrator*. Results highlight the relevance of the industrial context concerning ecosystem formation and its value structure. Startups further face common, interrelated challenges when engaging in CEI. To address these challenges, startups are found to apply *CEI strategies*. The most frequent challenge lies in convincing actors to join and contribute to the Circular Ecosystem. Differences in role and industrial context appear to explain variances in CEI strategies by affecting how challenges manifest themselves to startups. Beyond this, a set of common strategies is derived that seem to apply across ecosystem contexts. The study concludes by making ten propositions regarding the influence of startups in CEI. In illuminating the role of startups in Circular Ecosystem emergence, this study contributes to a better understanding of the processes that drive the transition to the circular economy.

Keywords circular economy, circular ecosystems, circular ecosystem innovation, ecosystem strategy, startup, multiple case study

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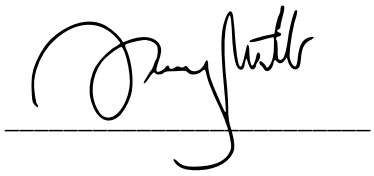

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List of Abbreviations

CBM	Circular Business Model
CBMI	Circular Business Model Innovation
CE	Circular Economy
CEAP	Circular Economy Action Plan
CEI	Circular Ecosystem Innovation
EMF	Ellen MacArthur Foundation
EU	European Union
FMCG	Fast-moving consumer goods
LCA	Life Cycle Assessment
VC	Venture Capital
WEF	World Economic Forum

1 Introduction

"There is no future for business as usual" (WEF, 2020, p.8)

The acceleration of destructive environmental events has reminded us that combating profligate wastefulness is arguably the most critical task of the present time. Fundamentally, it requires a transformation of essential socio-economic systems, including the use of land and sea, the infrastructure and built environment, as well as the extraction of resources (WEF, 2020). Driven by these environmental challenges, there have been repeated calls over the past decade to reorient capitalism and expand the responsibilities of business enterprises to optimize their overall societal impact by creating value not just for their customers and shareholders but collaboratively with a wide range of stakeholders, that includes environmental and social value (Möller et al., 2020). With the advent of industrialization, linear value chains relying on extracting and disposing of resources, have become dominant (McKinsey, 2016). Contemporary trends have led to increased awareness exposing the wastefulness of such 'take–make–waste' systems (Bocken et al., 2016). Today, some natural resources are dwindling, with a foreseeable end becoming imminent (WEF, 2020). This scarcity also implies that prices will continue to rise, which has significant implications for legacy technologies and the feasibility of linear business models (Bocken et al., 2018). After all, Covid-19 and the subsequent collapse of global supply chains have shown that companies can build resilience by utilizing and recycling locally available resources, thereby becoming less prone to input prices and disrupted supply chains (Nandi et al., 2021). These trends are enhancing the attractiveness of repeatedly utilizing resources across lifecycles (Centobelli et al., 2020; McKinsey, 2016). This describes the organizing principle of the circular economy (CE), while the potential benefits of operating in accordance can be significant. Designing and implementing promising business models incorporating these aspects is increasingly becoming a competitive advantage for businesses and a strategic priority for managers (Palmié et al., 2021; Salvador et al., 2021). Circular and resource-efficient business models are based on principles that break with linear 'take-make-waste' models (EMF, 2015). These models (1) keep products and materials in use for as long as possible, (2) avoid waste and pollution, and (3) regenerate natural systems by returning valuable inputs, thus creating tangible economic and social benefits (EMF, 2021).

1.1 State of Circularity

The urgency of climate change and resource scarcity has put the Circular Economy on the agenda of policymakers, particularly for its potential to sustain prosperity and growth by decoupling it from finite resources and environmental impact (Ghisellini et al., 2016; Pollard et al., 2021). The EU has recently introduced the 'Circular Economy Action Plan' (CEAP) as one of the main building blocks of the European Green Deal, the definitive agenda for Europe's strategy for sustainable growth and climate neutrality (European Commission, 2020). The CEAP contains very ambitious goals, such as the requirement to provide spare parts for ten years ('right to repair'), the introduction of digital product passports to achieve large-scale product traceability, and targets for secondary resource procurement (European Commission, 2020). However, the circularity of resources also increases the complexity of value and supply chains and can often no longer be managed within the confines of a single company. By pooling,

recovering, revaluing, and recycling resources, collaboration will be at the heart of new circular business models (CBMs) where interdependence becomes a constant reality, elevating business models to an ecosystem level. Thus, creating the conditions for collaborative and circular value creation is a prerequisite for systemic adoption (Bocken et al., 2016; Centobelli et al., 2020). Despite the promising outlook, political support, and decades of debate in the professional and academic literature, widespread adoption and integration of CBMs are still lacking (De Angelis, 2021; Fehrer & Wieland, 2021; Parida et al., 2019). Although more companies invest in sustainable process and product innovations, they are far from becoming circular and adopting new business models (WBCSD, 2018). According to Veleva and Bodkin (2018), large companies fail to adopt CE principles due to a lack of mandates, costs, logistical hurdles, and overall inertia.

1.2 Startups and Ecosystems

The transition towards the CE constitutes creative destruction, where new circular product standards, operating practices, and business models replace and deprecate linear business models (Schumpeter & Stiglitz, 2010). The innovator's dilemma suggests that startups might create more radical solutions than incumbents holding on to their established business models and pursuing operational excellence, which is deemed an inappropriate logic for systemic change (Christensen, 2013). Startups with innovative business models can provide the critical link for systematic change by engaging and collaborating with large companies (Veleva & Bodkin, 2018). The WEF (2021) classifies startups that aim to transform industries and demonstrate the feasibility of CBMs as 'trailblazers'. Trailblazers enable others to raise the level of circularity by collaborating and sharing their technology and knowledge. They actively engage in reshaping market conditions and policy, thereby creating significant opportunities for investors, other businesses, and themselves (WEF, 2021). As the CE is essentially about the circulation of resources, the supply chain and physical resources form a central aspect, tying up many assets and capital. Given their lack thereof, startups need to collaborate with incumbents to drive systemic change. The distribution of resources is one factor, but it is also the increasing complexity of supply chains and reverse flows that requires collaboration and new business models on an ecosystem level. In this context, the term 'ecosystem' broadly refers to interconnected actors sharing knowledge and co-creating value. If transitioning to the CE requires collaboration and business model innovation, innovation ecosystems are needed to convene previously unconnected actors and explore circular solutions from previously uncharted angles (Boldrini & Antheaume, 2021; Konietzko et al., 2020; Madsen, 2020).

1.3 Research Purpose

Both CBMs and ecosystems are still relatively nascent areas in the literature. Although research has increased significantly in recent years, there remain substantial gaps. While initial studies on CBMs focused on the financial and environmental benefits of circular strategies, contemporary studies focus on business model typologies, methods and tools that focus on value creation, delivery, and capture (Geissdoerfer et al., 2020). However, there is still little empirical work on the business model innovation process through which organizations operationalize CE principles (Bocken et al., 2019; Boldrini & Antheaume, 2021; Geissdoerfer

et al., 2020). To the best of our knowledge, no previous study has taken a startup-centric perspective on circular business model innovation.

Further, the context of CBMs has only been slightly illuminated from an ecosystem perspective. The synthesis of these two streams of research is still in its infancy, and many are calling for more studies at this intersection (Ferasso et al., 2020; Geissdoerfer et al., 2020; Parida & Wincent, 2019). Similar to the CBM literature, startups appear to be widely underrepresented in the ecosystem literature. Although we see much literature on Innovation Ecosystems, the collaboration of startups and corporates appears to be underrepresented since studies in this field usually focus on incumbents' efforts to collaborate (Veleva & Bodkin, 2018). The emergence of Circular Ecosystems, especially with startups as agents, has not been sufficiently addressed yet (Dedehayir et al., 2018). Thus, in both streams, startups' behavior, roles, and collaboration efforts have not been adequately studied. As a result, there is a significant gap in how entrepreneurs and startups affect Circular Ecosystems.

The purpose of this study is to address theoretical gaps in the Ecosystem and Circular Business Model literature by collecting and analyzing empirical data at their intersection. From this ambition, the following question arises that summarizes our research interest:

How do startups influence the emergence of Circular Ecosystems?

After the literature review, the research question will be specified according to prevalent literature gaps and broken down into actionable research-questions that shed light on startup roles and the functioning of Circular Ecosystems. The investigation of how startups shape, steer and disrupt such ecosystems from linear to circular will also provide insights into the emergence and transformation of ecosystems.

2 Literature Review

The Literature Review addresses the interface of circular business models (2.1) and ecosystems (2.2) while applying a startup and innovation perspective. Thus, our research takes place and contributes to the area marked with an "X" in Figure 1. After reviewing the streams of literature, findings are synthesized to derive research gaps and questions (2.3) before developing the theoretical framework (2.4) and stating the conceptual delimitations (2.5).

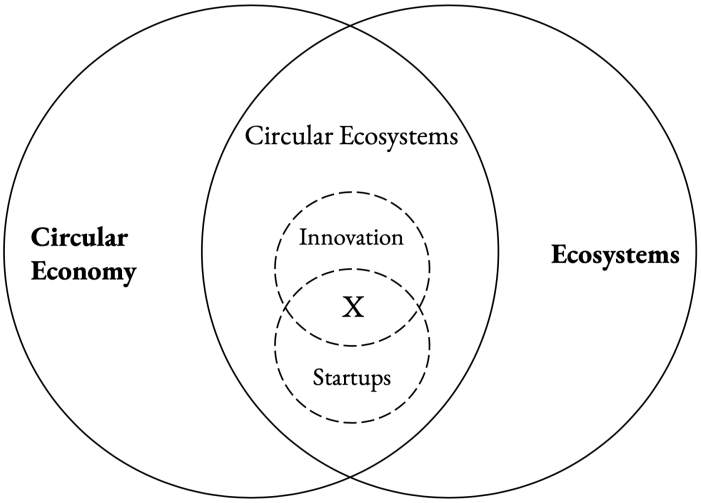

Figure 1: *Outlining the Research Area*

2.1 Circular Economy & Circular Business Models

The Circular Economy (CE) is a widely discussed approach intended to bring about an organizational paradigm shift towards more resource conservation and sustainable behavior while preserving and enhancing the fundamental economic order (Ghisellini et al., 2016). At its core, the circular economy represents a resource-driven strategy that narrows, slows, and closes resource loops by improving the design, lifetime, and reusability of goods (Bocken & Ritala, 2021; Homrich et al., 2018). Through optimizing the use of resources and redesigning value creation systems employing circular strategies, organizations can reduce the adverse environmental effects of their doing (Ferasso et al., 2020; Rosa et al., 2019; Urbinati et al., 2017).

The Circular Economy considers the planet to be a closed system and stresses the need to repurpose waste as an input for the creation of new resources (Pearce & Turner, 1990). Effectively, this means that CE decouples economic growth from resource extraction and waste generation through systemic resource efficiency, making it very popular among policymakers and businesses (Pieroni et al., 2019; Ranta et al., 2018). Compared to other sustainability frameworks, CE is often seen as more narrowly framed and tangible, allowing for more explicit directions for its implementation (Geissdoerfer et al., 2017).

Researchers are shifting their focus towards means of facilitating the transition to the CE by increasingly exploring the fundamental transformation of business strategies, value chains, and especially business

models (Ferasso et al., 2020; Rosa et al., 2019). In recent years, many authors addressed the pertinence of business models as the pivotal foundation and strongest lever to master the transition to a CE (Ferasso et al., 2020; Lewandowski, 2016; Merli et al., 2018; Nußholz, 2017; Pieroni et al., 2019; Ranta et al., 2018). Business models that incorporate CE thinking and strategies are often studied under the term Circular Business Models (CBMs). In this context, the area of business model innovation is seen as a potential catalyst to facilitate the transition to the CE (Pollard et al., 2021; Salvador et al., 2021).

2.1.1 Circular Business Models and the Notion of Value

The contemporary understanding of a business model encompasses the "design or architecture of the value creation, delivery, and capture mechanisms" of a business (Teece, 2010). Accordingly, a CBM can be defined as a simplified representation of complex organizational systems and relationships that create, deliver, and capture value by slowing, narrowing, and closing resource flows (Bocken et al., 2016; Geissdoerfer et al., 2018; Teece, 2010). Slowing resource flows refers to extending the product life; narrowing flows focuses on efficiencies in production and design, whereas closing resource flows describes reusing materials after usage and is often referred to as 'recycling' (Bocken & Ritala, 2021). Identifying new modes of value creation, delivery, and capture that adhere to CE principles (slowing, narrowing, closing) has become essential to the debate on how companies can adopt CBMs (Pieroni et al., 2019). The notion of value is central as it includes not only economically measurable but also intangible and non-monetary value (Centobelli et al., 2020). In CBMs, circular value creation involves an offering that can preserve the embedded economic and environmental value through the efficient use of resources (Nußholz, 2017), including, for example, lifetime extensions, the purchasing of upcycled waste, and recycling (Lewandowski, 2016). Circular value transfer covers the customer relationship and the delivery of the value proposition, which includes the procurement of products and end-of-life handling (Centobelli et al., 2020) . Finally, circular value capture envisions the ability to recover all costs associated with environmental design plus long-term sustainable profitability (Geissdoerfer et al., 2018) by activating additional revenue streams and reducing costs by preserving valuable resources (Centobelli et al., 2020; Ranta et al., 2018).

Several researchers have attempted to capture these activities in modified versions of the Business Model Canvas (Osterwalder et al., 2010) to conceptualize and describe CBMs (Antikainen & Valkokari, 2016; Bocken et al., 2018; Lewandowski, 2016; Nußholz, 2017; Pollard et al., 2021). The majority of these reference models conduct an organization-centric analysis of the CBM (Geissdoerfer et al., 2020). Pollard et al. (2021) pose an exception as they also include the broader ecosystem. Companies have employed different types of CBMs that seek to offer superior value while combating the prevailing linear 'take-make-dispose' business model (Bocken et al., 2016). Performing a morphological analysis, Lüdeke-Freund et al. (2019) have identified six major CBM patterns, which they define as repair and maintenance, reuse and redistribution, refurbishment and remanufacturing, recycling, cascading and repurposing, and organic feedstock business models.

2.1.2 Circular Business Model Innovation

The implementation of CE strategies into the firm's business model is conceived as circular business model innovation (CBMI). Due to its uncertain nature, which requires continuous experimentation and

adaptation, it is viewed as a process rather than an outcome. As a process, business model innovation becomes the continual and deliberate renewal and reconfiguration of the company's core business logic (Schneider & Spieth, 2013). Consequently, CBMI can be defined as the continuous effort of conceptualizing, implementing, and realizing novel solutions for value creation, delivery, and capture that adhere to CE principles (Geissdoerfer et al., 2020; Linder & Williander, 2017; Pollard et al., 2021). Most CBMI processes are related to the identification ("sensing") of opportunities, but few are related to the implementation or reconfiguration ("seizing") of CBMs (Pollard et al., 2021). This may stem from the higher uncertainty and complexity of realizing CBMI, for example, in the form of reverse logistics or the quality, quantity, and timing of recycled resources (Pieroni et al., 2019). Urbinati et al. (2017) propose a reference taxonomy that embeds CE principles at different levels of the CBM depending on ambition and capability. It is suggested that companies should develop a systemic understanding of value creation and look for opportunities in their value network and supply chain (Ünal et al., 2019; Urbinati et al., 2020). To fully exploit CBMI, Geissdoerfer et al. (2018) also consider a long-term perspective and the enlargement and proactive management of the stakeholder network to be of relevance when transitioning to the CE.

CBMI is also frequently viewed from a strategic perspective. Bocken and Ritala (2021) outline six CBMI strategies that companies can apply based on two strategic choices: the innovation strategy and the resource strategy. While a closed innovation strategy offers more control over processes and value capture, an open strategy provides the opportunity to bring in new capabilities and achieve more scale at a lower cost (Bocken & Ritala, 2021). One prevalent way to approach CBMI is business experimentation (Aminoff & Pihlajamaa, 2020; Bocken et al., 2018; Konietzko et al., 2020). Adopting a corporate lens, Geissdoerfer et al. (2020) describe four CBMI processes: CBM transformation; circular startups; CBM diversification; and CBM acquisition. The portfolio of acquired CBMs can ultimately also be used to innovate and transform the core business model. Many companies also use incubator-like structures to manage portfolio companies and intellectual property (Geissdoerfer et al., 2020).

To date, most research on relationships between startups and incumbents has viewed them as competitive, based on the ideas of disruption (Veleva & Bodkin, 2018). However, some scholars have suggested that circular startups might constitute an essential catalyst for CBMI (Antikainen & Valkokari, 2016; Geissdoerfer et al., 2020). Veleva and Bodkin (2018) looked at startup-incumbent collaborations for reverse supply chains and recycling to identify drivers and barriers of such constellations. They found that startups might play a critical role in reducing financial costs, time, energy while improving environmental impact and resources, thus helping establish viable business models. Henry et al. (2020) have developed a novel typology of circular startup archetypes: design-based, waste-based, platform-based, service-based, and nature-based. They note that circular startups tend to realize higher-order circular strategies than incumbents and conclude that startups may substantially contribute to the CE transition. Drawing on entrepreneurship literature, startups can be seen as problem-solvers in that they perceive complex problems as opportunities and act upon them in the pursuit of economic interest, potentially yielding social and environmental benefits (York & Venkataraman, 2010). There exists a structural difference between startups and incumbent companies in that they commonly follow different heuristics concerning risk and capital allocation and evaluate business success (i.e., profitability) based on different timescales (Christensen, 2013). These make

startups especially suitable for addressing new, complex problems requiring innovative solutions whose outcomes are highly uncertain, such as the circular economy.

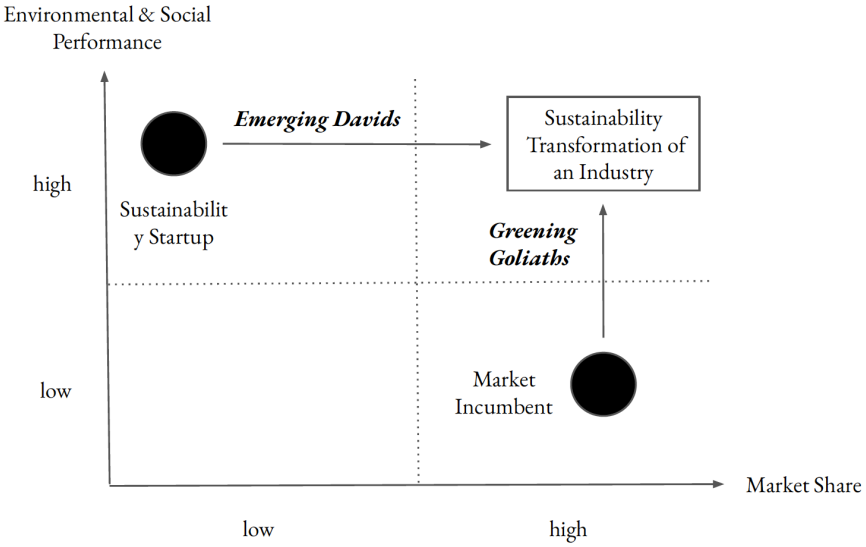

Figure 2: *Co-evolution of sustainability startups and market incumbents towards the sustainability transformation of an industry* (from Hockerts & Wüstenhagen, 2010)[1]

Hockerts and Wüstenhagen (2010) highlighted that strategic partnerships between startups and incumbent actors might foster industry transformation and sustainable progress (Figure 2). They describe how startups ('Emerging Davids') are more likely to launch sustainable business models in a niche, whereupon incumbents ('Greening Goliaths') slowly counteract and become greener. While these are less ambitious, they have a greater market presence, which means that their interplay through value exchanges and combined influence can significantly promote industry transformation.

2.1.3 Circular Business Models and Ecosystems

CBMs have been analyzed applying different levels of analysis. The complexity of CBMs and the concomitant proliferation of activities often leads to value being co-created "within an ecosystem of actors, moving from a firm-centric to a network-centric operational logic" (Pieroni et al., 2019, p.199). In an early work, Mentink (2014) conceptualized CBMs to include multiple organizations, creating a loop of interconnected business models. Urbinati et al. (2020) have highlighted the need for alignment in the value network to enable CBMI.

Pieroni et al. (2019) stress the particular need for collaboration among stakeholders in the CE, thus expecting a shift towards more systemic ecosystem approaches (Geissdoerfer et al., 2020). Often CE transition is classified on the micro- (company), meso- (ecosystem and value co-creation), and macro-level (industry trends and drivers) (Antikainen & Valkokari, 2016; Ghisellini et al., 2016). CBMs are primarily located on the micro-level as they capture the value creation logic of an individual business; however, sometimes they are also expanded to the meso-level (Ghisellini et al., 2016; Lüdeke-Freund et al., 2019). The rationale is that businesses do not necessarily need to close material loops within their operations but can

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also be part of a system of business models that together close material loops and become circular (Antikainen & Valkokari, 2016; Mentink, 2014). The latter view sees CBMI as networked since collaboration, communication, and coordination across independent actors are required to realize these business models (Antikainen & Valkokari, 2016; Pieroni et al., 2019). Organizations then depend on but also benefit from the innovation success of others in the same ecosystem highlighting the integrative and positive nature of collaboration (Galvão et al., 2020). The new challenge is to design ecosystem-level incentive structures that not only benefit but also guide, encourage and align stakeholder behavior (Geissdoerfer et al., 2020; Suchek et al., 2021).

Overall, the ecosystem view is particularly interesting for CBMs, given the collaboration of diverse actors within the ecosystem (Geissdoerfer et al., 2020). Kanda et al. (2021) stress that Circular Ecosystems are the superior concept to CBMI as it accounts for the high level of coordination between stakeholders and the complexity of value exchanges. However, they indicate that further research needs to be undertaken to shift the unit of analysis and derive generic perspectives, frameworks, and ultimately tools. Fehrer and Wieland (2021) have drafted a first holistic and systemic framework of Circular Ecosystems where all actors integrate and apply resources to benefit themselves and others, engage various actors in shaping institutions, and consider the role of institutions as being foundational to circular business models. Further, they describe the governance of such CBMs as decentralized, with some collective authority held by multiple organizations and entrepreneurs (Gallo et al., 2018).

Parida et al. (2019) have looked at how large manufacturing firms drive transformation towards Circular Ecosystems from an orchestrator position. They describe transformation as a two-step process consisting of an ecosystem readiness assessment and ecosystem orchestration through (1) *standardization*, (2) *nurturing*, and (3) *negotiation* mechanisms. Thereby, *standardization* describes the active influencing of industry standards on both process and technological levels; this is done informally and via formal certification. *Standardization* success is linked to co-development with selected partners. *Nurturing* describes mechanisms directed at ecosystem development, such as bearing early investments, developing competencies, and sharing knowledge with other actors. *Negotiation* is also an essential part due to the interdependence of actors and describes the establishment of rules to avoid conflicts.

Through applying a business and innovation ecosystem lens, Konietzko et al. (2020) have identified several 'Circular Ecosystem Innovation' (CEI) principles which are clustered around (1) *collaboration*, (2) *experimentation*, and (3) *platformization*. *Collaboration* principles delineate how companies can interact and innovate with other organizations in their ecosystem. *Experimentation* describes how companies organize pilots to test CE principles. *Platformization* entails how companies organize social and economic interactions through digital platforms. These principles relate to the idea of Antikainen & Valkokari (2016), who describe CBMI as networked. Konietzko et al. (2020) call for more studies on CEI in different contexts to refine the underlying principles and enable firms to go beyond the traditional firm boundaries through actionable steps.

Palmié et al. (2021) propose four orchestration methods for resource-sharing solutions based on the need for resource modification and the degree of actor interaction. Bertassini et al. (2021) propose a systemic

innovation process for corporations that maps value opportunities between stakeholders to strategically prioritize circular innovation opportunities. In summary, recent research increasingly calls for the two research streams (CBM and ecosystems) to be better integrated and systematically defined to create a holistic analysis framework (Brown et al., 2019; Fehrer & Wieland, 2021; Geissdoerfer et al., 2020; Suchek et al., 2021).

2.2 Business Ecosystems

In 1993, James F. Moore introduced the ecosystem concept to the business context to propose a new perspective on competition. In ecosystems, actors coevolve over time as they align with each other according to a direction provided by one or several central companies (Moore, 1993). Central companies may change with time and provide a shared vision that guides collaboration towards a system of "complementary capabilities and companies" (Moore, 1996, 2006).

Since Moore introduced the business ecosystem concept, it has been widely adopted and developed over the years. According to Hakala et al. (2020), three different streams of ecosystem thinking are apparent in business research which they classify as: (1) *business ecosystems, (2) innovation ecosystems,* and (3) *entrepreneurial ecosystems*. After Moore had introduced the concept, the focus of ecosystem research remained on *value capture* for roughly a decade (i.e., business ecosystems). In the early 2000s, Adner (2006) shaped the innovation ecosystem concept, which emphasizes joint *value creation* in ecosystem settings. This has led to a blurring of ecosystem definitions (Table 1) where scholars have also developed definitions for the *business ecosystem* that focus on joint value creation (e.g., Peppard & Rylander 2006; Autio & Thomas, 2014). For this research, the meaning originally assigned to innovation ecosystems is most applicable to target circular value creation (Hakala et al., 2020). This study follows the definition provided by Gomes et al. (2018) when referring to ecosystems:

> *"An Innovation ecosystem is set for the co-creation, or the jointly creation of value. It is composed of interconnected and interdependent networked actors, which includes the focal firm, customers, suppliers, complementary innovators and other agents as regulators. This definition implies that members face cooperation and competition in the innovation ecosystem; and an innovation ecosystem has a lifecycle, which follows a co-evolution process."*

Other scholars have highlighted its complex and adaptive nature, characterized by various types of relationships between diverse actors who drive collective innovation (Russell & Smorodinskaya, 2018). The keystone organization may orchestrate the ecosystem via a platform that may take different forms: (1) *supply chain*, (2) *technological*, or (3) *industry platforms* (Gawer & Cusumano, 2014). Based on these platforms, members of the ecosystem can innovate to improve the value created for the ecosystem's customers (Gomes et al., 2018).

Author	Definition
Moore, 1996	An economic community supported by a foundation of interacting organizations and individuals –the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organism also includes suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles and tend to align themselves with the direction set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments and to find mutually supportive roles.
Adner, 2006	[Ecosystems are] the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution.
Peppard & Rylander, 2006	[E]cosystems can be looked at as networks, in which value is co-created between actors.
Autio & Thomas, 2014	Business ecosystems are dynamic and purposive networks within which participating firms co-create value together with customers and other ecosystem stakeholders.
Adner, 2017	The ecosystem is defined by the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.
Jacobides et al., 2018	An ecosystem is a set of actors with varying degrees of multilateral, nongeneric complementarities that are not fully hierarchically controlled.
Gomes et al., 2018	Innovation ecosystem is set for the co-creation, or the jointly creation of value. It is composed of interconnected and interdependent networked actors, which includes the focal firm, customers, suppliers, complementary innovators and other agents as regulators. This definition implies that members face cooperation and competition in the innovation ecosystem; and an innovation ecosystem has a lifecycle, which follows a co-evolution process.

Table 1: *Definitions of the Business/Innovation Ecosystem construct*

2.2.1 Perspectives on ecosystems in business research

Innovation ecosystem literature generally views actors as boundedly rational decision-makers pursuing economic and strategic interests (Möller & Halinen, 2017). They are constrained and affected by resource availability and different forms of interdependence with other actors (Möller et al., 2020). Consequently, most literature tries to understand ecosystem dynamics by applying a resource-based view or the dynamic capabilities perspective (Gomes et al., 2018; Helfat & Campo-Rembado, 2016; Jacobides et al., 2018). Albeit, resource-based view is mainly concerned with owned rather than shared resources.

Present research on ecosystems can be classified according to its scope, stretching from macro views to micro-level research. Here, macro approaches look at ecosystems as extensive 'ecologies' while characterizing business fields as consisting of interconnected and often competing focal ecosystems (Möller & Halinen, 2017). On the other end, the more frequently adopted micro perspective looks at individual ecosystems as deliberate alliances of actors in so-called focal and strategic ecosystems (Möller et al., 2020). Adner proposed

the ecosystems-as-structures view (Adner, 2017), which concentrates on interdependent value creation by the ecosystem's actors to deliver a joint value proposition. It shifts the attention from the kind and number of relationships between actors to their value contributions. Thereby, critical contributions may be made by actors not directly related to a central player. These actors are still included in the ecosystem, as they are crucial in fulfilling the joint value proposition (Adner & Kapoor, 2016; Hou & Shi, 2021).

Tsujimuto et al. (2018) further derived what they called a multi-actor network perspective in their review of the ecosystem concept. It is characterized by an expansion of the analysis to "entrepreneurs and private investors, external innovators, users/user communities, governmental bureaucrats/policymakers, and consortiums" and a dynamic take on networks. Based on the different views on ecosystems ranging from broader to more narrow approaches, scholars have pointed at the nestedness of ecosystems (Möller et al., 2020). This idea provides an integrative take on the multiple layers of systems, as it sees smaller, more narrowly defined ecosystems as part of, or nested in, larger ecosystems.

Most definitions of innovation ecosystems describe them as organized around a central actor, also referred to as a keystone actor (Iansiti and Levien, 2004b). However, as the function that this player serves lies in providing solutions to other members and thereby facilitating value creation, this role may also be taken on by an independent or commonly owned technological asset or standard (Lusch & Nambisan, 2015). Other ecosystem actors have been classified as suppliers and complementors (Adner & Kapoor, 2010). Suppliers provide inputs (components) to the focal firm, while complementors add to the product of the focal firm to be provided as a bundled offering towards the customer (Figure 3).

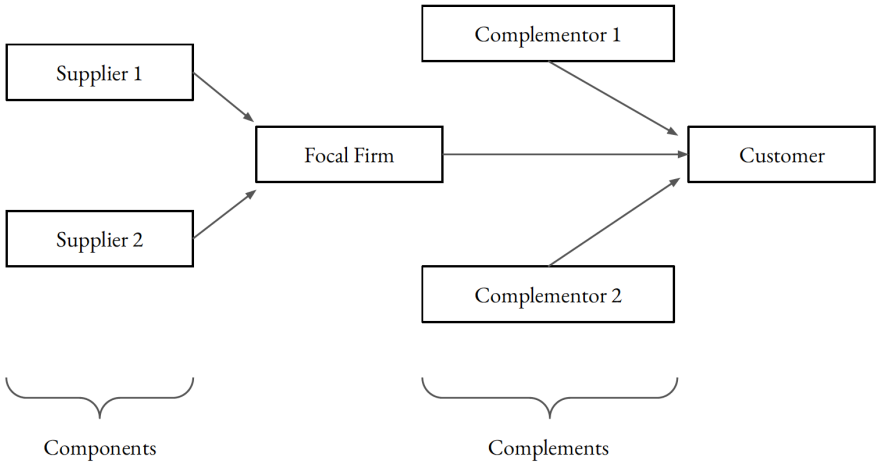

Figure 3: *Generic Schema of an Ecosystem (from Adner & Kapoor, 2010)*[2]

Ecosystem structures organize actors according to formal and informal rules given by the relative power positions of actors. This implicit form of governance allows for effective collaboration and specialization of actors according to capabilities and resources to contribute to a common value proposition. While former research referred to ecosystems as mainly not hierarchically managed due to the collaborative nature and mutual dependence, recent work has provided a more differentiated view. Scholars like Teece (2014) have

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highlighted formal instruments like standards and interfaces that central actors may use to discipline and incentivize others. Others (e.g., Cennamo & Santalo, 2013; Alexy et al., 2013) added platform governance and property rights as a means to actively manage ecosystems.

2.2.2 Development of ecosystems over time

The ecosystem construct can also serve to explain developments over time by applying a processual view. Initially, Moore (1993) presented four stages of development closely related to the ecological heritage of the term: birth, expansion, leadership, and self-renewal or death. Another classification was provided by Möller et al. (2020), who proposed three emergence phases: exploration, mobilization, and stabilization. Analogously, Dedehayir et al. (2018) explicitly focused on the emergence and influence of different roles in an ecosystem's genesis and defined three phases, being (1) *preparation*, (2) *formation*, and (3) *operation*. Table 2 provides an overview of the phases.

Preparation	Formation	Operation
• creation of necessary conditions to stimulate the genesis process • identification of user need • building of a platform • initial contact with actors • preliminary definition of roles • preparation of resources for the innovation process	• development of shape and purpose for the innovation ecosystem • enabling of interaction between actors • opening of the platform • potential redefinition of roles • creation of a network of actors	• achievement of holistic value creation • orchestration of collaborations and resource flows by a central actor • provision of value by enabling roles via components and complementarities • users realize value in adopting offering

Table 2: *Ecosystem emergence phases (adopted from Dedehayir et al., 2018)*

Most definitions see a well-established player as the originating point for an ecosystem (Iansiti & Levien, 2004a). A dominant explanation is their access to critical resources and the existing relationships with core members that may contribute to a joint value proposition. Through this position of power, the corporate may appear as a strategic designer of an ecosystem (Tsujimoto et al., 2018). Nevertheless, studies have also revealed that ecosystems can emerge autonomously without a dominant actor (Zahra & Nambisan, 2012; Tsujimoto et al., 2018). Moreover, few researchers have investigated the role of startups in ecosystem genesis or transformation (Fehrer & Wieland, 2021).

The realization that ecosystems are not only shaped by external conditions but may also be actively shaped from the inside by a given actor potentially benefiting from improving its position within the ecosystem or driving the development of the whole system led researchers to propose ecosystem strategy as a new discipline to management (Adner, 2017). Engaging in ecosystem strategizing means considering an organization's actions in relation to its embeddedness in an ecosystem context and the shared and individual interests of the ecosystem's members (Jacobides et al., 2018). Snihur et al. (2018) proposed an ecosystem-level process model on business model disruption. The scholars applied Christensen et al.'s (2015) definition of disruption and revealed a virtuous framing-adaptation cycle leading to business model

innovation via a startup in which framing is emphasized as a strategic tool. Autio and Thomas (2018) discuss endogenous strategies during ecosystem emergence that involve manipulating and effectuating the ecosystem's micro-institutional logics towards one's strengths and arriving at a shared vision of the ecosystem value proposition.

2.2.3 Collaboration in Business Ecosystems

An ecosystem consists of interactive, multilateral connections between actors (Adner, 2017). Given the variety of potential actors and the consequential diversity of interests, resources, and capabilities, a multitude of modes and forms of collaboration occur in ecosystem contexts. Through collaboration, actors co-create value according to a common proposition (Adner & Kapoor, 2010). Thereby, it allows members of an ecosystem to specialize in complementary contributions, which in turn creates 'technological interdependencies' (Kapoor & Furr, 2015). This constitutes a mutual dependency logic that separates ecosystems from other concepts like markets and hierarchies (Autio & Thomas, 2018). Coordination among actors is crucial as weak coordination within an ecosystem will cause innovations to fail (e.g., Adner, 2012; Kapoor & Lee, 2013; West & Wood, 2014). Mutual agreement among actors concerning their relative positions and exchanges determines the alignment structure, which is managed via an actor's '*Ecosystem Strategy*' (Adner, 2017).

Jacobides et al. (2018) introduced the concepts of *complementarity* and *modularity* as determinants for actors' collaboration and coordination behavior and relative power positions. *Complementarity* is defined as the degree to which the resources contributed by members complement each other towards the joint value proposition, which causes dependencies among them. *Modularity* refers to the interchangeability of members based on the uniqueness of the modules they contribute. Connected to the relative power positions is also the actor's value capture potential (Partanen & Möller, 2012). Platform providers may exploit their powerful position to capture substantial value. Depending on complementarity and modularity, relationships in platform-like arrangements are often not at arm's length, complicating the situation for substitutable complementors or startups (Rochet & Tirole, 2003).

Heuer (2011) stressed the relevance of managing power asymmetries effectively as collaboration in ecosystems could fail (see also Gardner et al., 1990). For a well-functioning ecosystem to render successful systemic innovation, mutual trust has been highlighted as a critical determinant (e.g., Heuer, 2011; de Groote & Backmann, 2019). Sjödin et al. (2020) investigated value creation and value capture alignment in business model innovation contexts and highlighted the need for an ecosystem perspective that exceeds dyadic relationships. In line with them, Oskam et al. (2021) looked at the tensions concerning value in innovation ecosystems trying to establish sustainable business models. They found conflicts between value creation vs. value capture, mutual value vs. individual value, and gaining value vs. losing value. Complications occur, as actors are unevenly affected by these tensions. Following the aforementioned propositions by Oskam et al. (2021), a common value system integrating the interests of multiple players, including startups and incumbents, is a fundamental condition for flourishing startup-incumbent collaboration in ecosystems.

Overall, little research has been conducted on the role of startups in ecosystems. Hence, literature provides few insights into how startups collaborate with other, more mature organizations within ecosystem settings (Aggarwal & Wu, 2018). However, complementarity between assets of incumbents (e.g., capital, infrastructure, relationships) and startups (e.g., intellectual property, technology) has been highlighted when considering their collaboration in ecosystems (Aggarwal & Wu, 2018).

2.3 Synthesis & Research Gaps

The literature review provided an overview of the current state of relevant research streams. The research interest of this study lies at the intersection of these fields. A brief synthesis of the presented literature is provided to outline and specify the identified research gaps, which aims to divide the initial research interest into more precise sub-questions. This part also illustrates our underlying assumptions, which are subsequently synthesized and merged into a theoretical framework that guides our research.

Circular Economy is a new economic paradigm that essentially aims to slow, narrow and close resource loops through the collaboration of multiple actors. CBMs are seen as a promising method to manifest circular strategies. The increased complexity of circular value propositions requires companies to increasingly pursue CBMI in collaborative contexts. Due to the multilateral nature and the interconnectedness of actors and their business models, an innovation ecosystem perspective is best suited to reveal the relevant dynamics in the shift towards circularity. To that end, Circular Ecosystems describe innovation ecosystems that realize circular value creation. Here, Circular Ecosystems are understood as dynamic structures of interconnected actors that are evolved and extended through CEI which fundamentally describes CBMI on the meso-level. CEI causes changes to the structure and governance of the ecosystem, the roles of actors, and finally to the underlying value generation logic. To date, only a few studies have pushed the scope of CBMs to the ecosystem level.

At its core, promoting the circular economy is an innovation problem. Drawing on disruptive innovation theory, startups are best suited to engage in CBMI, as the internal logic of incumbents makes radical departures and systemic change towards circularity more difficult. Consequently, startups may play a decisive role in the emergence of Circular Ecosystems by offering solutions to complex problems not addressed by incumbents. Due to the inherent focus on resource loops, collaboration between incumbents and startups is likely necessary for a successful transition towards the CE (Figure 4). Until now, the role of startups in Circular Ecosystem Emergence has not been explored in detail. The focus on incumbent-centric studies stems from applying a resource based view and concerns both the ecosystem and CBM literature. We challenge the premise that primarily incumbents can bring about CEI, and the assumption that ecosystem orchestration is exclusive to large incumbents.

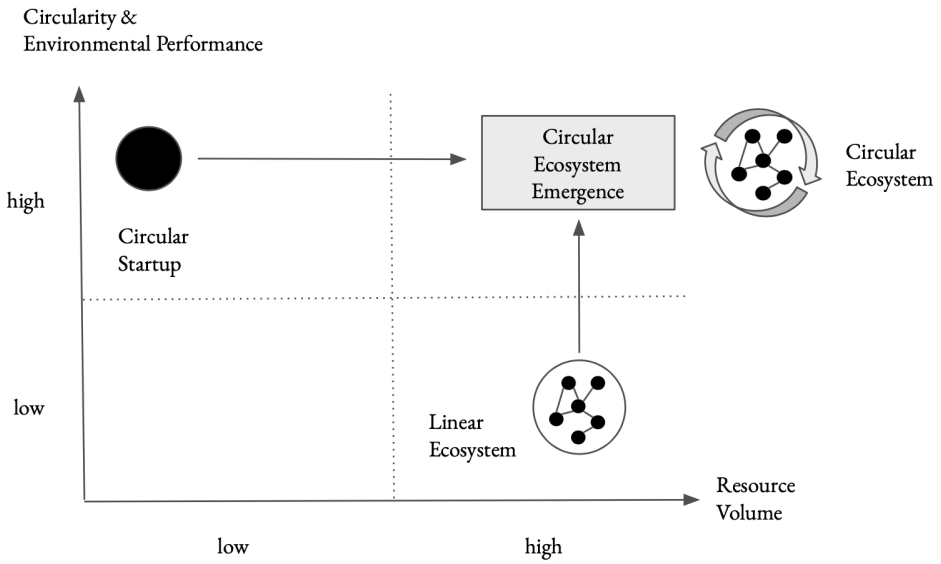

Figure 4: *Co-evolution of circular startups and market incumbents towards Circular Ecosystem emergence* (adapted from Hockert & Wüstenhagen, 2010)

The review of the existing literature reveals three major theoretical gaps. First, researchers call for an ecosystem lens to be cast on circular business models and their innovation. Second, the role of startups in Circular Ecosystems remains underresearched. Third, startups' active involvement in CEI processes has not been sufficiently explored. An overview of authors highlighting these gaps can be found in Figure 5.

Research Gap		Authors highlighting Gap	Addressed by
Gap 1:	Ecosystem perspective on Circular Business Models	Boldrini & Antheaume (2021); Fehrer & Wieland (2021); Geissdoerfer et al. (2020); Gomes et al. (2018); Konietzko et al., (2020); Madsen (2020); Oskam et al. (2021); Parida et al. (2019)	Study setup
Gap 2:	Role of Startups in Circular Ecosystems	Aggarwal & Wu (2018); Dedehayir et al. (2018); Fehrer & Wieland (2021); Valkokari et al. (2017); Veleva & Bodkin (2018)	RQ 1
Gap 3:	Startups as agents in Circular Ecosystem Innovation processes	Aggarwal & Wu (2018); Fehrer & Wieland (2021); Geissdoerfer et al. (2020); Henry et al. (2020); Möller et al. (2020); Veleva & Bodkin (2018)	RQ 2

Figure 5: *Research Gaps*

The initial research interest can now be further refined as a result of the literature review. Thereby, the synthesis has implications for the setting but also the research design and methods of our study. Overall, the setting of the study will cast an ecosystem lens on Circular Business Models. This thesis aims to narrow the first gap by exploratively illuminating the space and by providing a structured agenda for subsequent studies

to populate this nascent research field. The latter two gaps represent specific subsections of the former research interest and will be addressed by the following two refined research questions:

Research interest**:** How do startups influence the emergence of Circular Ecosystems?

RQ1: *What roles do startups take on in Circular Ecosystems?*

RQ2: *How do startups strategically shape Circular Ecosystem Innovation?*

2.4 Theoretical Framework

This study considers Circular Ecosystems as Innovation Ecosystems that place circular value creation at their center. CEI is considered an ongoing process that aligns the interwoven business models of all stakeholders, changing their roles and governance structures, hence impacting value creation and capture.

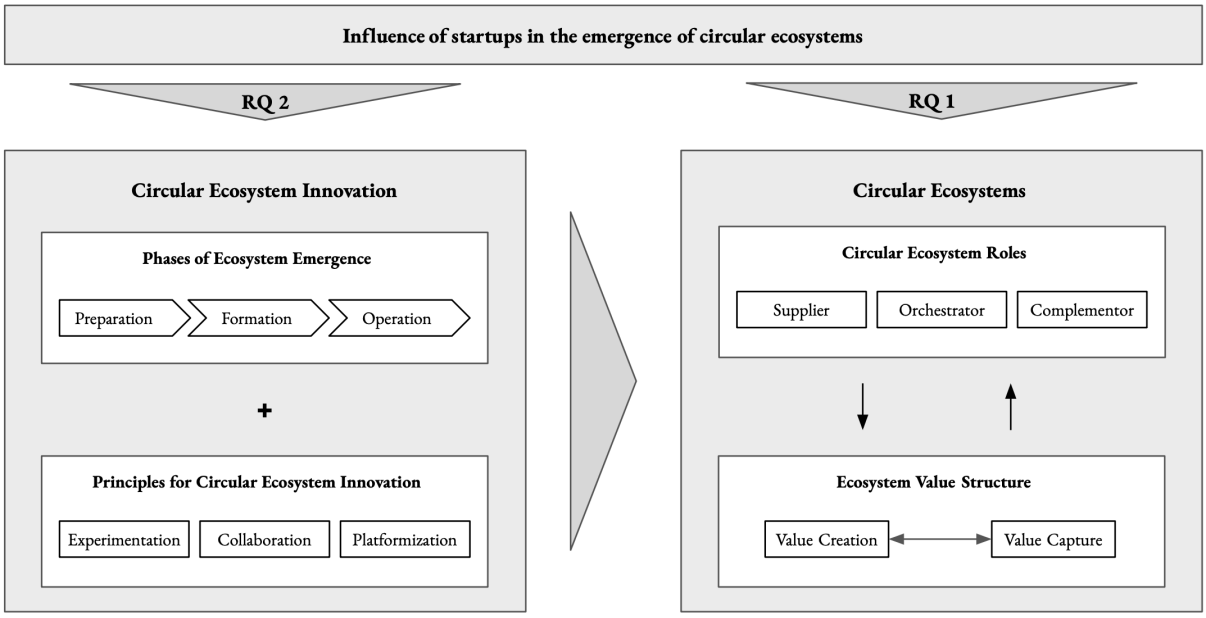

Figure 6: *Theoretical Framework*

Given the aforementioned research interest, which has been operationalized in the two research questions, the theoretical framework integrates relevant concepts from the reviewed literature streams that guide and structure the empirics (Figure 6). Corresponding to the research questions, the influence of startups is investigated from a structural (i.e., Circular Ecosystems) and a processual (i.e., Circular Ecosystem Innovation) perspective. Following the observation that CEI processes differ by ecosystem context, the structural (RQ1) will be preceding the processual perspective (RQ2) to allow for a differentiated analysis in the latter part.

Circular Ecosystems are further taken as dynamic structures of interconnected actors determined by the types of actors and their alignment structure. The analysis of startup roles in Circular Ecosystems builds upon the classical roles in ecosystem contexts being *orchestrator*, *complementor*, and *supplier* (Adner & Kapoor, 2010; Jacobides et al., 2018). As the context of circularity poses new complications requiring

additional value contributions in an ecosystem and as previous research has not focused on the roles of startups, this investigation could be expected to yield new roles or provide a more nuanced description thereof. The dynamics and outputs of Circular Ecosystems are dependent on the *ecosystem value structure* which is defined as the interplay of *value creation* and *value capture* processes. These processes depend on and influence the ecosystem structure. In the analysis of startup roles, this study will therefore employ the concepts of circular value creation and capture, to provide a comprehensive description of the roles in relation to their respective ecosystems.

Following the processual perspective, the thesis understands CEI as the innovation process that forms Circular Ecosystem structures. This process may appear closer to a transformation of an existing ecosystem or the emergence of a new one. Yet, based on the insight that circularity requires fundamentally new alignment structures, which in this work define an ecosystem, any process towards the formation of a Circular Ecosystem may be considered an emergence process as it will be distinct in form and function. The creation of circular value through closing, narrowing or slowing resource loops fundamentally alters the alignment structure of the ecosystem causing changes to actors and their value contribution. Accordingly, what has been described in previous literature as a transformation of existing linear ecosystems can also be understood as an emergence of a new Circular Ecosystem. In the further course, both the formation of new and transformation of existing ecosystems are considered as the emergence of Circular Ecosystems and are not further distinguished within the scope of this work. Consequently, this thesis investigates the behavior of startups along with different phases of ecosystem emergence as proposed by Dedehayir et al. (2018), namely *preparation*, *formation*, and *operation,* to investigate the influence of startups in the emergence of CEs. To structure the empirical findings, it draws on the three groups of CEI principles defined by Konietzko et al. (2020): *collaboration*, *experimentation*, and *platformization*. These principles provide the guiding framework for the analysis of cooperative settings between startups and other ecosystem actors. Based on this, the study aims to derive behavioral patterns applied by startups to actively shape collaborative settings towards Circular Ecosystems.

2.5 Conceptual Delimitations

The theoretical framework is built on the concept of Innovation Ecosystems, which in the literature is quite narrowly defined around value contribution, while the analysis also includes value capture and actors from the macro layer such as governments which only indirectly affect value contribution. Applying an ecosystem lens, this research focuses primarily on multilateral relationships, neglecting dyadic cooperation and agreements, allowing to capture more of the ecosystem mechanisms. Similarly, the startup's business model is subordinate to its value contribution and role in the ecosystem.

Further, the framework does not focus on the nested nature of ecosystems; instead, this study considers mostly one single ecosystem at a time. The setup only includes ecosystems in which startups play a role, neglecting large companies that realize circularity within their boundaries. Another limitation is that CEI is mainly viewed from the perspective of startups. While the strategies are all relative to the ecosystem, they also relate to the individual role and situation of the startup. The roles and behaviors of other ecosystem actors are not examined.

Value delivery is not considered separately but rather as part of value creation as the focus lies mainly on the dynamics between circular value creation and capture. In terms of the circular value proposition, the framework does not address which type or combination of circularity principles is applied (Lüdeke-Freund et al., 2019).

3 Methodology

This section outlines the methodological choices made to address the previously outlined theoretical gaps. It begins with an outline of the applied ontology (3.1) before showing the research approach (3.2) and the individual methods (3.3). Finally, the quality of the study (3.4) is discussed.

3.1 Methodological fit

The review of the existing literature and its synthesis have revealed several theoretical gaps in the intersection of ecosystems and circular business models. Qualitative research methods have been deemed suitable to explore this interplay (Flick, 2018). To answer our research questions, we chose an abductive approach. This allowed us to combine empirical data with existing theory to explain potential dynamics and stimulate new concepts at the intersection (Arbnor & Bjerke, 2008). The abductive setting enables us to make a tentative guess based on the interplay between existing theories and data that is likely to uncover altered circumstances, additional dimensions, or false biases requiring the development of provisional new theories built on an inductive conceptualization (Timmermans & Tavory, 2012). We, therefore, position our research as positivist-qualitative where we assume an external and observable reality that we investigate through non-statistical means, inferring causal relationships between real elements and summarizing patterns into generalized findings by utilizing systemic qualitative research techniques that are in line with the scientific community to develop novel concepts (Su, 2018).

3.2 Research Approach

Since the subject of this study is relatively undeveloped, we wanted to gain a baseline impression of Circular Ecosystems. Hence, we conducted an explorative pre-study to find interesting phenomena related to ecosystems and startups. Due to the novelty of the field, this was helpful to choose the right theories and to guide the further research process. We conducted three observations and interviewed four experts from various industries and functional roles to get a broad picture. Several insights were obtained throughout the interviews. First, our assumption that startups can make an essential contribution to ecosystems was reinforced. Second, the ways in which startups contribute depend on the context of the industry. Thereby, we concluded that our research questions could not be answered in a generalist way, as the preconditions for CEI appear to vary widely across different ecosystem settings.

Similarly, startups seem to have different roles in Circular Ecosystems, which have implications for their value creation and capture. We, therefore, decided to follow a two-step approach. In the first step, we identify different startup roles and types of ecosystems based on several parameters that we then organize in a grid. In the second step, we deliberately choose cases for a multiple case study from that grid, treating the dimensions as independent variables to investigate behavioral patterns applied by startups to influence CEI and shape Circular Ecosystems.

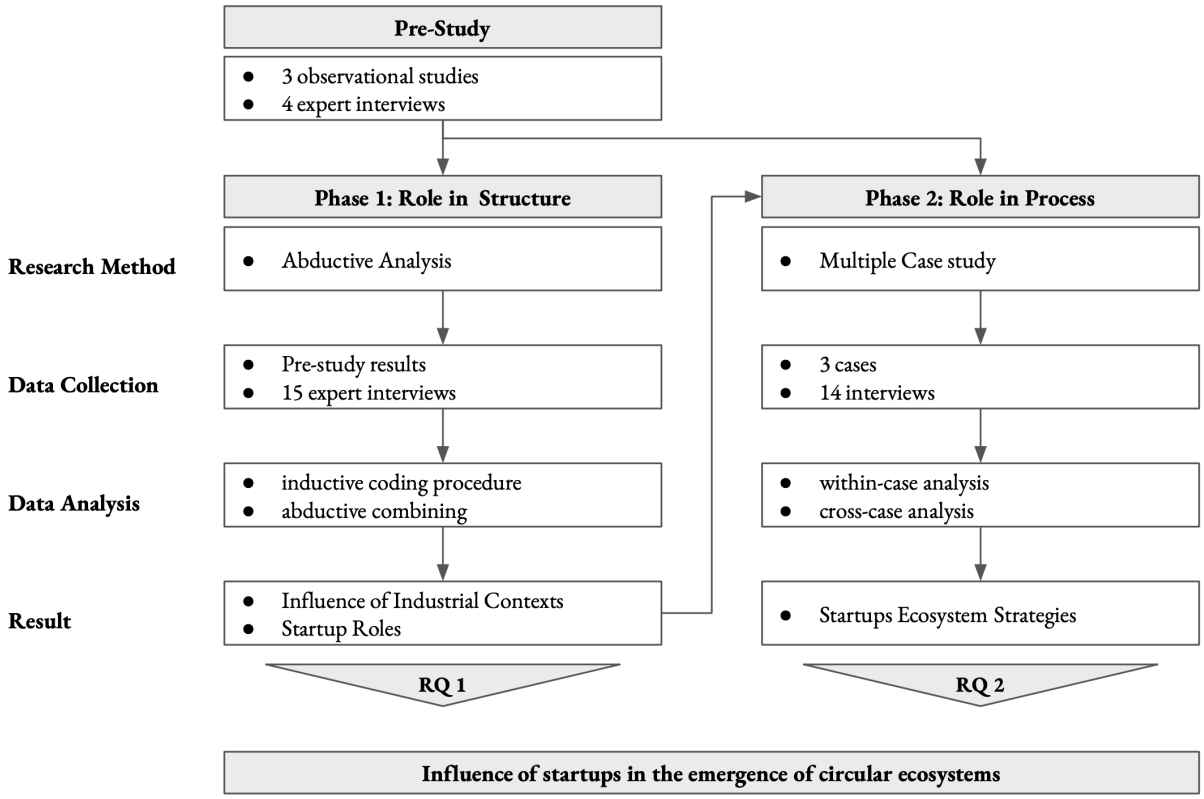

Figure 7: *Research Process*

3.3 Research Method

We applied an abductive analytical style to both parts in order to integrate relevant pieces of literature where we see empirical fit. Inductively derived concepts were compared to deductive concepts from the theoretical framework (Figure 7).

3.3.1 Phase 1: Abductive Analysis

The first phase was set up as an abductive analysis based on Timmermans & Tavory (2012). They position abductive analysis as a counter-proposal to grounded theory such that pure induction is replaced by an iterative process of imaginative thinking and checking theory (Charmaz & Belgrave, 2012; Suddaby, 2006). Thus, we simultaneously calibrated theory and the empirical context while iteratively fitting relevant concepts. This process was guided by the three elements of defamiliarization, revisiting, and alternative casing (Timmermans & Tavory, 2012):

> ***Defamiliarization:*** The data collection was accompanied by field notes, transcriptions, and extensive coding. In doing so, we take advantage of the fact that the transcribed text problematizes and crystallizes things that we would pass over in atextual contexts. Although it somewhat forfeits immediacy, the defamiliarized objects create a semantic distance enabling more detailed analyses (Timmermans & Tavory, 2012).

Revisiting: During the research process, we consulted the transcribed interviews multiple times, taking advantage of reevaluating and rethinking observations at different points in time. The situational specificity of reliving experiences allowed us to place our perceptions in new relationships to other phenomena and break the habituation of perception (Timmermans & Tavory, 2012).

Alternative casing: We also looked at the problem from different angles by including diverse perspectives on startups from different actors and industries. While some of these cases might resemble existing theories, others may be more difficult to assign. While our analytical framework is informed by theory, we can support abductive reasoning by defamiliarizing and revisiting different cases and contexts (Timmermans & Tavory, 2012).

3.3.1.1 Data Collection

Data collection was primarily based on semi-structured interviews with industry experts. The interviews from the pre-study were carried over into the first phase as the interviewees' were deemed suitable to the derived focus of the phase. We have used an interview guide to organize the data collection (Appendix A) that was subject to constant revision following emergent phenomena and themes found in the analysis. We later used triangulation to validate some of the findings, such as looking up startup business models and regulatory initiatives.

Interview	Country	Role	Company	Industry	Date	Duration
Interview 1	Europe	President	Industry Platform	Electronics	20.09.2021	32 min
Interview 2	Sweden	Sustainability Manager & Strategist	IT services firm	Multiple	27.09.2021	39 min
Interview 3	Norway	Startup Founder	Startup	Construction	29.09.2021	25 min
Interview 4	Sweden	Manager - Startup Acceleration	Incubator/Accelerator	Multiple	29.09.2021	65 min
Interview 5	Sweden	Recycling Broker	Self-employed	Construction	05.10.2021	42 min
Interview 6	Sweden	Consultant for CE	Self-employed	Fashion & Construction	05.10.2021	47 min
Interview 7	Germany	Sustainability Consultant	Consulting firm	Multiple	06.10.2021	41 min
Interview 8	Sweden	Manager - Corporate Scout	Incubator/Accelerator	Multiple	06.10.2021	35 min
Interview 9	Europe	Policy Officer (CE)	European Commission	Multiple	07.10.2021	54 min
Interview 10	Sweden	Startup Founder	Startup	Fashion & Electronics	07.10.2021	38 min
Interview 11	United Kingdom	Managing Partner	Venture Capital Firm	Packaging	08.10.2021	45 min
Interview 12	Germany	Consultant for CE	Self-employed	Fashion	11.10.2021	39 min
Interview 13	Sweden	Department Manager	Corporate Startup	Construction	12.10.2021	35 min
Interview 14	Norway	Startup Founder	Startup	Construction	13.10.2021	48 min
Interview 15	Sweden	Manager - Corporate Scout	Incubator/Accelerator	Multiple	14.10.2022	21 min
Interview 16	USA & Finland	Startup Founder	Startup	Packaging	15.10.2021	65 min
Interview 17	United Kingdom	Managing Partner	Venture Capital Firm	Packaging	15.10.2022	32 min
Interview 18	Norway	Head of Sustainability	Incubator/Accelerator	Multiple	18.10.2021	39 min
Interview 19	Germany	Chief Product Officer	Recycling firm	Multiple	20.10.2021	59 min

Table 3: *Interviews in Phase 1*

We purposefully sampled industry experts across different industries, roles, and companies to satisfy both the abductive process and create a bandwidth of views on the role of startups (Timmermans & Tavory, 2012). To that end, we used waterfall methods to spawn interviews with other exciting ecosystem participants. Table 3 presents an overview of the 19 interviews conducted with 17 interviewees. Among the interviewees were representatives from startups, incumbents, investors, consultants, incubators, and

accelerators. The interviews were conducted alternately, with one person working the interview protocol while the other collected field notes. In the end, the second interviewer had the opportunity to ask follow-up questions that emerged during note-taking. The interviews took place digitally, were held in English and German, and lasted 25 to 77 minutes at an average length of 44 minutes. The interviews were recorded upon the participants' consent. The number of interviews was deemed sufficient as we achieved knowledge saturation towards startup roles. Later interviews only yielded incremental insights concerning ecosystem differences.

3.3.1.2 Data Analysis

The analysis of the data started with the verbatim transcription of the recordings within 48 hours of interviewing to ensure that non-verbal and social cues were still on our minds. For this purpose, we used a tool called 'Trint' to facilitate transcription and the following coding procedure. The process was divided into several rounds in which the coding process was conducted independently by both researchers to increase the validity and objectivity of the method (Denzin, 1970). The first-level codes were generated purely from empirical data. In the second step, codes were compared, discussed, and merged, reaching a quick consensus due to large overlaps in the first-level constructs. Finally, first-level constructs were grouped into relevant overarching themes that were compared to the theoretical framework and matched when we saw empirical fit. An example of the coding procedure can be examined in Appendix B. When analyzing and reconciling the second-level constructs, it became clear that many of the constructs go beyond the theoretical framework. In particular, we found many constructs related to industry differences. This resulted in a division of the first phase into relevant industry differences and ecosystem roles. While the industry differences were inferred entirely inductively, we used the framework to match, refine, or extend ecosystem roles, thereby abductively building theory.

3.3.2 Phase 2: Multiple Case Study

In the second phase, we investigated how startups shape Circular Ecosystem Innovation. The pre-study had revealed that ecosystem settings (role + industrial context) have significant implications for the CEI process. Therefore, a multiple case study appeared especially suitable to examine the variety of contexts and derive similarities and differences between the applied behavioral patterns (Ridder, 2017). Hence, we were not exclusively aiming for analytical generalization via investigating similarities across cases (Yin, 2009) but embraced the importance of understanding the unique nature of the individual case (Ragin & Becker, 1992; Stake, 1995). In line with Yin (2013), our multiple case study is based on a priori investigation of theory to provide relevant evidence to narrow the intersection of those fields (Ridder, 2017).

3.3.2.1 Case Choice

We theoretically sampled cases based on the *Industry-Role-Grid* derived from Phase 1 (see Figure 14). Each case is defined as a particular ecosystem, meaning that the focus lies on the inter-organizational level. We maximized variety across cases by locating them in ecosystem settings that differed on both grid dimensions (i.e., industry and startup role) (Patton, 1990). Maximum variety sampling is applicable in examining variations due to different underlying conditions (Lincoln & Guba, 1985). Given the resource constraints of the research project, we purposefully chose three case settings that corresponded with the newly defined

roles stemming from Phase 1 (see Part 4.1.2). We further chose cases to vary in industry settings to optimize for the relevance of observed phenomena and to be able to differentiate across both dimensions of the ecosystem setting. Suitable case ecosystems within the chosen settings were derived from interviewees' recommendations from Phase 1. The cases are presented in Part 4.2.

3.3.2.2 Data Collection

For each case, we recruited three interviewees from within the case ecosystem. Thereby, we applied purposeful sampling to retrieve the first key informant from the startup company. In some instances, we were opportunistic in utilizing existing contacts of former interviewees to get access to suitable partners (Eisenhardt, 1989). Following the first interview, we then used a waterfall approach to derive further knowledgeable informants from either the same organization or other key ecosystem actors. While this allowed us to address relevant interviewees efficiently, a selection bias based on the referring person cannot be eliminated. To improve the validity of our empirical data, we triangulated them by additional interviews conducted with actors from the same role, industry, or both. This resulted in 14 interviews conducted in Phase 2 (see Table 4). All interviews were transcribed following the same principles as in Phase 1. Additionally, we also used interviews conducted during Phase 1 that fitted the respective ecosystem setting to contextualize and triangulate findings.

Interview	Country	Role	Company	Case	Purpose of Interview	Date	Duration
Interview 1	Netherlands	Startup Founder	Startup	(A) Construction Material Banks	Main interview	01.11.2021	59 min
Interview 2	Norway	Startup Founder	Startup	(A) Construction Material Banks	Triangulation (Horizontal Digitizer)	03.11.2021	50 min
Interview 3	Sweden	Architect	Architecture Firm	(A) Construction Material Banks	Incumbent perspective	11.11.2021	51 min
Interview 4	Netherlands	Member of Foundation	Startup	(A) Construction Material Banks	Main interview	16.11.2021	52 min
Interview 5	Netherlands	Startup Founder	Startup	(B) Fashion Traceability	Triangulation (Electronics - Vertical Digitizer)	01.11.2021	59 min
Interview 6	Sweden	Head of Sustainability	Startup	(B) Fashion Traceability	Main interview	08.11.2021	27 min
Interview 7	Sweden	Business Development	Startup	(B) Fashion Traceability	Main interview	12.11.2021	46 min
Interview 8	Sweden	Studio Manager	Incumbent	(B) Fashion Traceability	Incumbent perspective	15.11.2021	41 min
Interview 9	Germany	Startup Founder	Startup	(B) Fashion Traceability	Triangulation (Sustainable Fashion Brand)	16.11.2021	44 min
Interview 10	Germany	Project Manager	Industry Association	(C) Reusable Packaging	Main interview	28.10.2021	59 min
Interview 11	Germany	Startup Founder	Startup	(C) Reusable Packaging	Main interview	04.11.2021	56 min
Interview 12	Germany	Sustainability Director	Incumbent	(C) Reusable Packaging	Incumbent perspective	05.11.2021	55 min
Interview 13	Germany	Startup Founder	Startup	(C) Reusable Packaging	Triangulation (Indirect orchestrator)	08.11.2021	22 min
Interview 14	Germany	Startup Founder	Startup	(C) Reusable Packaging	Triangulation (Indirect orchestrator)	15.11.2021	38 min

Table 4: *Interviews in Phase 2*

The interview process was conducted analogously to the first phase. Based on the theoretical insights and the results from Phase 1, an interview guide was prepared for the semi-structured interviews and refined within the three different cases to allow for a comprehensive record of the case and give room to actor- and case-specific insights beyond a core set of questions (Appendix A). Data was collected and analyzed simultaneously, which allowed us to adapt to emergent themes and unique features of a case (Eisenhardt, 1989). Alternatively, a sequential analysis could have yielded possibilities for replication and stronger refinement of the constructs. A minimum of three interviews per case ensured complementary insights and allowed for triangulation within the cases to improve the internal validity of our findings.

3.3.2.3 Data Analysis

Following the transcription of the interviews, data were coded according to the procedure described in Phase 1 as can be seen in Appendix B. Both researchers engaged in parallel coding and within-case analysis, followed by cross-checks and discussions upon diverging interpretations of data (Flick, 2018). This form of investigator triangulation was employed to improve the validity of findings (Denzin, 1970). During this process, we iterated between the cases and emerging theory and tabulated evidence for each construct to sharpen its definition and validity (Eisenhardt, 1989). We followed a pattern-matching logic by constantly relating findings to the predefined theoretical framework (Ridder, 2017; Yin, 2009). The analysis for each case consisted of a structural description of the ecosystem, a conceptual formulation and condensation of behavioral patterns, grouped and ordered by emerging logical clusters, and a processual description of the CEI process within the ecosystem with references to crucial behavioral patterns. This approach allowed for successive explanation building during the within-case analyses. We further compared the resulting patterns with a preliminary list derived in Phase 1 to cross-check results and inspire later iterations of concept formulation.

Beyond the analysis of the three individual cases, we conducted a cross-case synthesis to derive case-specific and recurring, i.e., theoretically replicated concepts (Ridder, 2017). The theoretical replication of occurring similarities across case settings allowed us to propose more general behavioral patterns that may extend existing theory on startups' influence in ecosystem settings (Ridder, 2017). Meanwhile, the synthesis also analyzes differences and relates these to the formerly defined independent variables of the *Industry-Role-Grid*, i.e., the startup role and the industrial context. These findings were intended to inform future investigation on the context-specific nature of startup roles in CEI.

3.3.3 Ethical Considerations

To safeguard study participants and the integrity of the research, several ethical considerations were integrated into the study. We sought informed consent by first highlighting the voluntary nature of participation and informing participants about the purpose of the study and how their responses are processed ahead of the interview. Participants were explicitly asked for their consent to be included in the study and be recorded for means of transcription. Participants' requests regarding the exclusion of certain information were respected. Anonymity and confidentiality were guaranteed to increase the authenticity and truthfulness of the responses (Bell et al., 2018). Anonymity was also maintained between participants. Accordingly, interview participants and any personally identifying data were kept confidential. Instead, some generic information about the participant's location, role and company size are provided for context. In addition, case study companies are pseudonymized to impede any direct attribution. This mitigates the risk of financial or reputational damage that may be caused by disclosing information about the nature of partnerships, strategies and other sensitive information.

3.4 Quality of the study

We critically reflect on our study by discussing reliability, validity, and transferability. Although reliability and validity originate from quantitative studies, they have been deemed acceptable for qualitative research (Flick, 2018). Further, transferability has been added since it appears reasonable in the context of a multiple case study.

3.4.1 Reliability

Reliability deals with the quality of the data collection and the methods of measurement (Bell et al., 2018). We increased the reliability of data collection through a pre-study that informed the guide for the semi-structured interviews of Phase 1, thereby adding to the precision of the data collection. Likewise, Phase 1 informed the interview guide for Phase 2 as previous interviews with actors from the same role or industry could be used to improve question design. Further, the detailed description of the methodology employed in each phase contributes to the transparency and internal reliability of the method. Through recording and transcribing the interviews, we derived a transparent and reliable data foundation (i.e., defamiliarization) which allowed us to reiterate and check our interpretations (i.e., revisiting) from the empirical data (Timmermans & Tavory, 2012). However, due to the focus on CEI in Phase 2, the possibility of replicability is relatively low since social settings are of temporary nature. The external reliability of startup roles is higher since the chances of encountering similar archetypes are significantly increased.

3.4.2 Validity

Validity addresses the integrity of the drawn conclusions and the representation of the phenomena by the researchers (Bell et al., 2018). Generally, qualitative studies are more prone to validity issues because the analysis is based on individual researchers' interpretation (Bell et al., 2018). The essential concern is whether the researchers' data production has been subject to any conscious or unconscious reason to construct a distorted version of reality.

Internal validity refers to the congruence between the researchers' observations and the developed theoretical ideas. This was strengthened by the number of interviews across roles, sectors, and geographies. By sampling for maximum variety, obtained data could be triangulated from other ecosystem actors or actors occupying the same role in another geography (i.e., Alternative Casing; Timmermans & Tavory, 2012). The interviews were collected from various European countries (e.g., Sweden, Norway, Germany, Netherlands, United Kingdom), reducing geographical bias in data production, primarily improving the validity of industry differences and startup roles. Although impossible to completely eliminate, we reduced the risk of biased interpretations by defamiliarizing and revisiting the interview data (Timmermans & Tavory, 2012) and analyzing the data individually before comparing and discussing our respective views.

3.4.3 Transferability

Transferability or external validity concerns to which extent findings are transferable to other contexts beyond the examined setting. Lincoln & Guba (1985) suggest that researchers should clearly state the empirical context of the study, so that others can make judgments about transferability to other contexts.

The study clearly outlines industry differences that should facilitate the transfer of roles and strategies. While the roles were observed across multiple industries (Phase 1), transferability of the applied CEI strategies is limited. Yet, careful attention has been paid to describe the situation in as much detail as possible. The subsequent cross-case analysis (4.2.4) revealed common strategies and challenges across the different ecosystem settings suggesting a higher external validity. However, the small sample size does not allow us to draw definitive conclusions.

4 Results

This part presents the empirical findings of the two phases. In the first phase (4.1), conditions for circularity across industries are compared before identifying roles that startups can occupy in Circular Ecosystems. The second phase (4.2) then picks cases from an *Industry-Role-Grid* (4.1.3) to investigate startups' strategies in Circular Ecosystem emergence. The subsequent synthesis (4.2.4) discusses behavioral similarities and differences across roles and industrial contexts.

4.1 Phase 1: Role of Startups in Circular Ecosystems

During the analysis, it has become evident that there are significant differences between industries in terms of circularity (see Table 5). Therefore, variances between the industries are delineated to facilitate the placement of the roles in the various contexts. These differences also have substantial implications for the strategic behavior of the startup roles in Phase 2.

	Industries		
	Fashion	**Construction**	**Packaging (FMCG)**
Legislation			
Level of Regulation	low	very high	moderate
Legislative Pressure	moderate	high	high
Regional Fragmentation	low	high	moderate
Industry Logic			
Innovation Cycles	very short	long	long
Level of Strategic Planning	moderate	low	high
Margins	high	low	very low
Market Characteristics			
Level of Digitalization	moderate	low	low
Resource Scarcity	low	high	low
Market Stability	low	high	high
Centrality of Power	high	low	high
Scope of Supply Chain	global	global	national
Product Characteristics			
Product Complexity	low	high	low
Product Lifecycle	short	long	very short
Environmental Footprint per Unit	moderate	high	low
Role of Customer			
Consumer Awareness	high	low	high
Consumer Proximity (B2B/B2C)	high (B2C)	low (B2B)	high (B2C)
Customer Involvement in CBM	high	low	high

Table 5: *Industry Differences*

4.1.1 Moderating Influence of Industrial Contexts

The focus lays on the construction, fashion, and packaging industry as the most relevant to achieving circularity. This selection matches the focus industries defined by the European Commission (2020), which were picked based on urgency and potential benefits. From the interviews, factors were inductively derived that appear to differ across industries and clustered by abstraction level in descending order: *Legislation, Industry Logic, Market Characteristics, Product Characteristics,* and *Role of the Consumer*. Independent of industry, legislation was frequently named a key driver, as was the link between circularity and digitization.

While some factors differ only in strength, others are fundamentally disparate. Drivers and barriers that were found parenthetically during the interviews but are beyond the scope of this study can be found in Appendix C.

4.1.1.1 Fashion

The fashion industry is not very regulated, barely fragmented, highly modular, and characterized by rapid innovation cycles and global supply chains. Most products are designed for disposal, while trend cycles often constrain their effective use period. Fashion products are relatively simple and mainly differentiated via brand and aesthetic factors. A strong brand allows for relatively high margins, but there are also brands that have highly efficient supply chains and are volume-oriented ("fast fashion"). Brands occupy a powerful position within supply chains. The importance of brand also implies high consumer proximity. Consumers are increasingly exerting pressure on the industry to become more sustainable. Proving sustainable behavior to consumers can be a competitive advantage. At the same time, consumers must be incentivized to participate, as they have to return their garments.

4.1.1.2 Construction (Materials)

The construction industry is characterized by a very high level of regulation, making the industry inert and predominantly risk-averse. As one of the most polluting and resource-intensive industries, it is high on the agenda of policymakers which are establishing first quotas for secondary materials. Overall, construction is a highly traditional industry showing low levels of strategic planning and digitization, which also stands out due to its project-based nature. Long innovation cycles and product lifetimes lead to high cost pressure, slowing the adoption of the CE. Due to the high complexity and variety of buildings, the cost-effective requalification and valuation of secondary materials still poses a significant problem. This is due to a lack of knowledge about the quality, quantity, and timing of materials. Most of the industry operates B2B, which means that consumers hardly exert any pressure.

4.1.1.3 Packaging (FMCG)

Packaging as a sector spans several industries but is limited to FMCG goods for this case. Distribution is mainly carried out by food retailers, who hold a powerful position in the ecosystem. The industry faces mounting pressure from both governments and consumers due to the high awareness of plastic pollution. The low complexity and short lifecycle make packaging a low-cost commodity, where circular alternatives often substitute and compete with disposable packaging on price. The latter is especially cheap due to economies of scale and a high degree of standardization. This, in turn, has enabled food retailers to make substantial infrastructure investments to optimize process efficiency to compete on tight margins (about 1%). However, these infrastructure investments lead to temporary lock-ins, which do not account for the complexity of reverse logistics yet. Circular packaging is mostly not yet profitable due to this scale issue and the adherence to highly efficient linear processes. Circular packaging also heavily relies on customer participation. Incentivizing customers is often tricky because packaging appears very ubiquitous. Also, the customer experience is highly dependent on where and how products can be returned, which also calls for standardization and widespread adoption across retailers.

4.1.2 Startup Roles in Ecosystems

The analysis was guided abductively by the existing roles of the orchestrator, the complementor, and the supplier. These roles usually delineate the position of power as well as value creation and capture potential. Roles were divided into *enabling* and *orchestrating*, depending on a role's orchestrating power, i.e. its capacity to initiate and coordinate collaboration. In essence, all roles are found to drive circularity. *Enabling* roles facilitate Circular Ecosystems by adding to the joint value proposition and facilitating collaboration. *Orchestrating* roles actively shape the value proposition, bring together actors and coordinate the value structure of the ecosystem.

Table 6 presents the identified startup roles together with a high-level description of value creation and capture activities. In addition to the three known roles, the *Vertical Digitizer*, the *Horizontal Digitizer*, and the *Indirect Orchestrator* were added. The *Substitutor* role replaces the *Supplier*, contributing circular supplements to suppliers components while holding a similar role in the alignment structure of the ecosystem. The roles were ordered according to their value creation potential, from low orchestration power on the left to full orchestrating power on the right. It became clear that startups can promote CEI through a high level of digitization independent of role. In particular, *Digitizers* enable ecosystems through technological solutions enhancing collaboration and circular value creation. Data interfaces crucially facilitate ecosystem communication. Another insight is that roles are temporary; due to the attractiveness of the orchestrator role, startups often strive to move from a secondary role into direct orchestration. In the following, descriptions of the roles are accompanied by visualizations, in which the respective role is marked by the black circle (Figure 8-13).

	Roles					
	Enabling			**Orchestrating**		
	Substitutor	Complementor	Vertical Digitizer	Horizontal Digitizer	Indirect Orchestrator	Direct Orchestrator
	Low orchestrating power					Full orchestrating power
Description	enters an existing value chain and introduces circular alternatives	complements a circular value proposition by adding to the core offering	offers tracing solutions for products or materials along value chains	offers a platform for aggregated product and material data	initiates and operates a collaboration platform for actors to promote ecosystem emergence	establishes and coordinates the circular ecosystem
Value Creation	similar to existing system; replaces a product or component by a circular solution; module fulfills same function as the subsituted component; additional value is provided on sustainable dimensions	adds additional value to the ecoystem by complementing the focal actor's value contribution; allows the shared value proposition to become viable towards the customer	allows for transparency across value chains promoting trust among actors; traceability of products and materials enables for end-to-end monitoring of resource streams and an optimization of resource loops and can promote economic viability	aggregates data on resources in a database to drive transparancy over the supply of products and materials to various demand-side actors; thereby allows for matchmaking and transactions within the ecosystem driving circularity via promotion of reusing and recycling	initiates and oversees collaborative value creation activities; acts as a project manager and creates value through communication and alignment of actors to promote viabiltiy of circular value propositions without being directly involved in the closing, narrowing or slowing of loops.	central to the value creation; creates value through the orchestration of the circular ecosystem and by collaborating and integrating with other actors; depends on suppliers and complementors to realize circular value proposition and needs to attract them
Value Capture	bound to the value captured by the substituted componnet; more value capture possible if additional sustainable value is appreciated and priced in by the market	bargaining power towards focal actors depends on degree of complementarity and modularity; unique complementors may capture significant value; modularization drives commidization	does not own the data as a data processor, often charges based on data usage; may increasy value capture capacity by further integrating with core actors from the ecosystem (e.g. by providing data management software)	applies cost-based pricing to align actors interests; potential to capture additional value through offering augmented analytics and aggregated data; could potentially abuse position of power; trust building mechanism needed	fundamental to circular value creation but has limited control over it; does not capture value itsef but enables participating actors to increase value capture of their ecosystems; focus on coopetition between actors	may capture significant value due to central position ecosystem and value creation; may exploit dependency of other actors by diminishing their margins and capturing their value; yet needs to ensure their survival to sustain ecosystem

Table 6: *Startup Roles in Circular Ecosystems*

4.1.2.1 Enabling Roles

The *Enabler* has a peripheral role in the ecosystem enabling the functioning of the whole ecosystem by providing some capability without taking on any orchestration role. This role may be further classified according to the position in the supply chain relative to a focal actor, resulting in a *substituting* and a *complementing* role. Both these roles have been highlighted in previous research, i.e., the supplier and the complementor. The *Vertical Digitizer* primarily digitizes the value chain, thereby allowing actors across different levels to collaborate and share data.

i) Substitutor

Substitutors offer an alternative component for a linear supply chain. They appear as a supplier to a focal actor, replacing a linear component with a circular solution, thereby improving the environmental footprint of the focal actor's products (Figure 8). The *created value* is similar to the previous system before the substitution. In a functional sense, it is generally bound to the value created with the substituted linear component. However, additional value is provided in retaining some of the inherent material value and improving the attractiveness and branding of products.

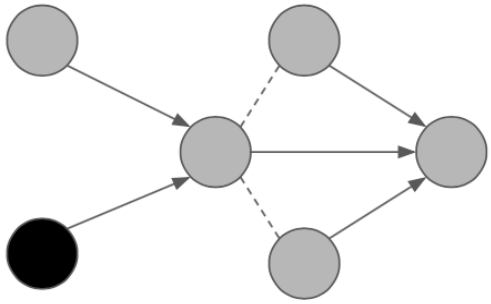

Figure 8: *Substitutor Role*

The *value capture* of a system involving a substitutor may be extended via increased value creation and reduced costs. Value is created at reduced environmental costs, making the value system more resource-efficient. This additional environmental value may be translated into economic value capture if the demand-side appreciates the value and therefore shows an increased willingness to pay (i.e., pricing in the positive externalities). Moreover, a circular substitute can further increase the value of a given brand, which may then materialize economically in the long run. On the other hand, costs related to legislation, like a carbon tax, can be avoided or reduced, directly reducing the costs of the value created.

A key challenge to the substitutor is the economic efficiency of the substituted component, which competes with linear, often cheaper solutions. As focal actors commonly base supply decisions on economic factors optimizing for short to medium term, it can be challenging for substitutors to appear as economically viable options, hence, be integrated into an existing ecosystem.

ii) Complementor

The complementor has a peripheral role in ecosystems. Yet, it can contribute essential pieces to the value proposition. This actor complements or supplements a circular value proposition by taking over specific responsibilities that either enable the ecosystem by enhancing the value or eliminating complexity and risk (Figure 9).

These can be additional services or combinable products, usually offered on the focal actor's platform and integrated into the product. Sometimes though, complementors can ease CEI. Examples would be insurance for servitization and sharing models or third-party cleaning services for packaging that make it easier to get started. Thus, these actors tend to have more influence than substitutors as they enrich ecosystems by supplementing additional services and functions.

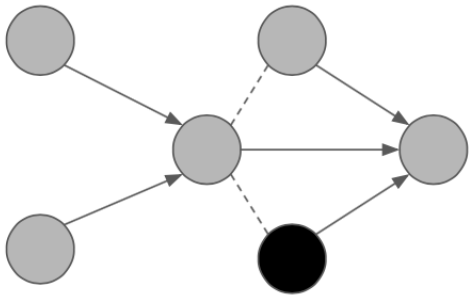

Figure 9: *Complementor Role*

In terms of value capture, their bargaining power depends on the degree of complementarity and modularity. While the substitutor tends to replace its linear predecessor, the complementor enriches and grows the ecosystem, extending the value creation horizontally. Complementors benefit from growing the ecosystem and encouraging central actors to integrate the products more profoundly.

iii) Vertical Digitizer

The *Vertical Digitizer* offers traceability solutions for products or materials along value chains (Figure 10). In addition, they may enable certain actors via integrated software solutions to better manage resource loops. For this role, the protection of the transferred data is crucial. Thus, the offered solutions rely on sophisticated encryption technology to secure sensitive information.

The *Vertical Digitizer* allows for transparency across value chains, promoting system-wide trust, a decisive determinant for collaboration within an ecosystem. In this manner, the role indirectly impacts the value co-creation of the ecosystem actors by enabling collaborations or the intensification of existing ones. In addition, the traceability of products and materials allows for end-to-end monitoring of resource streams. It can thereby optimize resource loops, improving the economic viability of circular value propositions.

As a data processor, the *Vertical Digitizer* commonly does not own the data, which puts them in a supporting position to the other actors in the ecosystem. This poses a limitation to the value capture of any

startup holding this role, which may be further affected by the appearance of competing solutions entering at various value chain steps, trying to establish their standards. A critical strategic question regards the degree of openness of the solution towards other, competing solutions. *Digitizers* are usually compensated based on the use of the technological infrastructure, thereby benefiting from ecosystem growth and a consequent increase of transaction volumes. Startups holding this role can increase their value capturing capacity by further integrating with one or several actors from the ecosystem, e.g., by providing data management software. This may yield additional revenues, create lock-in effects, and improve the bargaining power in the long run.

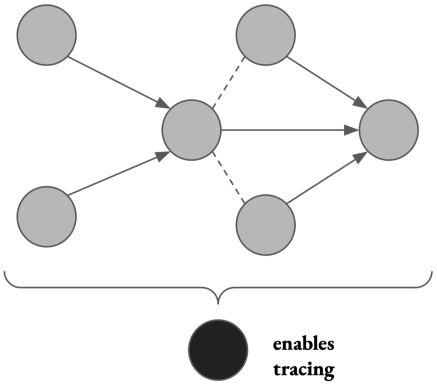

Figure 10: *Vertical Digitizer Role*

4.1.2.2 Orchestrating Roles

Orchestrating roles take on focal positions in an ecosystem. They are central to value creation by bringing together different actors and are instrumental for communication and collaboration. Due to their centrality, these actors gain influence and power in the ecosystem, which results in the potential to capture greater value. There appear to be three different orchestrating roles that differ regarding their contribution to value creating and capturing processes. This further relates to different qualitative levels of orchestration that include the coordination of information, resources, or both.

iv) Horizontal Digitizer

The *Horizontal Digitizer* offers an industry platform for product and material data. It aggregates data on resources in a database and makes them accessible to other ecosystem actors, creating transparency in formerly fragmented and inaccessible markets.

In making relevant data on product components accessible to other actors, the *Horizontal Digitizer* creates a market for suppliers of used products and their materials on the one end and a potentially diverse demand side of actors reusing or recycling the products and materials (Figure 11). A core competency of any startup taking on this role is the matchmaking of the involved parties, which depends on structuring and effectively presenting the data to reduce process costs for the demand side. Likewise, the *Horizontal Digitizer* needs to ensure critical masses on all ends of the platform for network effects to occur by motivating actors to participate. Additional value can be provided by offering aggregated insights or analyses and predictions of quantities or material compositions for other products based on existing data. These may be relevant to the same or additional actors, such as policymakers or producers of products. Due to the potentially sensitive

nature of the product-related data, an effective roles and rights system may be needed to protect the interests of the supplying actors.

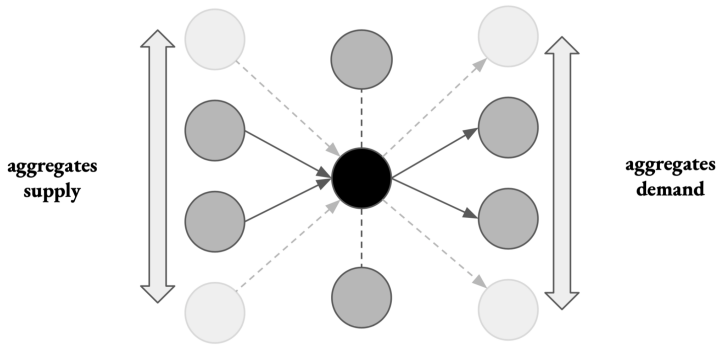

Figure 11: *Horizontal Digitizer Role*

As a platform provider, the *Horizontal Digitizer* holds a potentially powerful, orchestrating position. It may in some setups charge actors on both ends for either storing their data or by accessing it. The orchestrating role may implement a common marketplace business model, meaning an ability to charge fees for any occurring transaction. In such a setup, the powerful platform provider may develop the capacity to abuse its dominance and diminish the margins of the other actors. However, the dynamics and power relations between the actors forming the ecosystem usually do not allow this to unfold. On the contrary, a trust-building mechanism or governance model may be necessary to convince them to collaborate via the *Horizontal Digitizer*.

v) Indirect Orchestrator

The *Indirect Orchestrator* primarily manages the collaboration between different actors. Actors taking on this role engage in the initiation and operation of communication and collaboration platforms without participating directly in the value creation (Figure 12).

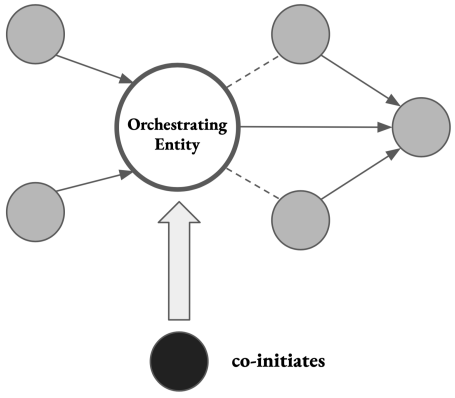

Figure 12: *Indirect Orchestrator Role*

Value creation is mainly undertaken by other roles. The collaboration and integration of different entities is managed and orchestrated via a shared external entity, causing the ecosystem to be de-facto decentralized. This setup may be necessary due to actors' reluctance to let an actor take on the role of the direct orchestrator, as such may capture value over-proportionally. The entity (jointly) run by the indirect

orchestrator serves as a body for standardization and booting risk out of one's organization. This means that companies can better allocate resources and time as multilateral cooperation is managed externally. One challenge, however, is the scale-up of various platform initiatives across the involved actors who are often too hesitant. Here, the power of the direct orchestrator to take the wheel and bear risks is missing. The indirect orchestration may take the form of industry associations or similar bodies. This role can also be temporary, for example, for the duration of a pilot. In addition, these actors often have political ambitions and are vocal in the political process using the power of the industry platform.

Although this actor is fundamental to circular value creation, the *Indirect Orchestrator* is usually not able to capture much value as this would limit the attractiveness for other actors to participate in the Circular Ecosystem. The entity tends to be funded through alternative methods such as licensing deals, issuing circular labels, flat service payments, and donations.

vi) Direct Orchestrator

The direct orchestrator is the most powerful and influential role in ecosystems. These actors occupy the focal position in the ecosystem and are central to value creation (Figure 13). They create value through the orchestration of the Circular Ecosystem and by collaborating and integrating with other actors. As mentioned earlier, this role is difficult to attain because it is highly contested. Especially for startups that are generally reliant on collaboration for resources, it may not be possible to step into this role from inception.

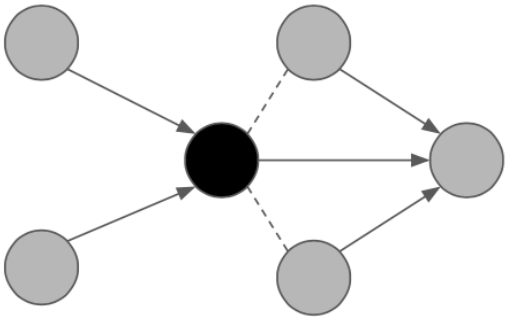

Figure 13: *Direct Orchestrator Role*

The direct orchestrator creates value by taking on complexity and risk by orchestrating the value creation between individual actors. This actor often also communicates with peripheral actors and oversees the entire process. Usually, some vital functions are performed by this actor, thereby contributing significantly to the narrowing, slowing, and closing of loops.

The direct orchestrator may capture much of the value due its favorable position in the ecosystem and being central to the value creation. *Direct Orchestrators* may organize ecosystems as multi-sided marketplaces, running platforms, thereby benefiting from each interaction (i.e. transaction) and ecosystem growth. As a result, they are difficult to replace.

4.1.3 Industry-Role-Grid

Based on the insight from the pre-study that a startup's influence on CEI is conditioned by the ecosystem setting, which is defined here as the combination of the industrial context and the role, results from this phase were combined to derive the *Industry-Role-Grid* (Figure 14). It states the foundation for the choice of cases in the second phase investigating startup's strategies in CEI (see also Part 3.3.2.1). The two dimensions are therefore treated as independent variables to understand strategies better. Cases are marked in the figure and were selected based on the newly identified roles (*Vertical Digitizer, Horizontal Digitizer, Indirect Orchestrator*) and spanning across industrial contexts. This grid is referred to in using the term 'ecosystem setting'.

	Enabling			**Orchestrating**		
	Substitutor	Complementor	Vertical Digitizer	Horizontal Digitizer	Indirect Orchestrator	Direct Orchestrator
Fashion			■			
Construction				■		
Packaging					■	

Figure 14: *Industry-Role-Grid*

4.2 Phase 2: Strategies for Circular Ecosystem Innovation

To fully capture the strategic behavior of startups in CEI, a processual view was applied that follows the genesis of the ecosystem. It was investigated how startups incrementally and strategically shape CEI across three distinct ecosystem settings to answer our second research question. The studied cases are outlined separately (4.2.1 to 4.2.3) before they are synthesized to capture similarities and differences, which are then contextualized based on the respective ecosystem settings (4.2.4).

Based on the theoretical framework, we initially intended to apply the ecosystem emergence phases (Dedehayir et al., 2018) in combination with the CEI principles (Konietzko et al., 2020) to structure behavioral patterns and abductively extend them through context-rich empirics. However, when analyzing the empirical findings, the existing CEI principles were too general and shallow to account for the chronological sequence and strategic depth of the actor's behavior and intentions. So, instead, we decided to use a set of inductively derived challenges that startups face across the emergence phases as a second structuring element to the observed strategies. Thereby, we sequentially coded case-specific challenges and subsequently derived clusters of common challenges recurring across ecosystem settings (Table 7). Although these common challenges apply across ecosystem settings, they may yield diverging strategies depending on the ecosystem context.

Accordingly, a set of *CEI Strategies* was derived that startups apply in addressing these challenges while following role-specific strategic objectives regarding value creation and capture and being constrained by their industrial context. These strategies are elaborated within the three cases, giving a hint at what challenges startups face over time and how they address them. With each case, a visualization of the applied

strategies is provided which is grouped by the ecosystem phases and the challenge they address (Table 8-10). The case descriptions refer to these strategies via a strategy code (e.g. A1). The presented strategies are denoted '*CEI Strategies*' as they originate from the startups' dominant objective to drive the emergence of its ecosystem. This entails endeavors targeting value creation, value capture, and the alignment structure of the ecosystem. The analysis yielded similarities and differences in applied strategies across cases, which are contextualized and analyzed in Part 4.2.4 The following case descriptions are accompanied by visualizations of the respective ecosystems in Appendix D.

Challenge	**Description**
Financing	Startups with Circular Business Models require funding to bridge the period until they can sustain themselves from their cash flows. Yet, their high dependency on other actors combined with their often limited value capture potential and high uncertainty regarding the scalability of solutions usually deter private investors.
Knowledge	As the creation of circular ecosystems is fundamentally an innovation problem, such endeavors are characterized by a lack of knowledge regarding applicable actions to take. Startups need to come up with innovative technologies, processes, and Business Models requiring substantial generation of new knowledge.
Awareness	Creating Circular Ecosystems means establishing multilateral relationships with and between sometimes previously unrelated actors. Hence, startups need to draw also large players attention to be able to initiate collaborations with them.
Convincing	The crucial task in forming the necessary collaborations to create the alignment structure of an ecosystem lies in persuading actors to join, i.e. to contribute value. This is often difficult as success is uncertain and there is no immediate business case that complies with the ROI logic applied by large firms.
Alignment	In order to deliver on the joint value proposition of Circular Ecosystem, the value contributions of the collaborating actors need to be carefully arranged to yield effective and efficient results. Further, there exist tensions between actors regarding the contributed values, and value capture on the other side, which have to be managed by a central actor to maintain mutual interests and ensure cooperation.
Scaling	For a Circular Ecosystem to have a real impact, it needs to be scaled and increase the volume of resources under management. Growing the set of actors can cause complications to the alignment structure, while further infrastructure and more refined processes are required with scale. Beyond the capacity of the Circular Ecosystem to deliver more value, sufficient demand for its offerings needs to exist.
Business Case	Circular offerings involve more complex processes and consequently yield higher process costs while requiring investments in infrastructure. At the same time, there exists not necessarily an increased willingness to pay. Consequently, achieving economic viability remains the core challenge of a Circular Ecosystem. In many cases, necessary investments and high process costs can be overcome only via economies of scale.

Table 7: Startup Challenges during CEI

4.2.1 Case 1: Vertical Digitizer in the Fashion Industry

'*Alpha*' is a *Vertical Digitizer* in the fashion industry, which provides the technical platform for the traceability of garments. The data platform started exclusively for the traceability of upstream supply chains but has now been extended for circularity by also tracking downstream loops (A9). The combination of upstream and downstream traceability enables fashion brands to repair and recycle garments by knowing the fiber composition and improving the design and purchasing towards durability. In addition, the *Vertical Digitizer* also collects other supply-chain-related information such as water consumption and CO2 emissions (A21), which helps the ecosystem with reporting and certification (A10). They add value by providing end-to-end transparency, which allows the ecosystem to optimize for durability, sustainability, and circularity. The ecosystem comprises fashion brands, their suppliers, repair shops, industry associations, and, in particular, the consumers. Consumers are increasingly aware of social and environmental issues, which allows fashion brands to charge a premium if they are able to prove and certify their sustainability efforts. Together with newly introduced CO2 reporting standards, it already forms an attractive business case for certain premium brands.

In the *preparation phase*, the actor strived for a pilot to develop and co-create a traceability solution for fashion supply chains (A3). Thus, they specifically approached front-runners in the field of sustainability, who place this at the heart of their brand values (A4). These actors were much easier to convince, particularly with brand-relevant storytelling elements (A5). The initial interest was leveraged as a tailwind to apply for public funding (A1), whose approval further increased the actors' willingness to enter the pilot (A2). Strategically, it was essential to design solutions that are compatible with the brands' existing digital infrastructure (A11). Within workshops, requirements and objectives were jointly defined, and the final solution was co-created accordingly (A6). Collaboration usually started with piloting and ended with embedding new functions in the platform for all users (A3, A12). Pilot companies can thus have more influence on the design. Circularity was a logical extension of traceability and was requested by strategic partners (A9). In addition, throughout the phases, the actor exchanges knowledge with vertical digitizers from other industries (A14), such as electronics or forestry.

In the *formation phase*, the fashion brands with their vocal power in the ecosystem ensure top-down that other actors join the platform. As this primarily creates value for the brands, *Alpha* charges them a use-based fee, while supply chain partners use the platform for free and are digitized in return for their collaboration (A13). *Alpha* then holds workshops to digitize the supply chain partners (A10). Within their pilots, they then involve relevant actors from the supply chain partners or repair shops for the case of circularity to ensure the scalability of the solutions since the data interfaces are critical (A15). Strategic attention is given to collecting data that enables the verification and certification of sustainability (A10). Overall, *Alpha* adapts to the needs of strategic partners with having an external-facing product roadmap, shaped according to actor majorities to avoid over-adaptation (A6).

#	Strategies	Addressed Challenges	Observed Behavior	Preparation	Formation	Operation
A1	Using alternative funding methods	Financing	Using alternative funding methods due to lack of commercial business case to come up with product vision e.g. bootstrapping and crowdfunding	X		
A2	Leveraging influence of corporates for funding	Financing	Obtaining interest from actors for a pilot first, then apply collectively for public funding with tailwind and big names to reduce costs and commitment for incumbents	X		
A3	Piloting solution with other actors	Convincing	Initiate small pilot programs to reduce commitment on the part of the incumbents; convincing them over the course of the experimentation and collaboration process	X	X	
A4	Targeting early adopters	Convincing	Targeting front-runners in sustainable fashion to build first critical mass of ecosystem actos	X	X	
A5	Using storytelling towards actors	Convincing	Using storytelling as a means to convey the attractivity of partnering; e.g. public relations and increased brand value through sustainability i.e. proofing good working conditions	X	X	
A6	Customizing the Value Proposition	Convincing	Co-creating the circular value proposition with strategic partners to achieve buy-in through shared goals and activities	X	X	
A7	Attending public events and holding presentations	Awareness	Attending industry and sustainability related events to create visibility and credibility for the solution and form new relationships with potential ecosystem actors	X	X	X
A8	Avoiding strategically motivated investors	Convincing	Preserving independence from brands to ensure neutrality as a platform	X	X	X
A9	Sequencing the value proposition	Convincing	Sequencing the rollout of the value proposition: started as tracing solution for sustainability to enable circularity on request of ecosystem actors. Adopting an external facing product roadmap to be tailored to partners	X	X	X
A10	Enabling sustainable certification and verification	Business Case	Helping corporates to get certified for social and environmental sustainability thereby improving their business case towards consumers	X	X	X
A11	Leveraging existing infrastructure	Business Case	Designing the platform to be integratable with the existing IT infrastructure (e.g. product-lifecycle-systems)	X	X	X
A12	Designing for scalability	Scaling	Designing the technical infrastructure to be scalable; easy and quick for new actors to join and integrate with the platform; rollout of new features to all platform users	X	X	X
A13	Charging where the value is added	Business Case	Charge where the value is added: offer solution free of charge to upstream suppliers, only charge brands	X	X	X
A14	Learning from experienced actors	Knowledge	Exchanging strategies across vertical digitizers from other industries and talking with ecosystem actors to generate industry know-how	X	X	X
A15	Involving actors across supply chain in pilot	Scaling	Involving partners along the vertical supply chain in experimentation for ongoing product development to directly test and ensure the scalability of data interfaces		X	X
A16	Leverage influence of corporate partners for access to new partners	Convincing	Leveraging strategic partners to advocate for them on industry platforms and convince other brands to join		X	X
A17	Reducing barriers to collaboration	Convincing	Internalising the complexity of variation and digitalisation, fully adapting product to ecosystem actor		X	X
A18	Collaborating with industry associations to drive upstream digitization	Alignment	Collaborating with industry associations to drive upstream digitization to broaden the base of network actors and drive ecosystem value		X	X
A19	Collaborating with industry associations to enhance value of data	Business Case	Collaborating with industry associations to augment data with additional industry insights (comparability)		X	X
A20	Driving consumer adoption at point of sale	Convincing	Helping develop automated processes in retail stores to provide a convenient customer experience for returns		X	X
A21	Integrating with core clients	Financing	Causing lock-in by integrating with core clients (brands) in helping with automated CO2 reporting to secure sustained revenues with core clients			X
A22	Leverage network effects to expand ecosystem	Scaling	Fostering scale of solution actively by utilizing occuring network effects via the introduction of a referral-system and by addressing most influential multipliers in the network			X
A23	Establishing and promoting standards	Alignment	Promoting the establishment of a data standards for the own solution; moderating the settlement among actors to ensure acceptance			X

Table 8: *Strategies observed in Case 1*

Towards the *operation phase,* industry associations and strategic partners are rising in priority, as the phase is primarily characterized by the growth of the platform. In this, industry associations were seen as great industry organs, with many actors being present. *Alpha* sees them as a relevant platform for standard-setting, which is why they seek collaboration to drive the digitization of upstream partners (A18) and to share and augment sustainability data (A19), creating further lock-in and becoming firmly embedded in reporting structures of ecosystem actors (A21). During this phase, standardization and large-scale adoption are gaining vehement relevance as a strategic topic. Standardization is vital for the strategic partners, as it reduces the risk of squandered investments and is actively promoted by *Alpha* and their partners (A23). These are often leveraged to recruit additional actors in industry associations (A22). In the long term, they aim to use these network effects to grow their platform and build a standard around them (A16, A23). They want to become the central platform for sustainability-related data by integrating into their partners' systems and processes, thereby causing a lock-in (A21).

4.2.2 Case 2: Horizontal Digitizer in the Construction Industry

'*Beta*' is a *Horizontal Digitizer* in the construction industry, mainly acting as a technology provider of data solutions. It enables the CE by offering a data register that captures all the materials in a building. This data is necessary to deconstruct and reuse, or alternatively, recycle materials in the respective building. The data is also crucial for the (re-)valuation of materials depending on variables such as age, form, and size. Materials can thus be traded to interested actors. The *Horizontal Digitizer* adds value by facilitating data exchange on a platform and creating aggregated insights. It charges fees for storing data, e.g. to asset owners, and license fees for access and retrieval to a variety of actors including real estate developers and architects. The need for this role lies primarily in the high fragmentation of the construction industry at the regional as well as the actor and material level. The high variability and complexity, and the monetary value of the materials, make this data particularly valuable. In addition, high legislative pressure and resource scarcity bring momentum to the industry. However, the high value of the data and the centrality of the position pose a barrier to realizing this orchestrating position as it contradicts the interests of the actors that are required to share their data.

For this reason, strategic considerations were already made in the *preparation phase*, revolving around strategy and communication. Since the role of the direct orchestrator seemed unattainable, a governance mechanism limiting the startup's value capture potential was created as a fundamental part of the strategy (B7). The aim is to actively decrease the attractiveness of the role, which means cost-based pricing covering the security and storage of the data. Data is considered a utility and not priced based on its value-adding potential. *Beta* stands out in the sense that it is rather impact-driven than profit-driven and therefore appreciates this role despite the limited potential for value capture. The actor vows to do good and never sell the data. To ensure that the pledge holds up, a second entity, set up as an NGO, controls the fulfillment of this pledge by holding the trademarks and having a supervisory board that can replace the management in the event of mistrust. However, this strategy has implications for growth tactics and funding as this case is too uncommercial for traditional investors such as venture capitalists (VCs). At the same time, it is difficult to sell equity to more prominent ecosystem actors, as this could harm transparency and legitimacy (B8).

#	Strategies	Addressed Challenges	Observed Behavior	Preparation	Formation	Operation
B1	Using storytelling towards actors	Financing	Exploiting that banks talk a lot about sustainability but have few options to actually pursue sustainability, framing it as a donation for a good cause	X		
B2	Using alternative funding methods	Financing	Using alternative funding methods due to lack of commercial business case to come up with product vision e.g. bootstrapping and crowdfunding	X		
B3	Prioritizing outreach according to financial power	Financing	Targeting financially strong players based on number of assets and insignificance of donation	X		
B4	Seeking public funding	Financing	Applying for funds from the EU to finance the project	X		
B5	Sequencing the value proposition	Convincing	Sequencing the value proposition by exposing large clients incrementally to small and stable portion of information and features	X	X	
B6	Learning from experienced actors	Knowledge	Exchanging strategies among successful startups and talking with ecosystem actors to generate industry know-how	X	X	
B7	Limiting value capture potential	Convincing	Decreasing the value capture potential and the threat of exploiting an orchestration position by setting up a governance structure which entails formal control mechanisms to ensure that the actor is impact-driven. Being fully transparent in order to promote trust.	X	X	X
B8	Avoiding strategically motivated investors	Convincing	Preserving independence from powerful companies and states to ensure neutrality as a platform	X	X	X
B9	Attending public events and holding presentations	Awareness	Attending public events to create visibility and credibility for the solution and form new relationships with potential ecosystem actors	X	X	X
B10	Customizing the value proposition	Convincing	Communicating an individual value proposition to different actors based on narrowing very wide possibility of use cases to their role. Talking their language and addressing their needs and pain points		X	X
B11	Reducing barriers to collaboration	Convincing	Internalising the complexity of variation and digitalisation, fully adapting product to ecosystem actor		X	X
B12	Lobbying for favorable market conditions	Convincing	Lobbying for positive change towards CE on a national and European level; discussing influence of new regulations		X	X
B13	Designing for scalability	Scaling	Designing the technical infrastructure to be scalable; easy and quick for new actors to join and integrate with the platform; rollout of new features to all platform users		X	X
B14	Prioritizing and enabling advocating actors	Awareness	Enabling certain actors that constitute industry advocates to strategically grow the ecosystem, for example architects have influence over reuse and design		X	X
B15	Use own research to promote credibility	Convincing	Create aggregated industry insights for ecosystem and society to build credibility and trust among industry actors			X
B16	Providing safe and efficient data interfaces	Convincing	Ensuring safe and efficient handling of data and framing it as main activity and source of revenue			X
B17	Establishing and promoting standards	Alignment	Facilitating the interaction between ecosystem actors to increase circular value creation			X
B18	Leverage network effects to expand ecosystem	Scaling	Focusing on achieving a critical mass of actors on each end of the platform to trigger network effects between supply and demand side			X

Table 9: *Strategies observed in Case 2*

After initial bootstrapping and crowdfunding (B2), *Beta* exploited the fact that real estate is an asset class; hence financial institutions play a more significant role than in other industries. Large financial players were asked for a donation (B3), which was framed as an opportunity for positive, sustainable public relations (B1). The positive image of the NGO was leveraged. With strong players behind them, they then successfully applied for EU funding to keep them afloat (B4). The initial value proposition was centered around simple storage and then extended by adding more and more functions later on (B5).

In the *formation phase,* this continued by prioritizing ecosystem actors with financial strength and many properties (B3). When collaborating with large partners, the style of working was adapted accordingly, as these actors are often less agile and knowledgeable (B11). They also customize the value proposition for each actor, depending on what they need and how they work. The relevance of speaking a common language and adopting established means of communication was stressed repeatedly (B10).

During all three phases, including the *operation phase*, visibility was sought, including appearances at public events (B9), interacting with experienced actors and other startups (B6), as well as lobbying for the Circular Economy, which was done increasingly through the NGO (B12). This phase focuses more on employing platform strategies that increase the value of collaboration (B16-18). Also, the startup can use insights and own research published through the NGO to appear credible (B15). In the long term, the startup has an interest in the growth of the platform while adhering to its utility strategy to maintain the balance between the interests of the involved actors.

4.2.3 Case 3: Indirect Orchestrator in the Packaging Industry

'Gamma' occupies the role of an *Indirect Orchestrator* within the packaging industry for food and fast-moving consumer goods. The startup holds a second role within an adjacent, subordinate ecosystem for cosmetics products and packaging. Therefore, the startup has different roles in two embedded ecosystems. In its latter role, *Gamma* established its own brand for cosmetics that is characterized by reusable packaging. They strive to establish a packaging-as-a-service offering to other brands. The startup took on the role of the indirect orchestrator to enable and promote its own business and facilitate the emergence of an overarching ecosystem for circular packaging in FMCG and food retail. In the stationary FMCG and food retail industry, supermarkets are the dominant outlets, making them the decisive bottleneck to the widespread introduction of products involving reusable packaging solutions. Large food retailers are characterized by strong inertia due to their long planning and investment cycles as well as their narrow margins. The success of the packaging solution offered by *Gamma* further relies on consumer acceptance and participation in buying the products, and later returning the packaging for reuse. To ensure consumer convenience, a high density of return points is required. This means that *Gamma* needs to partner with a high number of stationary retailers while at the same time facing extensive infrastructure requirements for decentralized logistics and cleaning facilities.

#	Strategies	Addressed Challenges	Observed Behavior	Preparation	Formation	Operation
C1	Using alternative funding methods	Financing	Financing the initial phase without external funding (e.g. via private investors)	X		
C2	Doing what looks good	Convincing	Using glass instead of plastics because of better reputation with consumers	X		
C3	Promoting first-movership as valuable PR move	Convincing	Selling option to be an early partner as an opportunity to gain a marketable advantage over competitors	X		
C4	Piggybacking	Awareness	Piggybacking with larger players to get noticed by large retailers	X	X	
C5	Targeting early adopters	Convincing	Increasing the likelihood of opt-in by addressing sustainability-focused retailers to drive revenues while creating credibility and momentum	X	X	
C6	Using storytelling towards actors	Convincing	Using storytelling as a means to convey the attractivity of partnering; e.g. via using analogies from adjacent industries or stressing sustainability value	X	X	
C7	Piloting solution with other actors	Convincing	Piloting solution with large retailers to reduce barriers for adoption by ensuring integrated ability	X	X	
C8	Customizing the Value Proposition	Convincing	Adjusting the solution to the individual requirements of retailers and stressing different features of reusable packaging as benefits depending on the interes	X	X	(X)
C9	Sequencing the value proposition	Convincing	Sequencing of rolling out the business model by launching own brand first as a proof of concept to be subsequently used to promote own platform solution	X	X	(X)
C10	Avoiding strategically motivated investors	Convincing	Avoiding investment by strategic investor as this would harm capacity to align other actors of ecosystem	X	X	(X)
C11	Leveraging existing infrastructure	Business Case	Leveraging existing vending machine infrastructure to decrease investment need and barriers to adoption for retailers while increasing consumer convenience	X	X	(X)
C12	Learning from experienced actors	Knowledge	Obtaining insights from experienced actors of adjacent ecosystem for reusable bottles	X	X	(X)
C13	Attending public events and holding presentations	Awareness	Attending industry and sustainability related events to create visibility and credibility for the solution and form new relationships with potential ecosystem actors	X	X	(X)
C14	Designing for scalability	Scaling	Relying on supra-regionally operating external service providers for logistics processes to ensure scalability of solutions from the start	X	X	(X)
C15	Leveraging partnerships for signaling	Convincing	Using existing small-scale partnership with renowned consumer brand to signal trustworthiness towards potential new ecosystem partners		X	
C16	Forming a coalition with similar actors	Convincing	Forming an interest associations of actors from reusable packaging to raise awareness, increase bargaining power, gain access to relevant partners, and to collectively develop solutions for common problems		X	(X)
C17	Lobbying for favorable regulations	Convincing	Sequencing of rolling out the business model by launching own brand as a proof of concept first; subsequently used to build and promote own platform solution		X	(X)
C18	Solving common problems with shared solutions	Business Case	Addressing common problems together to reduce costs, increase speed and create compatibility of solutions to allow for economies of scale		X	(X)
C19	Limiting value capture potential	Convincing	Founding a corporation for the interest association that is not profit driven and makes decisions via democratic processes of its members		X	(X)
C20	Collective buying	Business Case	Relying on collective buying to utilize logistics services for reduces fares per item and to realize volume discounts		X	(X)
C21	Collective pool management & Asset sharing	Business Case	Performing collective pool management across packaging segments enabled by compatibility of container solutions to drive scale and improve profitability		X	(X)
C22	Reducing barriers to collaboration	Convincing	Internalising the complexity of variation and digitalisation, fully adapting product to ecosystem actor		X	(X)
C23	Driving adoption at point of sale	Convincing	Training point of sale (POS) staff on reusable solutions to derive their buy-in and win them as advocates towards consumers to drive adoption of consumers and the success of pilot projects for a broader roll-out		X	(X)
C24	Ensuring measurability of resource flows	Convincing	Ensuring measurability of resource flow to promote trust in concept and its environmental effects which increases buy-in of other actors		X	(X)
C25	Holding physical workshops with actors	Alignment	bringing together different actors in workshops to define processes and goals and also to receive broad and aligned feedback		X	(X)
C26	Establishing and promoting standards	Alignment	Leveraging the interest association to collectively define standards (e.g. labelling, dimensions, cleaning procedures) that facilitate scale of reusable packaging via shared infrastructure (e.g. cleaning) and compatibility		X	(X)
C27	Mediating between actors to align processes	Alignment	Providing a platform for ecosystem actors to communicate and get together and thereby facilitate alignment of processes between actors		X	(X)
C28	Modifying Infrastructure via collective pressure	Scaling	Applying collective pressure to suppliers/operators of vending machine infrastructure to adjust machines and systems to include new container types		X	(X)
C29	Building & owning core assets of the value chain	Business Case	Occupying strategically relevant spots in the value creation of the ecosystem to improve value capture potential and drive own business case for strategically relto create business case			(X)
C30	Formalizing governance structure	Alignment	Introducing governance structure relying on representation of different interest groups with the scaling of the interest association to maintain actor alignment			(X)
C31	Extending platform via different user groups	Scaling	Scaling solution via corporate partners, other startups needing reusable packaging solutions and other compatible reusable packaging systems			(X)

Table 10: *Strategies observed in Case 3*

Facing these challenges, *Gamma* made several strategic considerations already in the *preparation phase* of its ecosystem. They decided to address the complexity of the undertaking by pursuing a sequenced approach, including two consecutively rolled-out business models (C9). In the first step, they launched the cosmetics brand to provide a proof of concept to other industry actors (C6). Building upon this, *Gamma* intends to introduce the reusable packaging-as-a-service solution to other brands and thereby create its own ecosystem once the market is ready. To deliver the proof of concept, the brand piloted its product with retailers to adapt it to the complex requirements and internal processes of large-scale food retail and thus convince key actors (C7). *Gamma* further made an explicit design choice to rely on glass as the primary material for packaging, as the consumer acceptance for glass was going to be higher than for plastics, ensuring maximum consumer acceptance (C2).

Entering the *formation phase*, the startup conducted training at the point of sale to encourage employee buy-in and consequently win them as active advocates of the solution with consumers (C23). Thereby, adoption of the solution within pilot projects could be promoted, increasing the chances of a large-scale roll-out. To drive the formation of an overarching ecosystem for reusable packaging across different FMCG segments, *Gamma* helped build an industry platform (C16). The aim was to collectively solve common problems (C18), such as getting access to large retailers, building necessary infrastructure (C21), creating a favorable market environment (e.g., via lobbying for adapted regulation) (C17), and achieving economic viability in realizing economies of scale (C20). The actors further approach the suppliers of relevant infrastructure (e.g., vending machines) to adapt their machines and match their containers (C28). In doing so, the industry platform enables more actors to build upon existing infrastructure, which lowers entry barriers and investment needs (C11). Pursuing economic viability, the industry platform aligns actors to jointly buy and operate infrastructure such as cleaning facilities and organize shared logistics (C21). A crucial strategic aim of the platform is further realized in the formulation of common standards for packaging (e.g., labels, dimensions, cleaning standards) that reduce friction and promote compatibility across product segments which allows for economies of scale in shared processes (C26). Hence, standards drive economies of scale both for shared processes and via limiting the complexity for retailers to adopt several reusable packaging systems, which further drives adoption (C22).

Gamma has not yet entered the *operation phase*. However, the startup intends to leverage its role as an indirect orchestrator to create the foundation for expanding its business model and thus become a direct orchestrator in its own packaging-as-a-service ecosystem.

4.2.4 Cross-Case Comparison / Synthesis

During the analysis, a temporal pattern of the defined challenges emerged (Figure 15). As depicted in the frequency table, there seems to be a tendency that the importance of the challenges changes per phase with *financing* and *knowledge* rather in the preparation and *alignment* and *scaling* towards the operation phase. Green tones indicate the temporal distribution of observed strategies per challenge. Regarding the strategies addressing these, similarities and differences can be identified across the investigated contexts. First, the similarities, meaning strategies observed in all three cases grouped by the challenges they address are presented. Second, the differences grouped by the three cases denoting the different ecosystem settings are

outlined and observed deviations are linked to contextual factors given by the independent variables of the startup role and the industrial context.

	Preparation	Formation	Operation
Financing	7	0	1
Knowledge	3	3	1
Awareness	4	5	3
Convincing	16	26	11
Alignment	0	4	3
Scaling	2	5	5

Figure 15: *No. of Strategies per Challenge over the Ecosystem Emergence Phases*

4.2.4.1 Similarities

Certain strategies appear to be reoccurring across industrial contexts and startup roles based on the clustered challenges, as depicted in Table 11. Following the phases of ecosystem emergence, the first common strategy refers to the challenge of *financing*. Startups aiming at contributing to a Circular Ecosystem and consequently depending on its emergence face high uncertainty, ultimately relying on collaboration with other organizations for their success. Following the observed roles and their descriptions proposed in Part 4.1.2, their value capture is inherently limited as the startup needs to balance its interests against the requirements of other ecosystem actors to achieve and maintain actor buy-in and alignment. These factors contradict the interests of traditional private investors, which compels them to resort to alternative ways like bootstrapping or public funding.

Challenge	CEI Strategy
Financing	Using alternative funding methods
Knowledge	Learning from experienced actors
Awareness	Attending public events and holding presentations
Convincing	Using storytelling towards actors
	Customizing the value proposition
	Sequencing the value proposition
	Avoiding strategically motivated investors
	Reducing barriers to collaboration
Alignment	Establishing and promoting standards
Scaling	Designing for scalability

Table 11: *Common CEI Strategies grouped by Challenges*

Because startups enter the CEI process as new actors with little visibility, *awareness* by other actors appears as a crucial challenge. Hence, strategies aiming at raising awareness were observed in all cases. Attending and speaking at public events to gain attention turned out to be a common motive. As an innovation process, creating Circular Ecosystems is knowledge-intensive and characterized by high uncertainty. On that account, startups further use physical events and other formats to gather with more experienced actors from related roles or industries to participate in their learnings and avoid costly mistakes.

As an active yet economically still insignificant actor, the greatest challenge to startups in strategically shaping Circular Ecosystems lies in *convincing* necessary actors to join the ecosystem. Overarching strategies include storytelling to convey an appealing vision and demonstrate its attractiveness by, e.g., drawing on analogies of successful examples from adjacent industries. Startups further commonly customize their value propositions to the approached actor to appeal to their needs. This may either be done exclusively verbally by highlighting particular product attributes or expressed in actors-specific product development and adaption, e.g., via co-created solutions. Related to this pattern, startups further appeared to sequence the build-up of their value propositions towards actors strategically. Thereby, they focus on a specific actor type and focus resources on winning them for the ecosystem to broaden their value proposition later to include other actors and thereby successively create a complex ecosystem of diverse actors around them. To realize this, startups tend to avoid strategic investors, as those may impair their capacity to manage or contribute to the ecosystem in the perception of critical actors, preventing them from joining. All cases showed efforts made by the startups to reduce the barriers for cooperation for other actors by internalizing complexity and thereby moderating and mediating between other actors. This was evident in startups' measures to integrate with existing infrastructure and processes of relevant actors to reduce setup costs for them.

Related to this strategy, startups appear to experience challenges of *aligning* actors in an ecosystem. The most efficient and universally applied strategy to foster alignment was promoting standardization. Standards may occur in different forms and address, for example, product specifications, processes, technologies, or data input for exchange. In driving the formulation and establishing of standards, friction can be limited. The compatibility between different actors and products facilitates cooperation within an ecosystem and drives joint value creation. Standards promote mutual trust and are also one of the main preconditions for scalability, which, in turn, is the main driver for economic viability in Circular Ecosystems. *Scaling* appears to be the principal challenge for any Circular Ecosystem. Consequently, the strategy of designing for scalability in all ecosystems was observed. Beyond strategies targeted at scaling, The analysis did not show common strategies regarding the *business case* of the Circular Ecosystem. Such strategies were found to be highly context-specific.

4.2.4.2 Differences

In line with the consciously chosen variance in ecosystem settings, differences among the strategies applied by the startups to promote CEI were observed. Some of them can be related to the respective industrial contexts and the differences in the defined roles.

Industrial contexts differ regarding their proximity to the consumer. In the consumer-facing fashion and packaging industries, the relevance of the consumer was apparent and expressed in various ways. Thereby, consumers in the fashion industry show a comparatively high awareness regarding sustainability issues and have an increased willingness to pay premiums for more sustainable products. This facilitated the business case for fashion brands to collaborate in CEI and promoted the success of convincing large partners early on. In both the fashion and packaging industry, the consumer is highly involved in realizing circularity. Accordingly, strategies targeting consumer adoption among both contexts could be shown.

In the fashion and FMCG packaging industries, the startups face a specific dominant actor in the value chain, i.e., fashion brands and food retailers, respectively. In parallel, startups seem to focus their *convincing* strategies on these players. Responding to the complex processes in the fashion and packaging industry, the startups relied on pilotization with these actors as a critical strategy to win them as early partners in the preparation and formation phases by integrating their solutions with their processes and achieving proof of concept. However, the power asymmetry between the dominant actors and startups bears the risk of so-called "pilot-washing", where dominant players exploit pilots as PR measures while having no real intentions to scale the collaboration. Both industries are further characterized by complex value chains with widely adopted existing infrastructure around which actors have aligned processes. Accordingly, strategies targeting the utilization of existing infrastructure to reduce barriers to cooperation for the dominant actors were observed.

Unlike fashion products, packaging and construction materials are commonly considered utilities because they appear as inputs for more complex products. Concurrently, customers of end products show only limited willingness to pay premiums for improved sustainability of packaging and construction materials. This poses challenges to the business case for circularity in both industries. In the packaging industry, this is strategically addressed by promoting standards to drive the compatibility of solutions and ultimately utilize economies of scale. In both contexts, the legislation still appears to limit the emergence of Circular Ecosystems. They were reported as highly institutionalized environments where existing regulation determines processes and solidifies traditional structures. Accordingly, interviewees highlighted the relevance of lobbying as a strategy to modify the regulatory framework of the industries and create favorable market conditions for circular solutions to emerge. Contrasting this, authorities have already formulated regulations (e.g., relating to certifications) posing pressure on fashion brands to monitor their value chains and limit environmental impact. Aptly, the analysis did not show strategies related to lobbying in fashion.

Concerning the different roles, a pattern became apparent relating to the two *Digitizers*. Both run on a digital platform that integrates actors of the ecosystem. As a result, the value created by the platform is subject to network effects. In the case of the *Horizontal Digitizer*, this reflects in the strategic aim to drive supply and demand on each end of the platform to create a critical mass and trigger network effects to drive the adoption of the platform. Similarly, the *Vertical Digitizer's* solution incurs positive network effects that motivate certain actors to actively refer the solution to their value chain partners. This inspired the startup to strategically leverage network effects, e.g., by building the business model around the brands as the strongest multipliers in the network.

Given its enabling role in the ecosystem, the *Vertical Digitizer* may become modularized and thereby substitutable, yielding a strategic disadvantage and jeopardizing the long-term economic viability of the startup. Hence, the startup aims for lock-in effects by fostering integration with brands and providing additional sustainability monitoring functionalities. On the other hand, the orchestrating roles face particular challenges related to trust when aiming at convincing actors to join the ecosystem. As a *Horizontal Digitizer*, *Beta* holds an orchestrating role in an environment of powerful incumbents that operate on low margins and are reluctant to change. These factors would contradict the emergence of the startup as a common central actor that would usually inhibit a powerful position, potentially allowing it to capture

disproportionate value in the ecosystem. To overcome these, the startup relies on a unique governance structure that limits its value capturing potential. Hence, the startup may take on the central role of the ecosystem while adhering to their mutual interests via this trust-building structure. This is in line with an *Indirect Orchestrator* that realizes its coordinating influence only via an external entity outside the organizational boundaries of the startup. The collective nature of the interest association involving a democratic governance structure promotes trust and enables the individual startup to participate in orchestration. Beyond the trust-building element of this setup, collaboration with external actors is further driven by the collective power of the association's members. Notably, the *Indirect Orchestrator* role appears to be accompanied by a second role in a nested, subordinate ecosystem, where the startup takes on the former to orchestrate the ecosystem towards more favorable conditions for its latter. This insight appears promising but, as mentioned in the conceptual delimitations, lies beyond the scope of this research and is therefore only briefly touched upon in the discussion.

5 Discussion

This section discusses the findings from Phase 1 (5.1) and Phase 2 (5.2) in light of the existing literature. Figure 16 presents the adapted theoretical framework based on our findings. The discussion aims to shed light on what it means for startups to strategically engage in the shaping of Circular Ecosystems. Furthermore, it moves the findings of this study to a higher level of abstraction in relating them to existing theory, yielding new contributions and directions for future research.

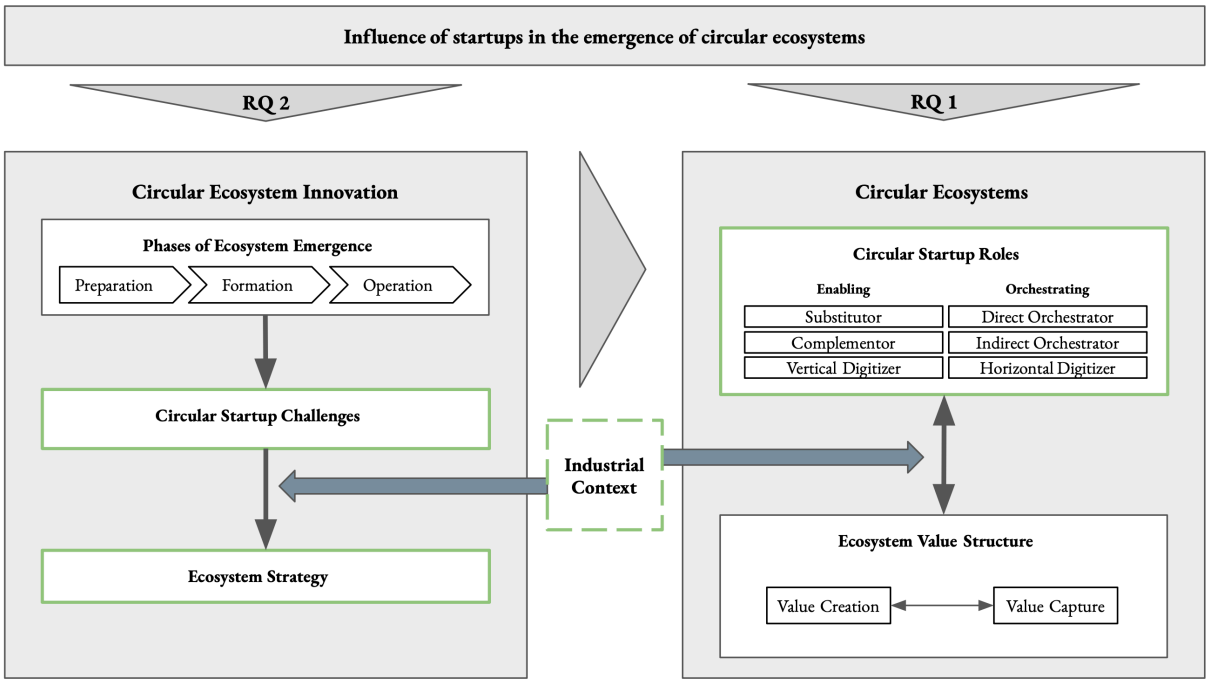

Figure 16: *Adapted Theoretical Framework*

5.1 Startup Roles in Circular Ecosystems

The identified *Circular Startup Roles* (Table 6) follow the prevalent division of ecosystem actors, consisting of a central orchestrator and other value-contributing roles, here framed as (circularity) enablers (e.g., Adner & Kapoor, 2010). In addition to the existing roles, orchestrator, complementor, and supplier, the study found other relevant roles that startups occupy. First, circular startups that engage as suppliers appear as *substitutors* by offering circular alternatives to linear components, which is in line with Henry et al. (2020), who describe waste-based and nature-based CBMs that create materials from waste or regenerative materials.

Second, two digitizing roles are proposed, one *Vertical* as a provider of traceability and communication solutions for existing ecosystems and supply chains, and one *Horizontal*, which establishes market transparency and orchestrates collaboration and resource flows. These roles highlight the relevance of digital technologies in the CE, which has previously been addressed in the literature (Jabbour et al., 2019; Rosa et al., 2020). This also addresses the gap outlined by Luoma et al. (2021) that improved access to data is widely viewed as a driver and enabler of the CE; however, understanding the role and value of data has not been

systematically addressed. This thesis contributes to this by defining roles that focus on circular value creation through the digitization of ecosystem actors and their collaborative processes.

Third, the *Indirect Orchestrator* role is added. Indirect orchestration describes the decentralized governance of ecosystems towards circular value creation. Startups occupying this role can impact the orchestration of the ecosystem through leadership in these structures. In fact, Gallo et al. (2018) describe a similar phenomenon with some decentralized collective authority held by multiple organizations and entrepreneurs. Together with the *Horizontal Digitizer*, it belongs to the orchestrating roles that startups can take. This finding is inconsistent with previous ecosystem literature, which fundamentally assumes that only a well-established actor is capable of designing and orchestrating an ecosystem due to its position of power reflected in its access to critical resources and existing relationships (Iansiti & Levien, 2004a). While this is reflected in the observed inability of startups to take on the role of the *Direct Orchestrator* throughout the early phases of ecosystem emergence, our findings indicate that the other two orchestrating roles are alternative and indirect pathways to achieve the same end, i.e., innovating Circular Ecosystems.

> **Proposition 1:** *Startups can take on orchestrating roles in Circular Ecosystems.*
>
> **Proposition 2:** *Startups may enable CEI through solving problems related to digitization and novel circular value contributions.*

Some authors have described that ecosystems can also emerge without a dominant actor (Tsujimoto et al., 2018; Zahra & Nambisan, 2012), suggesting the possibility of decentralized governance structures. Our findings indicate that the tensions regarding value creation and capture may promote more implicit forms of orchestration via startups as thereby incumbents do not get a "feel of disruption". Oskam et al. (2020) have highlighted these tensions and particularly described the complications concerning the asymmetric nature of gaining and losing value. It may be assumed that the increasing need for ecosystem-level incentive structures has enabled indirect orchestration as a model to preserve actors' interests and fairness. This also echoes other CBM researchers who argue that these structures should not only benefit but also guide, encourage and align stakeholder behavior (Geissdoerfer et al., 2020; Suchek et al., 2021). Adner (2017) describes this as the alignment structure which actors can proactively shape via their Ecosystem Strategy. While the *Horizontal Digitizer* throttles its potential value capture through self-regulation to stabilize the alignment structure, the *Indirect Orchestrator* relies on ecosystem-wide agreements employing a democratic governance structure, co-creation, and standardization. In this sense, this study builds on Lusch and Nambisan (2015), who proposed orchestration via an independent or commonly owned technological asset or standard that, as has been shown, can be held by a collective authority and jointly operated by the *Indirect Orchestrator*.

Noticeably, all newly derived startup roles introduce platforms that connect and align actors to create ecosystems. The observed types of platforms are in line with Gawer and Cusumano (2014) as they represent supply chain (*Vertical Digitizer*), technological (*Horizontal Digitizer*), and industry (*Indirect Orchestrator*) platforms. However, they differ in their modes of orchestration, i.e., whether they coordinate information, resources, or both (Gawer & Cusumano, 2014).

> **Proposition 3:** *Startups may drive CEI by connecting actors via different forms of platforms (i.e., value chain, technological, industry).*

Another crucial factor that proved relevant in our study is the industrial context, which appears to influence how the role of startups and the alignment structure shape up. This is in line with Möller et al. (2020), who described the nested, multi-layered, and conditional character of the business environment. The analysis showcased factors such as institutional agreements, political factors, and technology paradigms that influence the *Ecosystem Value Structure*. Often these different layers have been researched as drivers and barriers rather than Industry Differences. For example, researchers have identified institutional, market, supply chain, organizational, technological, and financial barriers (Guldmann & Huulgaard, 2020; Vermunt et al., 2019). To our knowledge, there are no previous studies relating the industry context to the *Ecosystem Value Structure*. This can be a valuable perspective to explain nuances in the formation of Circular Ecosystems as dynamic structures of value creating and capturing processes.

> **Proposition 4:** *The industrial context affects the interplay of startup roles and the ecosystem value structure.*

5.2 Startup Strategies for Circular Ecosystem Innovation

In the second phase, this study examined Circular Ecosystem Innovation (CEI), adopting the view that ecosystem emergence is subject to certain phases (Dedehayir et al., 2018; Möller et al., 2020). As mentioned in the analysis, it was initially intended to merge the ecosystem emergence phases with the CEI principles (Konietzko et al., 2020) to derive a processual account of behavioral patterns and strategies applied by startups to shape ecosystem emergence. However, the existing CEI principles turned out to be too general and shallow to account for the chronological sequence and strategic depth of the actor's behavior and intentions. There appear to be two main reasons for this. First, they investigated a multi-stakeholder project which had a distinct starting point and commitment of all relevant actors from the start. Second, the authors did not specify how the three sets of principles relate to each other and whether there is any logical order in which they occur. Our findings suggest that the principles proposed by Konietzko et al. (2020) may be logically related in that experimentation is utilized as an entry point to collaboration, while platformization formalizes collaboration in connecting actors. The analysis revealed that the emergence phases induce different challenges that startups face when engaging in CEI. The specific challenges could be grouped to derive common challenges that appear to apply across ecosystem settings and help in structuring the derived challenges in place of the CEI principles.

> **Proposition 5:** *Startups across ecosystem settings face similar challenges when engaging in CEI.*

Parida et al. (2019) have described three ecosystem orchestration mechanisms taking the form of 'Negotiation', 'Standardization', and 'Nurturing', which may be related to the common challenges we observed. *Negotiation* mirrors startups' challenge of convincing other actors to join the ecosystem. However, negotiating is rather atypical for startups, which tend to deal with *convincing* from a position of relative weakness. *Standardization* describes activities roughly equivalent to the challenge of *Alignment*. They

describe the co-creation and promotion of industry standards, which startups actively pursue to foster *Alignment*. Scholars have highlighted the orchestration power of formal instruments like standards and interfaces to discipline and incentivize others (Teece, 2014; Lusch & Nambisan, 2015). Lastly, *Nurturing* refers to the maintenance and prosperity of the ecosystem and consequently corresponds to the challenges of scaling and deriving the business case. Unlike those formerly mentioned, the challenges of *Financing*, *Knowledge*, and *Awareness* directly affect the startups more than the ecosystem per se and are therefore not reflected in the ecosystem orchestration mechanisms proposed by Parida et al. (2019).

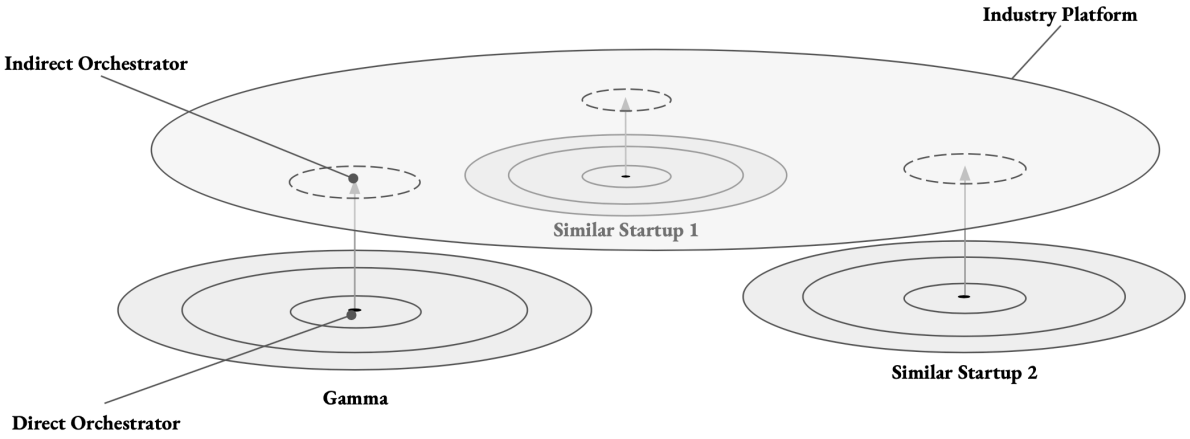

Figure 17: *Nestedness of Ecosystems; The Industry platform states a superordinate ecosystem of similar actors.*

Depending on the industrial context of the Circular Ecosystem, the common challenges unfold differently. Consequently, startups tend to apply varying CEI strategies that address these specific challenges. The two dominant industry differences observed relate to the consumer proximity and the institutional setting of an industry. Firstly, consumer-focused industries happen to involve the consumer in realizing circular value propositions. This implies the need to convince customers for continuous participation while also allowing for demand-induced pressure on actors driven by changes in consumers' value systems. Secondly, institutional settings vary across industries and involve factors such as regulations and standards. It was shown that institutions both shape startups' scope of strategic action while also being subject to strategic measures to alter the institutional framework of the surrounding industry. These findings correspond with the idea of nestedness of ecosystems, which assumes them to be embedded in other systems, e.g., its institutional environment, with which there exist reciprocal relationships (Autio & Thomas, 2014; Möller et al., 2020). For example, case company *Gamma* simultaneously engages as an *Indirect Orchestrator* in the Industry Platform while seeking direct orchestration of its own packaging-as-a-service ecosystem, thus highlighting the nestedness of ecosystems and roles (Figure 17). Further research could investigate the strategic implications of startups taking multiple roles across ecosystems. Along with the industrial context, observations revealed differences in strategic behavior that appear to be related to the startups' role in the ecosystem. As described earlier, the roles coincide with different modes of governance induced by the type of platform at play as well as with different degrees of orchestration (Gawer & Cusumano, 2014).

> **Proposition 6:** *In response to varying challenges, startups apply varying CEI Strategies to drive ecosystem emergence.*

> **Proposition 7:** *Depending on the ecosystem setting, determined by the industry context and the startup's role, challenges express differently and to different extents.*

Startups were observed to amplify their influence in CEI via different forms of cooperation. They use existing partnerships to get access to and convince other actors to join their efforts and thereby strategically sequence their steps, potentially even involving their value proposition, to make efficient use of resources. In addition, results highlighted the formation of associations of similar actors to engage in indirect orchestration targeted at shaping institutions and promoting their convincing strategies. Convincing appears to be the most frequent challenge that circular startups face throughout the continuous expansion of the ecosystem. This aligns with Heuer (2011), who stressed the relevance of effectively managing power asymmetries as collaboration can easily fail. Circular startups are highly contingent on incumbents' approval due to resource dependency; thus, mutual trust and a common vision are fundamental for CEI. In this line of thinking, Oskam et al. (2021) argue for the importance of a common value system as a condition for flourishing startup-incumbent collaboration in ecosystems. Our findings are further consistent with Autio and Thomas (2018), who stressed the strategic relevance of shaping perceptions of value regarding a common value proposition among actors. This relates yet again to the idea of how startups shape the alignment structure through their Ecosystem Strategy. Jacobides et al. (2018) describe that in employing Ecosystem Strategies, actors must consider other organizations' actions as well as the shared and individual interests of ecosystem members.

> **Proposition 8:** *The most central challenge to startups in the pursuit of CEI lies in continuously "Convincing" other actors to add and contribute to the value structure of the ecosystem.*

> **Proposition 9:** *The more orchestrating power a startup holds through its role, the more it needs to engage in "Convincing" strategies to maintain trust.*

Echoing Galvão et al. (2020), findings indicate that achieving a viable business case is the most relevant challenge to solve for startups in successfully creating and scaling Circular Ecosystems. Meanwhile, challenges appear to follow a logical sequence of improving the business case, starting with drawing awareness, convincing others to collaborate, aligning the ecosystem, and scaling. Hence, successful CEI is characterized by startups' well-sequenced operation of challenge-specific strategies.

> **Proposition 10:** *To achieve economic viability in a Circular Ecosystem, a startup must carefully sequence and apply adequate CEI Strategies to overcome the generic Challenges of Awareness, Convincing, Alignment, and Scaling.*

6 Contributions

The contributions of this study are grouped by practical (6.1) and managerial implications (6.2). Beyond them, the limitations of this study are outlined (6.3), and suggestions for future research are given (6.4).

6.1 Theoretical Contributions

This research contributes to closing the three previously defined research gaps. Firstly, the study exploratively structures the intersection of Circular Business Model and Ecosystem literature as a nascent research field in applying an ecosystem perspective to circularity. Secondly, it adds to the understanding of the roles that startups play in Circular Ecosystem settings. By building upon existing ecosystem roles, this work abductively added additional roles that startups take in Circular Ecosystems. This yields the proposition of an adapted and extended set of six startup roles for Circular Ecosystems grouped into enabling (*Substitutor, Complementor, Vertical Digitize*r) and orchestrating (*Horizontal Digitizer, Indirect Orchestrator, Direct Orchestrator*) roles. Thirdly, this paper addresses a research gap concerning the role of startups in the emergence of ecosystems by investigating how they strategically shape Circular Ecosystem Innovation (CEI) processes. A set of challenges was derived that occur along the phases of ecosystem emergence that translate into CEI Strategies. Finally, by deriving common and unique strategies between observed ecosystem settings, this paper adds to the growing body of literature on ecosystem strategies (see Adner, 2017). Beyond this, it contributes to Circular Ecosystem literature in proposing a set of industry dimensions that explain the influence of industrial contexts on Circular Ecosystem emergence in affecting the formation of alignment structures between ecosystem actors and the translation of challenges into CEI strategies.

6.2 Managerial Implications

The results of this research are presented as propositions based on an explorative study in an emerging field and hence remain to be further substantiated for generalizability. Nevertheless, findings allow for cautiously formulated managerial implications addressing startups and other ecosystem actors.

Applying the *Industry-Role-Grid* (Table 6), startup managers may locate their role within their ecosystem or strategically choose an aspired role in comparing the setup of a given industry and their own capabilities. Our propositions of common challenges for startups in Circular Ecosystems can educate managers and help them in structuring and anticipating challenges in the CEI process. The derived common strategies may provide managers with a repertoire of universally-applicable CEI strategies (Table 11). Based on the aspired role of the startup, the derived role-specific or common strategies may guide their strategic planning and support the sequencing of strategic actions and the deployment of resources. Thereby, startups may derive favorable positions in their ecosystems by convincing other actors. Specifically, our results may help startup actors establish working relationships with larger incumbents. They may further find inspiration to establish favorable conditions for Circular Ecosystem emergence.

The findings of this study can support other ecosystem actors in understanding startups' roles in ecosystems and making strategic choices based on outlined patterns regarding specific roles and industry profiles and the resulting challenges and strategies. Our elaborations may further aid incumbent actors in realizing the need for collaboration to realize complex value propositions occurring in the context of circularity. Our findings suggest that through collaboration, incumbents can utilize startups as drivers for digitalization and sustainability.

6.3 Limitations

The underlying theoretical and empirical choices made for the present research yield a number of limitations that provide opportunities for future research. As a more thorough description of the deliberate conceptual delimitations is provided in Part 2.5, this part mainly focuses on limitations stated by the empirical setup.

The temporal frame of the research project did not allow for a longitudinal setup, which appears most suited to investigate processes. Hence, the analysis had to rely on historical accounts provided by the interviewees from the case ecosystems. This might induce distortions and incompletions that were countered by involving additional informants consulted for triangulation (e.g., Eisenhardt, 1989; Yin, 2013). Nevertheless, follow-up studies would be needed to holistically observe the emergence of Circular Ecosystems and the related formulation, implementation, and effects of the observed strategies over time. Adding to this, studies employing larger samples and quantitative methods may investigate the actual effectiveness of specific strategies applied by startups in CEI to allow for more definite causal claims and recommendations for practitioners. The purposeful case choice limits the generalizability of the derived challenges and strategies. In addition, the choice of qualitative methods might cause researcher bias, which was addressed by theory-based coding (Yin, 2013) and researcher triangulation (Denzin, 1970).

6.4 Suggestions for Future Research

Referring to the distinguished ecosystem settings (Figure 14), investigating other combinations could yield valuable additional insights and complement the present challenges and strategies. Further, additional industries could be investigated. Thereby, comparing different roles within the same industrial context or the same role across different industrial contexts could enrich the proposed descriptions of roles and the implications of the ecosystem setting for the strategic behavior of startups.

The derived strategies are likely not exhaustive. Further research could systematically match drivers and barriers to CEI (Vermunt et al., 2019) with ecosystem strategy to generate a broader set of strategies. While this study focused on ecosystem roles, matching CBM typologies (Lüdeke-Freund et al., 2019; Henry et al., 2020) with challenges might yield additional patterns and insights into CEI strategies. As mentioned in the discussion, future research on the implications of the nested nature of ecosystems for startups roles and strategies appears as a promising research avenue. In addition, standard-setting and aligning mechanisms should be analyzed in more detail due to their relevance across cases. Finally, each of the propositions formulated in the discussion provides a potential foundation for further research.

7 Conclusion

The purpose of this study was to deepen the knowledge about the influence of startups in the emergence of Circular Ecosystems. Hence, this thesis investigated the roles that startups take and the strategies they apply to drive Circular Ecosystem Innovation (CEI). Thereby, we look at the emergence of Circular Ecosystems as an innovation process while explicitly focusing on startups as drivers therein. Given the exploratory setting at the intersection of two previously sparsely related research fields, namely CE and Ecosystems, that neglected the role of startups, we employ an abductive approach to contribute to Circular Ecosystem theory. For this, we draw on qualitative data from three observational studies and 33 interviews obtained through a pilot study and two successive phases involving an abductive analysis and multiple case study in three different ecosystems.

RQ1: *What roles do startups play in Circular Ecosystems?*

Applying a structural perspective, we determine two independent variables that predominantly affect startups' influence in ecosystem settings, namely the *industry context* and *the startup's role*. In this, the ecosystem is characterized by its value structure, resulting from the interplay of value creation and value capture processes. The industry context appears to have a moderating influence on the relation of startup roles and ecosystem value structure. Several industry dimensions are proposed that may determine the ecosystem setting. Further, building upon established ecosystem roles, we introduce three new roles that startups may take to strategically shape CEI, deriving a set of 6 startup roles grouped into *enabling* and *orchestrating* ones. Roles appear to differ in their degree of orchestration power, meaning the capacity to actively shape the value creation and alignment structure of the ecosystem. Notably, all three newly introduced roles employ types of platforms to connect ecosystem actors. Including two forms of digital platforms, the results highlight the centrality of digitization to the emergence of Circular Ecosystems and the relevance of startups in promoting it.

RQ2: *How do startups strategically shape Circular Ecosystem Innovation?*

Looking into the CEI process, we identified common challenges that startups face across the ecosystem emergence phases. Startups approach these challenges via *CEI Strategie*s. The process appears to be affected by the ecosystem setting given by the independent variables of the *industrial context* and the *startup's role*. This is indicated by differences in observed *CEI Strategies* that seem to be explained by variations in the ecosystem setting, which guided the case choice. Yet, the multiple case study showed partial similarities between applied *CEI Strategies*, hence more generally applicable strategies that startups employ across ecosystem settings. Overall, the derived strategies highlight the relevance for startups engaging in CEI of balancing the interests of involved actors with their own ones to create and maintain a favorable alignment structure yielding successful ecosystem emergence.

In answering our two research questions, we enhance the understanding of the ways in which startups influence Circular Ecosystem emergence, which we support in making ten propositions regarding startups' role in CEI. We find that startups can enable and orchestrate systemic change by taking on different roles in

Circular Ecosystems. Thereby, they need to overcome specific challenges by applying adequate *CEI Strategies* to successfully innovate Circular Ecosystems. Despite their alleged disadvantages, startups appear as powerful actors in promoting the transition towards a Circular Economy.

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Appendices

Appendix A - Interview Guides

The interview guide has been repeatedly updated and was adapted based on the interviewee's background and industry. The guide was used in a supportive way.

Phase 1

1. **Which products and industries did you come across that are circular?**
2. **What are the critical contributors or actors in circular ecosystems?**
    1. What actors do you think play a role in circular (eco-)systems?
    2. What role do startups play in general?
    3. Who drives the change? (Regulation, Incumbents, Startups?)
    4. What role do logistics companies play?
3. **From your experience, how do circular ecosystems come into being?**
    1. What are the processes and drivers involved?
    2. Where are the critical break points that may determine the success of any effort to circularize an industry?
4. **How do companies form or alter relationships to create circular ecosystems?**
    1. How do firms approach the topic of circularity?
    2. How willing are firms to change their business model?
    3. What role may organizations such as accelerators or universities play in this process?
5. **Have you witnessed any particularly interesting ecosystem transformations?**
    1. Are there ecosystems that have been representative of the typical process?
    2. Are there ecosystems that have been outliers?

Phase 2

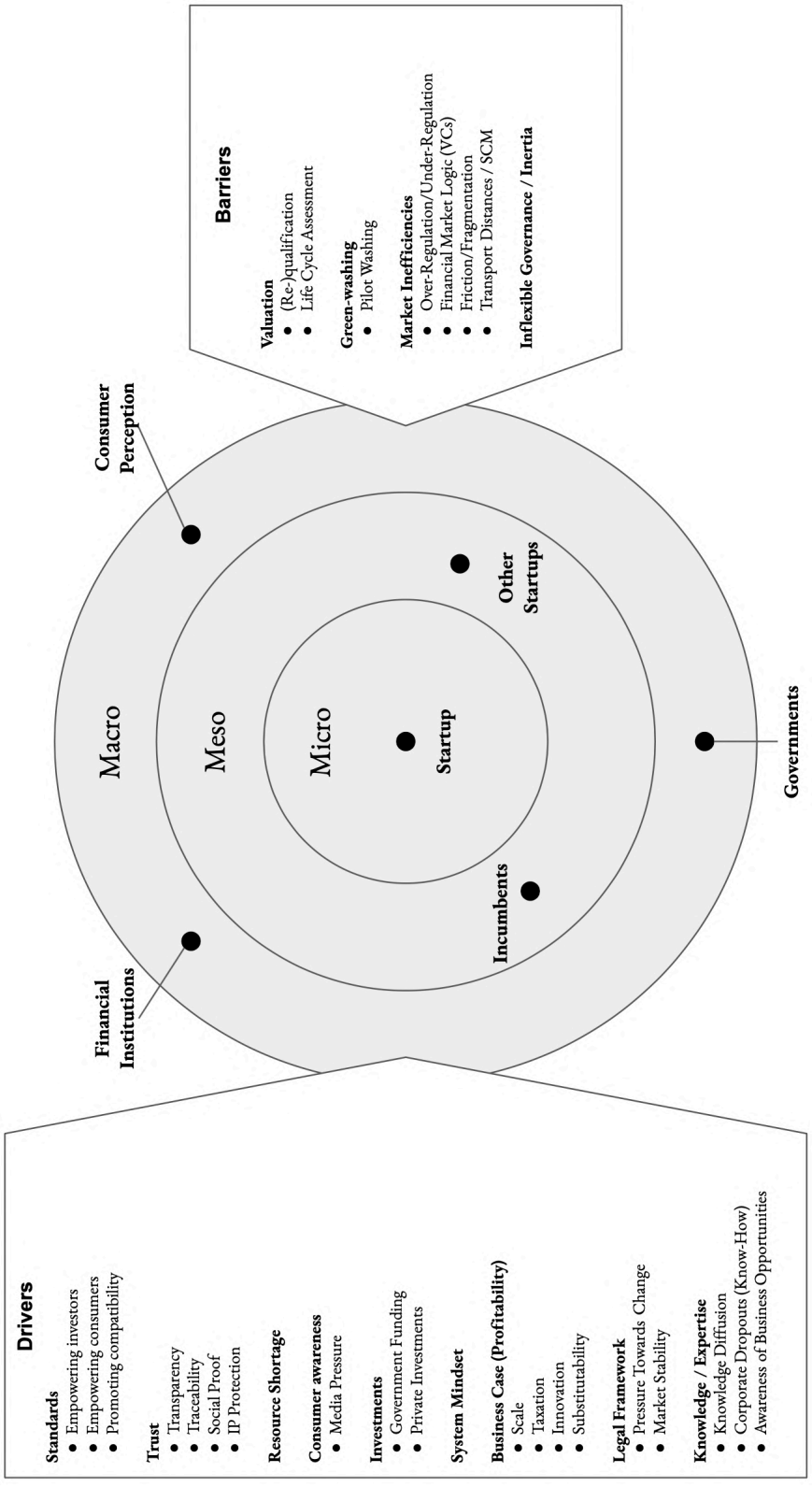
1. **Can you briefly describe your firm's business model?**
    1. How do you help with the Circular Economy? Do you believe you're actively changing the .... industry?
2. **With whom do you collaborate to deliver your value proposition?**
    1. What determines the relative power or strength of these actors?
    2. What are bottlenecks or points of contention?
    3. How do you manage these?
3. **What do individual relationships with partners look like? What influences them? What is the frequency?**
4. **How did you enter/create your circular network/ecosystem?**
    1. With whom did you need to collaborate first?
    2. Did you perform any major pivots along the way?
    3. How did your platform grow?
5. **What factors determine positions and relationships in your network?**
6. **What problems/barriers occur? How did you address them?**
7. **How did you actively influence your position and relationships with other organizations and parties?**

Appendix B - Coding Examples from the Data Analysis

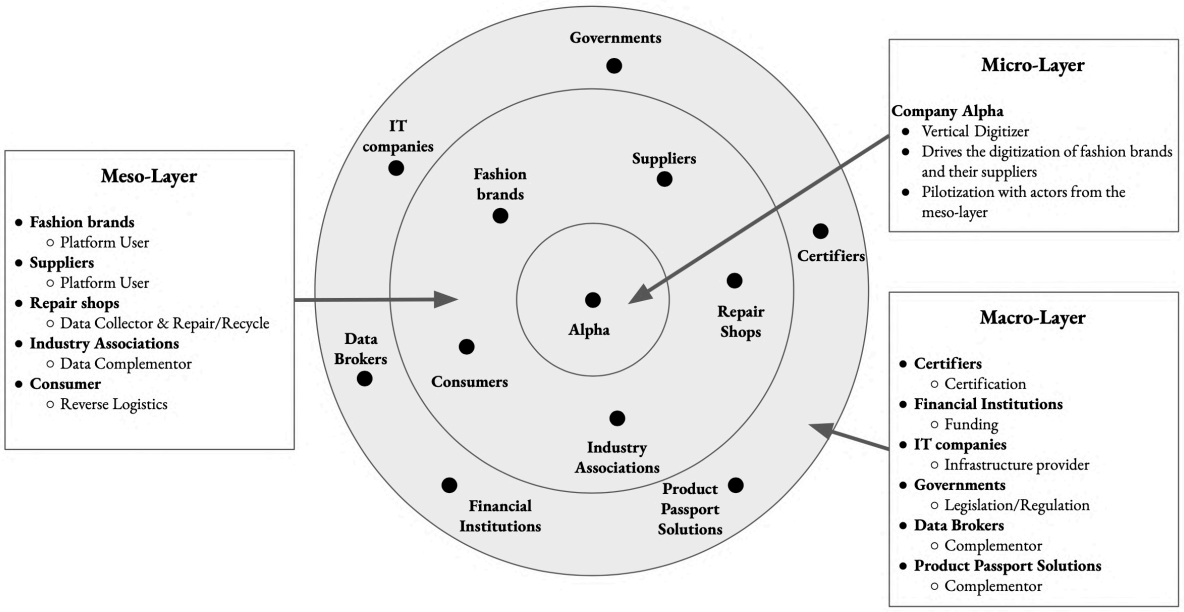
	Data	Code	Category	Perspective
Phase 1 - Industrial Context	"When the European Commission has adopted the European Strategy for Plastics, this has already changed the approaches in the entire industry a lot."	(High) Legislative pressure	Legislation	Industrial context
	"Customers have become much more sensitive and are observing what's being done. And companies definitely have to be much more forthcoming."	Consumer Awareness	Role of the Consumer	Industrial context
Phase 1 - Startup Roles in Circular Ecosystems	"When we're talking refurbished, it's about guarantees and extended warranties. About 68 percent of consumers are stating that warranties or guarantees are key to buying refurbished. The platform provides the product or service towards the end client, but it's the end client that is buying the actual insurance from us."	(1) Extending the platform's value creation (2) Enabling sale of refurbished goods	Complementor	Startup Roles
	"We are at the last stages of building an automated platform that extracts building data exactly how we need it. We put a nice UI/UX layer so see what's going to happen within a municipality right now in Norway within the next five years. What buildings are being taken down, what buildings will be renovated, what buildings will be erected. Looking at several hundred buildings in the area, comparing them by type, by size, by age, by purpose. So, this algorithm can tell you with a 30 percent deviation about the materials, like what is supposed to come out of X? We're also trying to find other ways of business and collaboration. How can we bring everyone together on our platform? So as the next step, we start collaborating with storage facilities and logistics companies that can facilitate the last step of the process of reusing the materials so they can get them from point A to point B or store them somewhere."	(1) Operating an automated platform (2) Facilitating data retrieval (3) Gathering data across municipalities (4) Estimating quantity of reusable materials to enable reliable planning (5) Orchestrating logistics providers to perform transport of materials	Horizontal Digitizer	Startup Roles
Phase 2 - CEI Strategies	"When we identified [...] as a main bottleneck, we had a working group with the incumbents. And since the concept was completely new and there were no solutions in place for these types of platforms, we really had to build the solution from the ground up."	Learning from experienced actors	Knowledge	Strategies
	"We need to create value for each of the parties individually and then as a collective, they'll benefit from their collaboration, but the value is not the collaboration itself."	Customizing the Value Proposition	Convincing	Strategies

Appendix C - Drivers and Barriers to Circular Ecosystem Innovation

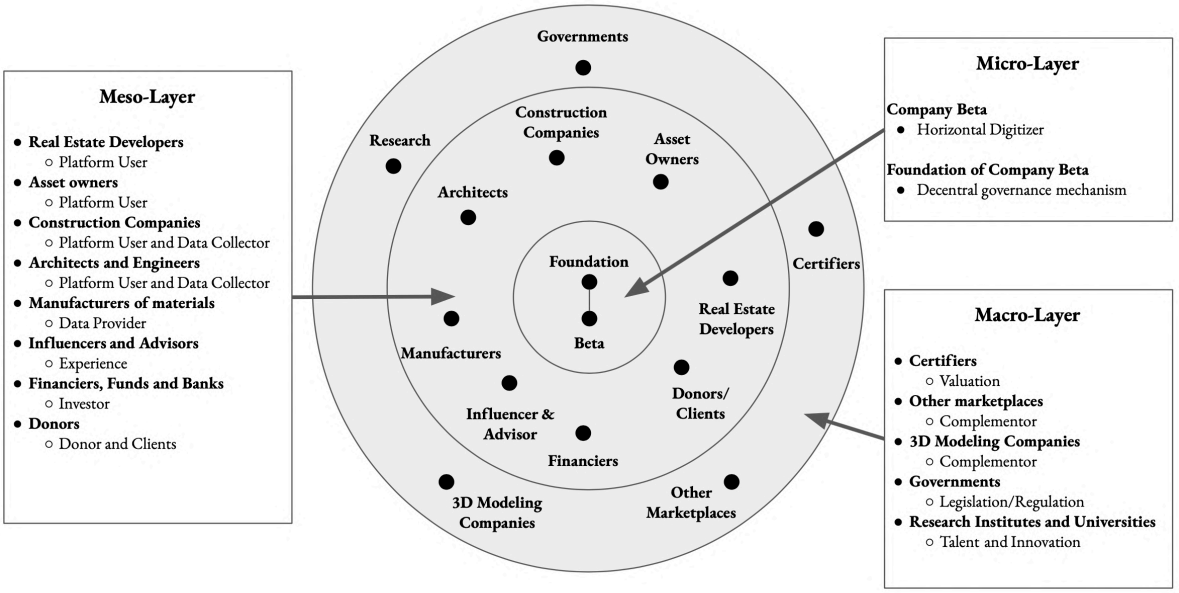
We inductively derived drivers and barriers from the first phase interviews and coded them in two steps to come up with second-order constructs which are presented in the figure below. Most drivers and barriers sit in the macro layer. The graph also shows ecosystem actors which are usually present.



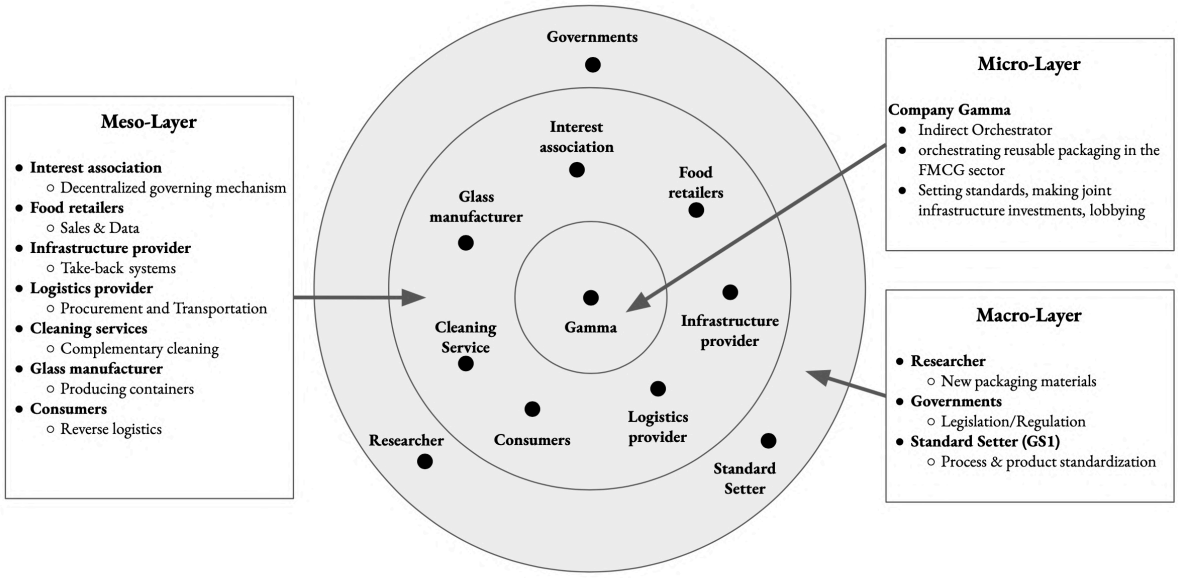
Appendix D - Case Ecosystem Visualizations



Case 1: Vertical Digitizer in the Fashion Industry



Case 2: Horizontal Digitizer in the Construction Industry



Case 3: Indirect Orchestrator in the FMCG Packaging Industry