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Master's in Strategy, Innovation and Sustainability

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BUSINESS ECOSYSTEM FRAMEWORK FOR CIRCULAR BIOECONOMY AND ACTOR MOTIVES FOR ECOSYSTEM PARTICIPATION

Examiners: Professor Ari Jantunen

Professor Karl-Erik Michelsen

ABSTRACT

Lappeenranta-Lahti University of Technology LUT
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Business ecosystem framework for circular bioeconomy and actor motives for ecosystem participation

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The global sustainability challenges, such as climate change and resource scarcity, call for an urgent shift towards a more sustainable society. Circular bioeconomy (hereafter, CBE) is suggested as a pathway to sustainability. This thesis aims to find how to facilitate a pathway to CBE. The first research question asks if the concept of business ecosystems is useful in advancing CBE. This leads to the second research question. If business ecosystems can advance CBE, what motivates business actors to participate in a CBE ecosystem? The first question was addressed in the literature review and a research framework was proposed: business ecosystems for CBE. This framework suggested how business ecosystems can benefit both business actors and a transition to CBE. The second question was addressed in the empirical section with case study method. Nine representatives from companies acting in a CBE ecosystem were interviewed and the interview data was analyzed with the suggested framework.

It was found that participation in a CBE ecosystem does interest business actors. The two main motives were resources and flexible involvement of others to advance own goals. The effect of the ecosystem was that it allows for synergies and alignment of the different individual motives. In practice the mechanism that binds the ecosystem together is collaboration of win-win nature and clear communication of the ecosystem vision. It was also found that the multilateral nature of business ecosystems created intangible assets such as viability, possibilities, trust and anticipated innovation trajectories. From the perspective of advancing CBE, these aspects are beneficial as they facilitate collaboration by creating an ecosystem mindset. Additionally, the innovation trajectories can enable a macro level transition to CBE. No recurring issues regarding CBE ecosystem participation were found. In conclusion, business ecosystems can advance CBE by facilitating motivating collaboration, which is critical for the innovations and new practices needed for CBE.

TIIVISTELMÄ

Lappeenrannan-Lahden teknillinen yliopisto LUT
School of Business and Management
Strategy, Innovation and Sustainability - koulutusohjelma

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Liiketoimintaekosysteemin viitekehys biokiertotaloudelle ja toimijoiden motiivit osallistua ekosysteemiin

Pro gradu -tutkielma
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Globaalit kestävyyshaasteet, kuten ilmastonmuutos ja luonnonvarojen niukkuus, vaativat pikaista siirtymää kohti kestävämpää yhteiskuntaa. Biokiertotaloutta on ehdotettu väyläksi kohti kestävyyttä. Tämä tutkielma selvittää, kuinka siirtymää kohti biokiertotaloudellista yhteiskuntaa voidaan edesauttaa. Tutkielman tutkimuskysymykset kysyvät olisiko liiketoimintaekosysteemin käsite hyödyksi biokiertotalouden edistämisessä. Ja jos näin on, mikä motivoi yrityksiä liittymään biokiertotalouden ekosysteemiin? Ensimmäistä kysymystä tutkittiin kirjallisuuskatsauksen avulla. Sen perusteella tutkielma ehdottaa viitekehystä: liiketoimintaekosysteemit biokiertotaloudelle. Tämä viitekehys esittää, että liiketoimintaekosysteemit hyödyttävät sekä yksittäisiä yrityksiä että siirtymää kohti biokiertotaloudellista yhteiskuntaa. Toista kysymystä tutkittiin empiirisin menetelmin, case-metodilla. Tutkimuksessa haastateltiin yhdeksän yrityksen edustajaa, jotka toimivat biokiertotalouden ekosysteemissä. Haastatteludata analysoitiin ehdotetun viitekehyksen avulla.

Tulokset osoittavat, että osallistuminen biokiertotalouden ekosysteemiin kiinnostaa yrityksiä. Motiiveina osallistumiselle olivat resurssit sekä muiden toimijoiden sitouttaminen omien tavoitteiden edistämiseen. Liiketoimintaekosysteemi toi esiin synergiat erilaisten tavoitteiden välillä ja auttoi linjaamaan ne osaksi samaa visiota. Käytännössä ekosysteemitoimijat sitoutuvat ekosysteemiin win-win luonteisen yhteistyön sekä selkeän ekosysteemivision kommunikoinnin kautta. Tulokset osoittavat myös, että ekosysteemirakenteen multilateraalisuus luo aineettomia etuja, esimerkiksi toimijoiden välistä luottamusta, elinvoimaisuutta, mahdollisuuksia ja innovaation yhteisiä kehityskaaria. Nämä luovat eräänlaista ekosysteemihenkeä, joka taas edesauttaa yhteistyön syntymistä. Koska yhteistyö on keskeinen edellytys biokiertotalouden kehittymiselle, liiketoimintaekosysteemit voivat siis edesauttaa biokiertotaloudelliseen yhteiskuntaan siirtymistä. Toistuvia esteitä ekosysteemiyhteistyölle ei löytynyt. Työn johtopäätös siis on, että liiketoimintaekosysteemit voivat edistää biokiertotaloutta edesauttamalla yhteistyötä.

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Helsinki, 7.6.2021
Tiia Huuskonen

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LIST OF ABBREVIATIONS

CE	Circular economy
BE	Bioeconomy
CBE	Circular bioeconomy
EMAF	Ellen MacArthur Foundation
GHG	Greenhouse gas
CO_2	Carbon dioxide
SMEs	Small and medium-sized enterprises
R&D(&I)	Research and development (and innovation)

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1 INTRODUCTION

This thesis explores if the concept of business ecosystems could be useful for advancing sustainability. Circular bioeconomy is seen as a pathway to a sustainable economic system: a society that circulates renewable materials in an efficient and sustainable way. Could business ecosystems be a way to stimulate circular and sustainable collaboration between business actors? This first section introduces the reader to the background of this thesis as well as the overall structure of the report. The first chapter discusses the background of the study. It places the thesis in context and introduces the issues that ultimately inspired this topic. It also briefly argues why the concepts are relevant and would likely suit the Finnish context well. Next, the research gap in the academic literature is pointed out, the connection between the main theoretical concepts argued and the research questions introduced. The following chapter clarifies the research design and structure of the study. The last chapter of the introduction briefly discusses the scope and delimitations of this thesis.

1.1 Background of the study

Climate change and natural resource scarcity serve as the starting point for this thesis. When these urgent global challenges are coupled with another megatrend, the growing middle-class population (PwC 2021a;b;c), it is clear that new solutions are needed to maintain our society within the planetary boundaries (Vandermaesen et al. 2019, Steffen et al. 2015). Due to these challenges, sustainable development has been on the United Nations' agenda since the Brundtland Commission (WCED 1987). Recently this message seems to have reached the heart of capitalism as well. In August 2019 Business Roundtable, an organization devoted to promoting policies favorable to business, shifted their perception of the purpose of a corporation from placing shareholder interests above all else into delivering value for all stakeholders, including the environment (Business Roundtable 2019). Whether or not the statement is to be taken seriously or only as empty rhetoric (c.f. Winston 2019), 181 signatures from world's largest companies' CEO's is certainly a powerful statement: the need for more sustainable regimes is urgent.

The concept of circular economy (hereafter, CE) addresses these current problems in a way that allows for economic value creation while maintaining the environmental resources (Velte et al. 2018; Lieder & Rashid 2016; EMAF 2013). CE has been recognized as a possibility for a more sustainable future also by the EU and Finnish government. The EU Circular Economy Action Plan was adopted in 2015 (European Commission 2020) and in the same year CE was highlighted by the Finnish Government as means to achieve sustainable growth (Valtioneuvoston kanslia 2015). More recently, Sitra, the Finnish Innovation Fund, published a report on the most important megatrends from the Finnish point of view that mentions that the importance of CE keeps growing (Dufva 2020). In the Finnish context, bioeconomy (hereafter, BE) is often highlighted alongside CE on the list of sustainable solutions for growth (Valtioneuvoston kanslia 2016, 61; 2019). Similarly to CE, BE is often seen to make a considerable contribution towards sustainability by e.g. reducing GHG emissions (McCormick & Kautto 2013). Finland has a long tradition and strong knowledge base in bio-based economy and the national BE strategy highlights its possibilities as a building block for a low carbon future (Biotalous 2014).

In the academic literature CE and BE both are usually seen as pathways towards sustainability (D'amato et al. 2017). Recently these two concepts have been considered together and a merging concept of circular bioeconomy (hereafter, CBE) has been suggested (Toppinen et al. 2020; Carrez & Van Leeuwen 2015; Hetemäki et al. 2017). It has been argued that BE is circular by nature (Carrez & Van Leeuwen 2015), but that does not guarantee sustainability, if resources are used recklessly. Hence, the concept of BE could benefit from CE thinking. Vice versa, CE could benefit from BE as dependence on fossil-based and other non-renewable materials needs to be reduced. (D'Amato et al. 2017; Allen 2016) Therefore, a combination of the two concepts is better equipped in solving the complex global issues.

As CE and BE are already both present in the Finnish policies for sustainable growth, the merging concept of CBE would likely fit well into the Finnish context. Currently, in the governmental projects to advance sustainable growth, BE and CE projects are often presented separately (Valtioneuvoston kanslia 2019; 2016;2015). Similarly, Hetemäki et al. (2017) have observed that in the EU the BE and CE projects belong to different responsibility areas: BE to the Directorate-General for Research and Innovation, whereas CE to the

Directorate-General for Environment. They argue that the combined CBE approach could attract more resources and bring synergies to the advancement of the initiatives. Therefore, the adoption of a combined CBE approach would likely bring synergies in the Finnish context as well and be more effective as means to achieve sustainable growth. Ways to implement CBE should thus be examined.

1.2 Identifying research gap and questions

If CBE indeed is a better pathway towards sustainability, what is the pathway to CBE? For successful implementation of CE, BE and CBE, the importance of cooperation is frequently argued for in the literature (Guerrero & Hansen 2018; Kunttu et al. 2020; Srai et al. 2018) because e.g. efficient use of side streams as well as innovation and new business models call for cross-sectoral engagement. Additionally, it is argued that the most impactful implementation of both CE and BE is systemic. It should run through the society and cooperation between different societal levels is needed. (Ghisellini et al.2016; Wesseler & von Braun 2017) Consequently, a good implementation of CBE includes a societal transition away from the current linear system. However, organizing collaboration between different business actors is often challenging and the willingness to cooperate between companies has been found to be a barrier for CE transition (Fisher & Pascucci 2017; Kirchherr et al. 2018). The lack of firm and stakeholder collaboration has been found to be lacking as well in the CBE context in the Finnish forest sector (DeBoer et al. 2019). However, the research does not provide information on why cooperation is perceived difficult.

One approach for studying collaboration between economic actors with a common goal, is through the concept of business ecosystems. It has been applied in studying interdependence on multiple fields, especially the ICT industry (Adner 2017; Järvi & Kortelainen 2017). As the interaction between different CE actors is currently gaining more attention, it is argued that the business ecosystem framework can offer great insight and opportunity for the CE research (Hsieh et al. 2017). The concept of business ecosystems has been suggested as a unit of analysis for sustainability transitions as well (Lazarevic et al. 2019; Planko et al 2017). Therefore, business ecosystems perspective would possibly be beneficial for studying the implementation of CBE as well.

Thus, the first research question of this thesis is:

Is the concept of business ecosystems useful for advancing CBE?

The first question leads to the implementing actors of the transition. If CBE ecosystems indeed are fit for advancing a CBE transition in theory, who are the central actors and what motivates them? Business actors are seen to be the primary actors driving the society towards a shift to circularity (EMAF 2013) and thus are an integral actor driving the transition to CBE as well. Specific to the CBE transition, it has been argued that the forest sector has a potential role on the center stage. Especially in the EU, forest sector is significant in volume, and wood-based materials hold the potential to replace almost all products traditionally made from fossil materials. Recycling and cascading use of material already belong to the tradition in the forest sector, however it is argued that the industry is undergoing rapid change and is in need of new innovative approaches that cross sectoral boundaries (Näyhä 2019). (Hetemäki et al. 2017)

A good example of this kind of an actor is the Metsä Fibre bioproduct mill in Äänekoski, Finland. Metsä Fibre, a Finnish forest sector company with a long tradition, has initiated a new ecosystem approach around their new bioproduct mill (c.f. Metsä Fibre 2018). The Äänekoski ecosystem operates in the field of CBE and has a goal of fostering new business and innovations around forest industry and its side streams. It thus resonates well with both main theoretical concepts. The emerging phase of this ecosystem has been on researchers' focus already, and e.g. the roles of different actors (Haarla et al. 2018) as well as the structural drivers and challenges of the area (Ylimartimo 2018) have been studied. However, the drivers and challenges from the point of view of individual firms have not been studied and this is where this thesis will contribute.

Hence, the empirical section of this thesis will study the motivations for ecosystem participation in the business ecosystem in Äänekoski.

The main empirical research question is:

What motivates business actors to participate in a CBE ecosystem?

And sub questions:

What are the main motivations to join a CBE ecosystem?

What other benefits there are?

What kind of questions and issues there are to solve before cooperation can begin?

1.3 Research design and structure

Figure 1 concludes the design of this research and visualizes how the research questions are addressed to different sections of the study. The theoretical section answers the first research question and studies if the concept of business ecosystems is useful for advancing CBE? The literature review studies the main theoretical concepts chosen for this study: CBE and business ecosystems. Both concepts have been argued to be relatively new and still lacking clear unified definitions (D'Amato et al. 2020; Tsujimoto et al. 2018). The theoretical framework thus first outlines the concepts for this study and connects them to the global challenges presented as the starting point of this thesis. After clarifying the concepts, the research framework is presented. It binds the main concepts together and proposes how the concept of business ecosystems provides aspects that are beneficial for CBE and how it could be useful in advancing a transition to a sustainable CBE society. Essentially, the framework suggests how certain aspects of the ecosystem concept enable collaboration between CBE actors.

The second set of questions is presented for the empirical section of the study. The motivations for the ecosystem participation are studied with the case study method. It is a suitable method as it is typically argued to be well fit for studying contemporary phenomena in real-life contexts (Yin 2003, 13; Eisenhardt 1989). The objective of the case study is to find out what motivates the real-life CBE actors to participate in a CBE ecosystem. The sub questions dig deeper and broke this question down to three separate topics: the main motivations, added benefits and issues. The case analysis utilizes data from case Äänekoski ecosystem that is gathered from interviews with relevant ecosystem actors as well as information available in media and company websites. The data is first analyzed against the suggested research framework to find if the real-life actors' motivations and perceptions of the ecosystem benefits follow the suggested framework. Later in the discussion section the findings are compared to existing literature in the field of CBE and business ecosystems.

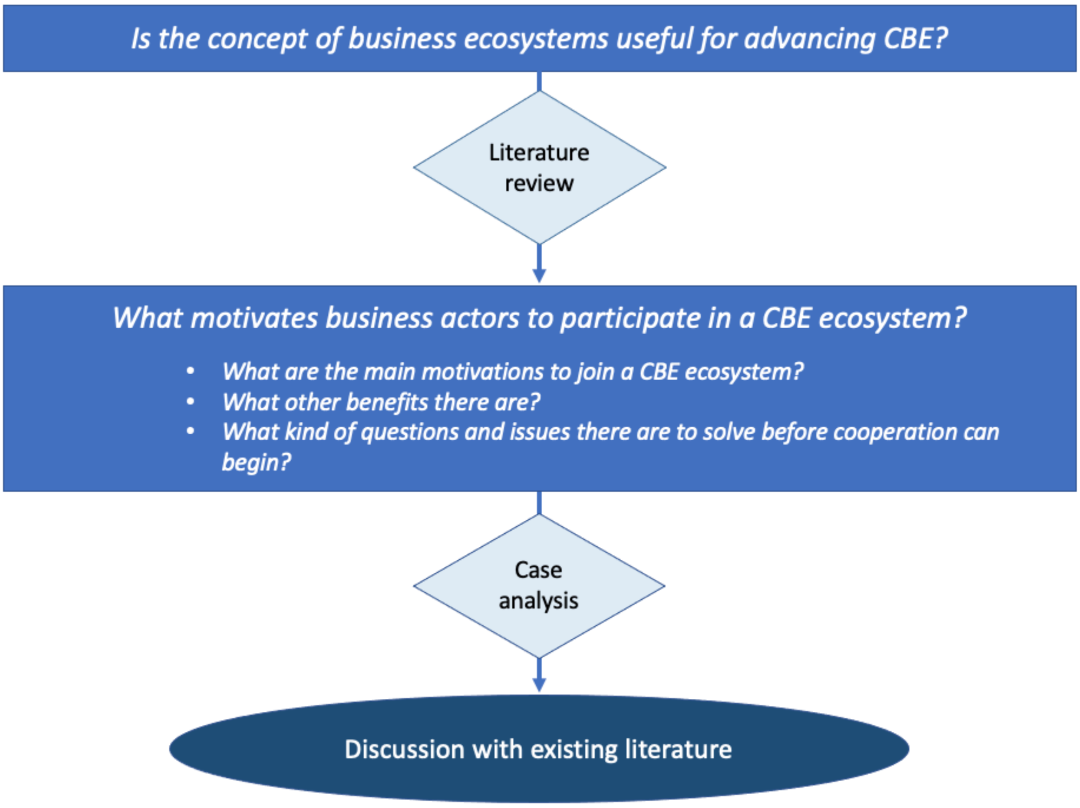

Figure 1: Research design

Lastly, the structure of the thesis is as follows. The first chapter presented the issues that inspired the start of this thesis, as well as the main theoretical concepts and research questions. Chapter two includes the literature review for both main concepts. After outlining the concepts, the chapter presents a research framework that binds the concepts together and suggests how they can contribute towards solving the global challenges that were introduced as the catalyst for the thesis in chapter one. Chapter three declares the research data and methods. It also briefly introduces the case ecosystem and interviewed companies. Chapter four discusses the empirical findings and analyzes the ecosystem. Chapter five answers the research questions individually. It discusses the empirical findings in a more critical manner and compares them to the existing literature. At the end of chapter five the findings are connected, and the contribution of this study is assessed. Also the limitations of the study and suggestions for further research are presented here. Lastly, chapter six concludes the research by summarizing the process and pointing out the most relevant findings.

1.4 Scope and delimitations

The scope of this thesis is CBE ecosystems in the Finnish context. The suitability of the ecosystem concept for advancing systemic CBE is studied on the theoretical level. The motivations of ecosystem actors are studied empirically from the business actor perspective. This is an embedded single case study, to be able to analyze the case through multiple actors' perspectives. For more robust analysis other cases should be examined, but for the scope of a master's thesis, single embedded case analysis was seen to be sufficient. The chosen case ecosystem is a good representative for the topic as it resonates well with both main theoretical concepts.

Other delimitations regard the concept of business ecosystems. The academic literature on this field of research suggests multiple different sub concepts for the business ecosystem. However, the distinctions between these concepts are not yet clear in the literature. (Gomes et al. 2018) The Äänekoski ecosystem could possibly be viewed to represent different sub concepts. For example, it could be classified as an entrepreneurial ecosystem as well as an innovation ecosystem. However, Äänekoski ecosystem is discussed as a "business ecosystem" in the official communications on the company websites. Additionally, it could be seen that the concept of innovations is central to all the ecosystem definitions as well as the main aspect regarding a CBE transition. Thus, for the purposes of this research the overarching concept of "business ecosystems" is appropriate for the analysis.

2 THEORETICAL FRAMEWORK

This section of the thesis contains the literature review of the main theoretical concepts chosen for this study: circular bioeconomy (CBE) and business ecosystems. Both concepts have been argued to be relatively young concepts and the literature is criticized to be unorganized (e.g. D'Amato et al. 2020; Tsujimoto et al. 2018). Thus, they need to be thoroughly studied and clarified for the purposes of this research. The concepts' connection to the background of the study is also examined. After the concepts have been outlined, a research framework that binds the main concepts together is suggested. This framework is later used in the empirical analysis as a tool for analysis.

2.1 Circular bioeconomy (CBE)

This chapter studies the concept of circular bioeconomy (CBE). As the concept is new and still at an emerging stage (D'amato et al. 2020) it is approached through the constituting concepts: circular economy (CE) and bioeconomy (BE). These two concepts are first defined and characterized. Next it is argued why a new combined concept is necessary. Lastly, the implementation of CBE is discussed combining perspectives from academic literature that discusses CE or BE implementation.

2.1.1 Circular economy

Circular economy (CE) is described as an economy where raw materials circulate in closed loops. It is presented as a contrast to the linear "take, make, waste" -economic model. The concept has been traced to originate from the ecological and environmental economics and industrial ecology. (Ghisellini et al. 2016; Homrich et al. 2018; Geng & Doberstein 2008) In a Scopus analysis (in May 2021) the most prominent fields in CE research are environmental sciences, engineering and energy. Circular economy is currently a popular concept in the academic and policy literature as well as among practitioners (Kirchherr et al. 2017). The Scopus analysis with the term "circular economy" shows over nine thousand publications. CE has been appearing in literature and policies for decades (Milios 2018; Blomsma & Brennan 2017). However, majority of the Scopus articles have been published after 2015, which is also the year the European Commission adopted its first EU -level CE action plan

(EC 2021). Another region with active CE policies is China, where it has been promoted on the national level (Milios, 2018; McDowall et al. 2017).

The main driver for CE is the realization that our current linear economic model is unsustainable. The current levels of production and the externalities that result from all the fossil fuel -based activities are challenging the planetary boundaries, harming the environment and threatening the biodiversity. (Korhonen et al. 2018a; EMAF 2013) CE is seen as a strategy that binds value creation with resource conservation, a win-win approach to the challenge of resource scarcity and waste disposal. (Velte et al. 2018; Homrich et al. 2018; Kirchherr et al. 2017) Ultimately, it is aiming to decouple the environmental pressure from economic growth (Ghisellini et al. 2016; EMAF 2013). It is also seen to offer potential for economic growth with new innovations and business opportunities as well as to moderate the volatile prices of scarce commodities (EMAF 2013; McDowall et al. 2017).

In the literature, early scholars have described CE as an economic system, where raw materials circulate in closed loops that mimic the natural cycles (Geng & Doberstein 2008; Pearce & Turner 1990) Some scholars (e.g. EMAF 2013; McDonough & Braungart 2002) distinguish CE into separate biological and technical cycles, as described in the butterfly diagram in Figure 2. The biological materials are regenerative. After use, they are designed by nature to re-enter the biosphere safely as nutrients where they build natural capital. In the biological cycle in Figure 2, on the left, materials cascade through different applications and lastly return to the soil. In contrast, technical materials do not decompose, hence they should not re-enter the biosphere. However, they are designed to circulate within their system at highest possible utility. The technical side thus essentially mimics the biological side, looping the “technical nutrients”, but without leaking them back to the biosphere as waste. (EMAF 2013; McDonough & Braungart 2002)

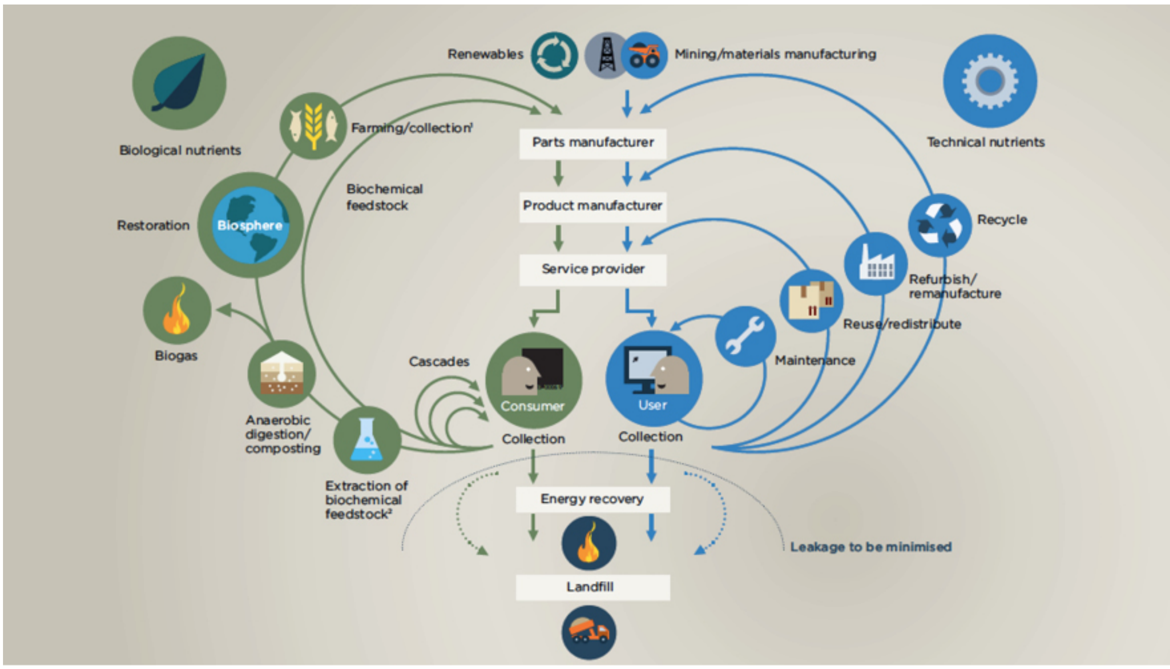

Figure 2: Biological and technical cycles of CE (EMAF 2013, p. 25)

In the CE literature the technical loops are often described through a concept of R's – most often as 3R: reduce, reuse, recycle. This concept is also found to be frequently attached to the CE definitions and it is argued that the 3R are perhaps some of the most central building blocks of CE (Kirchherr et al. 2017). This R framework appears in different forms; perhaps the most nuanced version is the 10 R loops framework by Potting et al. (2017). All the R frameworks include a hierarchy as main feature, where the first R loop has the highest circularity and thus saves the most energy and resources. (Kirchherr et al. 2017) Hence the aim is keeping products, components, and materials in use at their highest utility and value as long, as possible (EMAF 2013; Wübbeke & Heroth 2014). The tighter the loop in Figure 2, the better. In practice these slowing and closing loops are accomplished through industrial symbiosis, new business models, modes of ownership and design strategies that allow for modularity and new modes of consumption, such as collaborative consumption (Bocken et al. 2016).

Some scholars have criticized the CE concept as unorganized and lacking a clear definition (Homrich et al. 2018; Korhonen et al. 2018a; Korhonen et al. 2018b). In a literature review Kirchherr et al. (2017) note that the concept can mean different things to different people. In addition, it has seen to host different schools of thought, e.g. biomimicry, performance economy and regenerative design have been named (EMAF 2013). CE has also been argued to be an umbrella concept, i.e. it has brought attention to a character that is common in many fields, that are previously not considered together (Blomsma & Brennan 2017). Perhaps this umbrella nature and the diverse background is to blame for the lack of clarity. However, as a unifying theme, many definitions are found to be based on the characterization provided by Ellen MacArthur Foundation (EMAF 2015, p.5): "*an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles*" (Korhonen et al. 2018a; Milios, 2018).

2.1.2 Bioeconomy

Bioeconomy (BE) is an old concept that has been gaining new popularity in the academic literature since the early 2000's. Research on the topic has started on the field of natural sciences and evolved through biotechnology towards social sciences. The recent interest in the topic is seen to be fueled by societal and economic change and the call for sustainable development. (Näyhä 2019; Wesseler & Braun 2017) Also the attention to BE in the policy literature has attributed to the growth in academic interest, perhaps most influentially the OECD 2006 scoping document (Staffas et al. 2013). (Meyer 2017). A Scopus analysis (in May 2021) for the search term "bioeconomy" has earliest mentions in 1979. Thereafter the number of papers remains low or lacking until 2006 when the number of the publications start to grow. The Scopus analysis shows that the dominating field of study remains to be environmental science, however since 2014 the category of social sciences is on the rise. Also, search results with the added term "sustainab*" show exponential growth since 2014, indicating the role of sustainable development as a driver for the interest in BE.

Food and feed, bioenergy, and other biobased products are seen as the main research streams in BE. Within these streams lie many traditional BE industries such as agriculture, fishery, wood and pulp production, as well as chemistry, biotechnology and energy industries for example (Cristóbal et al. 2016; Meyer 2017). As the concept has gone through some reshaping, the definition is currently looking for a clear form. (Hetemäki et al. 2017) It is argued that different actors understand the concept slightly differently, which is likely due to the broad adoption of the concept on different fields as well as the differences in the underlying values of actors. (Bugge et al. 2016; Näyhä 2019; McCormick & Kautto 2013) Some scholars have sought to clarify the field of bioeconomy research. Bugge et al. (2016)

have identified three underlying visions of what a BE constitutes: the bio-technology vision, the bio-resource vision and the bio-ecology vision. Meyer (2017) distinguishes BE definitions by their narrow or broad approach.

The bio-technology vision emphasizes the use of science in different sectors of the economy. The goal of BE here is to obtain higher biovalue from living matter through biotechnology and innovation, implement the methods in production and eventually to promote economic development (Brunori 2013; Sanz-Hernández et al. 2019). One of the most used BE definitions, from the OECD scoping document (Brunori 2013), is a representative of this vision. It "*supposes the bioeconomy to be the aggregate set of economic operations in a society that use the latent value incumbent in biological products and processes to capture new growth and welfare benefits for citizens and nations* " (OECD, 2006, p. 3). Thus, the application and commercialization of bio-technology are in the center of this vision. (Bugge et al. 2016) Meyer (2017) notes that within the biotechnological vision, BE is usually understood in a narrower sense, as a separate sector to the economy. (Meyer 2017)

The bio-resource vision discusses upgrading biological raw materials into valuable products and replacing fossil materials with renewable ones. This vision is based on biomass as a resource. Meyer (2017) names this research stream as transformational vision where BE is seen in a broader sense, encompassing all economy. It highlights the transformative role of BE in a movement towards an economy where production throughout the value chain is based on renewable, biological resources (Meyer 2017; Staffas et al. 2013; De Besi & McCormick 2015). Similarly, Wesseler and Braun (2017) argue for considering bioeconomy as a pervasive phenomenon that runs through the society and has an effect in all, much like digitalization. The bio-resource vision is aiming towards economic growth, like the bio-technology vision. A BE definition identified to follow this vision is e.g. *"an economy where the basic building blocks for materials, chemicals and energy are derived from renewable biological resources*" (McCormick & Kautto 2013, p. 2589). The renewable biological resources as the base of production are highlighted in the EU definitions as well (European Commission 2018). (Bugge et al. 2016)

The third identified vision is the bio-ecology vision, which is more concerned about sustainability. Here the goal is to support ecological processes and promote biodiversity, the goals of economic growth are secondary. Within this vision the scholars highlight local perspectives as well as the optimal and sustainable use of biomass. This includes cascading use of biomass and using the raw material at its highest possible value (Näyhä 2019). (Bugge et al. 2016) This vision has also been named as an alternative vision by Meyer (2017), as they argue it has risen as an alternative to the current agro-industrial perspective. Even though BE is presented largely as a solution to many sustainability issues, a large part of the literature does not elaborate on the sustainability effects and there is no consensus on what a sustainable use of biomass is (Bosch et al. 2015). On the bio-technological vision BE is often seen as inherently sustainable. (Meyer 2017) In contrast, some scholars argue that if biomass is used unsustainably, BE can also be harmful to sustainability. (De Besi & McCormick 2015; Pfau et al. 2014). Thus, an alternative vision is needed to spark a thorough discussion of sustainability in BE.

2.1.3 Why CBE?

Both CE and BE are often suggested as pathways towards sustainability. It is now argued that the concepts can benefit from each other and together create a more holistically sustainable perception (Hetemäki et al. 2017; Allen 2016). (D'Amato et al. 2017) Consequently, a merging concept of circular bioeconomy (CBE) has recently been proposed in the academic literature (e.g. Toppinen et al. 2020; Carrez & Van Leeuwen 2015). The drivers behind the concepts are similar – e.g. climate change and resource scarcity mitigation – and both concepts are aiming towards a sustainable, resource efficient society with a low carbon footprint. Ultimately, both aim to weaken the link between environmental pressure and economic growth. (Carus & Dammer 2018; Ghisellini et al. 2016) A Scopus analysis for ”circular bioeconomy” shows earliest mentions in 2016. In May 2021 the number of hits is approximately 300, thus the concept is at an emergent stage. The dominant fields of research are environmental sciences and energy, both common fields in CE and BE context as well.

CE and BE share similarities and have also borrowed from each other in the past. CE is described as restorative and regenerative, and it is said to mimic biological cycles (Murray et al. 2017; Ghisellini et al. 2016). Some scholars divide CE into biological and technological material cycles (EMAF 2013, 22-27; McDonough & Braungart 2002). In BE literature the cascading use of biomass is frequently mentioned (Meyer 2017; De Besi & McCormick,

2015) and it has been argued that BE in fact is circular by nature (Carrez & Van Leeuwen, 2015). As the concept of CBE is currently at an emergent stage, it is still undefined in the literature (D'amato et al. 2020). However, Stegmann et al. (2020, p. 5) suggest the following definition for CBE: "*The circular bioeconomy focuses on the sustainable, resource-efficient valorization of biomass in integrated, multi-output production chains (e.g. biorefineries) while also making use of residues and wastes and optimizing the value of biomass over time via cascading*."

The literature has suggested that combining CE and BE thinking can help address the sustainability issues of each concept (Hetemäki et al. 2017; D'Amato et al. 2017). In the case of CE, the dependence from fossil-based and other non-renewable materials needs to be reduced. While CE is concentrating on resource efficiency to diminish the use of virgin resources, the economy is still depending on fossil resources, as the concept is limited by thermodynamic constrains. Most materials are not indefinitely recyclable, hence circular economy is not capable of looping them forever. Losses in quantity (e.g. physical material losses and by-products) and quality (e.g. mixing and downgrading) happen in all stages. In addition, all recycling processes require energy and thus require additional resources. As an extreme example, in some cases recycling might be more GHG intensive than sourcing new materials. (Giampietro 2019; Allwood 2014)

Another issue for CE comes from the idea of long-lasting products. It is argued that they might not always lead to most ecological efficiency. Murray et al. (2017) suggest that long-lasting products and materials might consume more useful energy. E.g. an old electric appliance possibly consumes considerably more energy in use than a new one. They also argue that that long-lasting products from technical materials release more entropy at the end of life stage as their ultimate breakdown into elements is difficult. In contrast, natural options made from biological materials can be easily recycled and will only be removed from the biosphere briefly. (Murray et al. 2017) Similarly EMAF suggest that short-lived products should be produced in the bio-loops. (EMAF 2013) Thus, bioeconomy could provide CE with more sustainable raw materials that have the possibility to circulate in the system more efficiently, making CE more regenerative.

In the case for BE, the sustainability impacts are debated in the literature (e.g. Pfau at al. 2014). The main issues are seen to be the unsustainable use of biomass, competing use of biomass, tensions in land use, social issues and biodiversity threats. Even though the sustainable use of biomass is a key aspect in BE (Meyer 2017; De Besi & McCormick 2015), there is no consensus on what "sustainable" means nor standards for measuring it (Bosch et al. 2015; McCormick & Kautto 2013). Also, the evaluations on how much potential there is in the available biomass, are vastly different (Thrän et al. 2010). The issues of competing use of biomass, land use and social issues are tightly interwoven. The growing need for food for the growing population has risen a concern for competing food and non-food production systems, as all biomass production takes up arable land. From the social sustainability point of view, e.g. in biofuels sector, local communities have suffered as wealthy lands have imported biofuel crops to poorer lands. (Sheppard et al. 2011; Bosch et al. 2015) Additionally, food production has sustainability issues as well e.g. the current practices of industrial agriculture using artificial fertilizers and harmful farming practices. (Chisti 2010) Lastly, the effects of homogenic crops on biodiversity and ecosystem services, genetically modified high yield crops on biosecurity and possibly lost carbon sequestering capacity rise questions on BE sustainability. (Dale et al. 2010; Bosch et al. 2015; Sheppard et al. 2001)

Thus, it is argued that emphasizing circularity could improve the sustainable use of biomass, making BE more resource efficient and restorative. It is suggested that the principle of cascading loops should be highlighted to find the optimal use of biomass and to get the highest possible value from the biomass at all stages. (Näyhä 2019; De Besi & McCormick 2015) Additionally, the circular design strategies could be useful in the planning stage of bioproducts, to enable efficient cascading. It is also argued that BE could benefit from expanding focus from B2B networks towards consumers to e.g. ensure correct disposability in end-of-life stage. This would allow for most efficient reusability and recycling in the biobased society. (Hetemäki et al. 2017)

The main argument for CBE is that it can fix sustainability issues in CE and BE. Scholars argue that the combined concept creates synergies and thus CBE is more effective at addressing the complex global concerns. (Toppinen et al. 2020; Stegmann et al. 2020) However, the new concept has also received criticism. It has been blamed as just another new business model that maximizes growth through efficiency (Giampietro 2019).

Additionally, it has been pointed out that all sustainability issues are not yet solved, e.g. the social sustainability aspects are largely left out and (D'Amato et al. 2020; Toppinen et al. 2020). Regardless of the shortcomings, it is argued that CBE has the potential to directly contribute to 11 out of the 17 United Nations Sustainable Development Goals (Lokesh et al. 2018). It is also argued to be spatially quite inclusive as CE focuses on industrial urban processes and BE focuses on rural development (Hetemäki et al. 2017; D'Amato et al. 2017). Additionally, some debates from the BE fields could be useful in advancing a holistic CBE. For example the sustainability oriented perspectives from the bio-resource vision literature or the suggested concept of accounting of natural capital to valuate bio-resources in economic terms (Hetemäki et al. 2017), could foster a transparent and inclusive discussion which in turn could lead to a more balanced, sustainable concept.

2.1.4 Towards a systemic and sustainable CBE

Giampietro (2019) recognizes two possible interpretations of CBE implementation. A pessimistic interpretation is where the concept is seen as an oxymoron that combines two flawed concepts. It is restricted by thermodynamic constrains and the ecological boundaries pose limits to growth, thus it is not sustainable in the long run. The other is where the concepts enforce and fix each other. CE is the system where raw materials flow, which gains full circularity with renewable biological materials. (Giampietro 2019) D'Amato et al. (2017) clarify the different focus of CE and BE, stating that CE discusses how resources are used whereas BE discusses what resources are used. Thus, the idea of a combined CBE logic could be summarized as: BE forms the materials, the "what" should be used, and CE the "how" it should be used.

To arrive to the second interpretation of CBE, the transition to this bio-based and circular economic system needs a multidimensional, multilevel implementation. The global problems the concepts addresses are complex and dynamic, so called messy problems. As the problems are interrelated, they can't be solved alone but as part of the bigger system (Ackoff 1997). (Jackson et al. 2014) While some CE discussions revolve tightly around recycling only, most definitions describe CE as an "economic system" contrasting the current linear approach. Thus, it is implied that the transformation to a circular system requires a fundamental shift in the economic system. (Kirchherr et al. 2017) Similarly, some BE scholars argue for a transformative BE where the economic system is based on renewable, biological resources (Meyer 2017). Therefore, it is argued that the transition to CE as well as BE needs to be systemic and happen simultaneously on different levels of society.

The implementation of a systemic CE is examined on three levels: micro, meso and macro. The micro level usually refers to individual consumers and companies, and is implemented through concepts such as clean tech, eco-design and consumer responsibility. The meso level refers to the inter-organizational relations, often in form of eco industrial parks that utilize by-products as resources. The meso level also usually discusses regional level activities of CE. The macro level discusses structures of economies in global or national level: infrastructures such as recycling or clean energy, policies or collaborative consumption. (Geng & Doberstein 2008; Kirchherr et al. 2017; Ghisellini et al.2016) In order for the systemic shift to realize, the actors on all levels need to work in cooperation (Stahel 2016), thus creating a virtuous circle where public policies support companies through policies and legislation, enabling them to innovate new sustainable solutions for responsible consumers, who are willing to change their behavior and adopt the new solutions. (Inigo & Blok 2019; Ghisellini et al. 2016)

It is argued that especially for a systemic CBE, collaboration between different actors is crucial (DeBoer et al. 2020). The cascading use of biomass is in the heart of CBE. For efficient cascading, companies must work in close cooperation to enable the efficient use of waste and side streams. (Stegmann et al. 2020) Coordinated logistics are important to connect businesses with each other as well as other relevant sectors such as the waste management (Carus & Dammer 2018; Stegmann et al. 2020; Zabaniotou 2018). The resulting interconnectedness of value chains require coherence in technologies and practices as well as good communication (Lokesh et al. 2018). It is also recognized in the literature, that new innovations outside the companies' focus areas are central for the transformation towards sustainability. Efficient cascading use of biomass requires new innovations through the entire value chain, and it is highlighted that besides technological innovations also disruptive innovations on how and where to use the existing technologies, are needed. (Näyhä 2020; Lokesh et al. 2018) Thus, innovations in products, processes and business models are necessary, and collaboration is essential in their development.

Additional important argument from the CE literature is, that the choices made in the design stage mostly define the sustainability of later life stages of the product (Ghisellini et al. 2016). Thus, the “design to redesign” -thinking (EMAF 2013) might be applied as “design to cascade and collaborate” for CBE. For this kind of new innovative concepts to be born, innovative actors with knowledge from various fields and product-life stages are needed (Näyhä 2019). In addition to the versatile collaboration of the economic actors – within and across industries – it is argued that a larger societal point of view between different stakeholders on different societal levels is important, e.g. in regards to enabling policies and consumers’ acceptance (Hetemäki et al. 2017; D’amato et al. 2020).

Lastly, as it is argued that CE can be the operationalization of sustainable development (Kirchherr et al. 2017), all three aspects of sustainable development - ecological, economic and social - need to be part of the systemic implementation. CE is often described as a strategy that binds value creation with resource conservation (Velte et al. 2018) and is environmentally and economically regenerative (Lieder & Rashid 2016). These descriptions simplify the sustainable development concept and forget the social aspect. Even though the economic opportunities and ecological regeneration do benefit the humankind, it is unclear if and how CE will lead to greater social equality. (Murray et al. 2017). In terms of the social aspects, new job creation is discussed but the larger questions of values, societal structures and cultures are not discussed (Korhonen et al. 2018a). Both CE and BE have also been criticized of exporting environmental and social issues to poorer countries (Korhonen et al. 2018b; Bosch et al. 2015). Korhonen et al. (2018b) argue that a successful circular economy contributes to all the three dimensions of sustainable development, and the same argument should concern CBE. To arrive to a truly regenerative CBE all societal levels and sustainability dimensions should be balanced together.

2.2 Business ecosystems

This chapter studies the second central theoretical concept of this thesis, the concept of business ecosystems. The concept is first defined and the drivers behind the emergence of it examined. As business ecosystems are sometimes seen to be almost synonymous to business networks (Aarikka-Stenroos & Ritala 2017), it is next distinguished from other neighboring concepts. The third part outlines the characteristics of business ecosystem and the concepts benefits for different actors. The last chapter connect business ecosystems to systemic and societal perspectives.

2.2.1 Defining the business ecosystem concept

The business ecosystem is a concept for strategic management. The origin of the term is traced to Moore (1996), who first made the metaphor between biological ecosystems and business management (Rong et al. 2010; Dias Sant´Ana et al. 2020; Gomes et al. 2018). It is argued that businesses are affected by their surroundings just like changes in species affect biological organisms. Instead of viewing a company as part of an industry, it is suggested seeing it as part of an ecosystem that consists of a variety of co-evolving industries. This point of view can help businesses to anticipate strategic managerial challenges. (Moore 1993; 1996) A Scopus analysis (in May 2021) shows that the concept has remained low on publications for approximately ten years after the initial article, but the number of publications started rapidly rising during the early 2000's. The academic discussion is dominated by ICT ecosystems such as platform ecosystems (Adner 2017; Järvi & Kortelainen 2017) and this is visible in the Scopus analysis as well: the dominant subject areas are computer science and business management & accounting.

The ecosystem concept is seen to describe well the increasingly networked nature of contemporary business. For example globalization of competition and continuous technological change have been recognized as drivers towards this change. Value is no longer created only inside a firm as companies are increasingly able to outsource the activities around their core competencies. (Möller & Halinen 1999) Knowledge and creativity from outside the firm are also important in the creation of new innovations (Chesbrough & Appleyard 2007; Halinen & Törnroos 2005). The possibilities for coordination are enabled by the rapid progress of information and communication technologies (Adner 2017). Instead of traditional dyadic relationships, the value creation has shifted to networks and involves multiple different types of actors, such as customers, legislators and universities (Möller & Rajala 2007). It is recognized that to succeed, a business must attract resources from a multitude of partners vertically and horizontally. Many of these organizations do not belong to the traditional value chain of suppliers and thus the concept of business ecosystems is suggested to aid management and strategy development. (Moore 1993; Iansiti & Levien 2004)

Moore defines business ecosystem as an economic community of interacting organizations and individuals who – collaboratively and competitively – coevolve toward shared visions and support ongoing new innovations. (Moore 1993; Moore 1996) Another influential definition is provided by Iansiti and Levien (2004) who state that the performance of a firm derives from "*the success of their respective business ecosystem (...), loose networks – of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations – affect, and are affected by, the creation and delivery of a company's own offerings.*" (Iansiti & Levien 2004, p. 69). Also other stakeholders such as regulators, customers and companies producing complements are frequently mentioned (Santos & Eisenhardt 2015; Tsujimoto et al. 2018; Gomes et al. 2018). Setting out the ecosystem mechanisms, Adner (2017, p. 40) defines the concept as "*the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize*". These descriptions paint a picture of interconnected stakeholders within and across industries, who are coevolving in a collaborative or competitive manner towards a common goal.

The concept has been criticized in the literature for being only a buzzword without real meaning. The definitions have been blamed to be loose, too broad and unclear (Tsujimoto et al. 2018; Aarikka-Stenroos & Ritala 2017; Suominen et al. 2019). In addition to the term "business ecosystem", the literature suggests multiple sub terms, such as platform ecosystem (e.g. Gawer 2014; Jacobides et al. 2018), entrepreneurial ecosystem (e.g. Shi et al. 2018), knowledge ecosystem (Suominen et al. 2019) and innovation ecosystem (e.g. Adner & Kapoor, 2010; Suominen et al. 2019). The plethora of sub terms with both overlapping and contradictory interpretations is confusing and thus the business ecosystem literature lacks conceptual clarity. (Gomes et al. 2018) However, the theme of innovations is strongly present in all: Platform ecosystems discuss e.g. platform complementing innovations. Knowledge ecosystems discuss e.g. information sharing that often aims for better innovation. Entrepreneurial ecosystems highlight the role of geographical proximity in innovation. Thus, innovation is the common underlying denominator of most ecosystem literature and was highlighted by Moore (1993) in the seminal article already.

2.2.2 Business ecosystems in the field of network research: neighboring concepts.

If business ecosystem is an economic community of interacting stakeholders, how does the concept differ from a network? Whether or not business ecosystem is a synonym for a network, the literature has differing point of views (Aarikka-Stenroos et al. 2017; Anggraeni et al. 2007). One of the most cited definition by Iansiti and Levien (2004) defines business ecosystems as “loose networks”. The initial description by Moore (1993; 1996) highlights business ecosystem as a larger entity than a network, however Adner (2017) argues that this characterization and its numerous followers are hard to distinguish from other network theories. In general, practitioners are found to view ecosystem as a bigger entity and networks as smaller structures. Ecosystems can be seen to also include networks that describe the relations within the ecosystem (Wulf & Butel, 2017). Likewise, Jacobides et al. (2018) argue that ecosystems can include strategic alliances. Further, Aarikka-Stenroos & Ritala (2017) argue that all ecosystems are comprised of networks.

As the concept is still ambiguous and looking for form, the literature often discusses business ecosystems in relation to other network theories, pointing out distinguishing characteristics. Clusters discuss cross-industry collaboration of companies, usually within interrelated sub-industries or a particular field, located in geographical proximity (Möller & Halinen 2017; Rong et al. 2010; Suominen et al., 2019). The scholars argue that there is partial overlapping with the ecosystem concept, but the latter generally has a larger scope across industry boundaries. Also, geographical proximity is not usually mentioned, with the exception of entrepreneurial ecosystem. Another related concept that emphasizes close locations is industrial symbiosis or industrial ecosystem. This concept is seen to be different from business ecosystems as it concentrates on monitoring material flows, whereas ecosystems are concerned with business actions, value creation and capture (Aarikka-Stenroos & Ritala 2017; Tsujimoto et al. 2018). Industrial structure and value or supply chains are conceptual tools to also analyze the character of networked firms. They usually discuss hierarchical bilateral relationships and controllable situations when ecosystems are typically not hierarchical and have multilateral relationships and are better in understanding the uncertain and dynamic elements. (Adner 2017; Rong et al. 2010; Rong et al. 2018) Less hierarchical and more dynamic concepts are open innovation, strategic net and strategic alliance. The concepts do partially overlap but in relation to ecosystem, strategic alliances and nets focus on smaller amount stable relationships and open innovation is mostly concerned with creation and exchange of knowledge and innovation only in the R&D and market stage of the value chain. (Adner 2017; Rong et al. 2010; Tsujimoto et al. 2018; Jacobides 2018) Table 1 summarizes some of the neighboring concepts frequently mentioned in the literature and distinguishes them from the ecosystem concept.

Table 1: Added scope to the field of network research by the concept of business ecosystem (Rong et al. 2010; Adner 2017; Möller & Halinen 2017; Aarikka-Stenroos & Ritala 2017)

Neighboring concept terms	Neighboring concept attributes	Added scope of business ecosystem concept
Cluster	Interrelated industries and fields Geographical proximity	Wider cross-sectoral scope Not necessarily geographical proximity
Industrial symbiosis/ ecology/ecosystem	Focus on material flows, aim to extend value of a material Geographical proximity	Focus on business actions, e.g. new value creation and capture Not necessarily geographical proximity
Value/supply chain	Hierarchical relationships Bilateral relationships Stable positions	Non-hierarchical Multilateral relationships More dynamic perspective
Open innovation	Focus on creation and exchange of knowledge Focus on R&D and market	Multiple integrated actors Multilateral relationships and coordination Comprehensive focus
Strategic net/alliance	Focus on actor ties Stable relationships Set agreements and goals	Focus on value proposition More flexibility

As different types of networks are rather intertwined with business ecosystems, the concept resonates well with existing network theories. However, it is argued that these network theories are not enough to analyze the character of the dynamic and multifaceted business environment of today. Uncertainty and interconnectedness among different stakeholders and industries call for new approaches. (Rong et al. 2010) The new ecosystem concept is seen to add value to the analysis allowing for better understanding of coordination among partners and making interdependencies between actors explicit (Adner & Kapoor 2010; Jacobides et al. 2018). It is suggested that the ecosystem concept rises the analysis to the system level, thus it can be seen as new layer in which the different business networks are embedded. Alternatively, it can be seen as another perspective providing new approaches for analyzing the character of the networked business environment. (Aarikka-Stenroos & Ritala 2017; Möller & Halinen 2017; Anggraeni et al 2007)

2.2.3 Business ecosystem aspects

This chapter examines the distinct characteristics of a business ecosystem. The concept of business ecosystems was defined as "*the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize*" (Adner 2017, p. 40). This definition neatly describes how the ecosystem approach is centered around the value proposition – the benefit that is to be created – instead of the products firms need to produce. This perspective naturally includes the analysis of partners. It starts from the end goal and travels backwards to recognize the set of actors that are needed for the value proposition to be fulfilled. (Adner 2017) It is emphasized that ecosystems are systemic entities, and the value is co-created in interaction of the ecosystem participants (Thomas & Autio 2012; Vargo et al. 2015). The ecosystem perspective is especially relevant when the multilateral relationships of co-creation can't be decomposed into bilateral relationships, i.e. the relationship between actors A and B is affected by the relationship between A and C. (Adner 2017)

Additionally, the ecosystem has a non-hierarchical, co-evolutionary logic: the participating actors are evolving towards their individual goals and these goals are aligned through the shared ecosystem vision (Suominen et al. 2019; Rong et al. 2010; Adner 2017). The ecosystem often has symbiotic relationships. The complementary capabilities of participants create synergies in their co-evolving journey. The synergistic development keeps the ecosystem together, but it is also argued that fair sharing of value across the ecosystem is highly important for the ecosystem performance and longevity. Despite the non-hierarchical and self-organizing nature, ecosystems are characterized as rather stable institutions. (Thomas & Autio 2012) It is also argued that the co-evolutionary logic is the aspect that moves the analytical focus of the concept beyond other similar concepts as it binds the ecosystem actors together in both short- and long-term (Aarikka-Stenroos & Ritala 2017).

For the structure of business ecosystem, some scholars argue it is not a widely researched topic in academic literature. However, multiple articles have recognized that ecosystems often organize around a "keystone", "orchestrator" or "hub". It is normally a larger company assuming a leadership role in connecting organizations, providing stability and aligning values and visions (Nambisan & Baron 2013; Suominen et al. 2019). Around the keystone, niches can emerge, where different niche organizations join and add value to the ecosystem with their specialized capabilities. (Iansiti & Levien 2004; Rong et al. 2013) Thus, instead of set architectures, the ecosystems are described as dynamic and systemic entities, where actors are interacting independently but towards a shared goal. (Haarla et al. 2018; Vargo et al. 2015) In terms of boundaries, it is argued in the earlier literature that it is not possible nor necessary to draw clear boundaries (Moore 1996; Iansiti & Levien 2004). However, more recently scholars have seen the boundaries as a necessary aspect and it is suggested they can be determined by the value proposition or value creation process (Colombo et al. 2017; Nambisan & Baron 2013).

But why companies choose to initiate and participate in business ecosystems? In emerging industries ecosystem structure allows firms to benefit from a wider range of capabilities across industries. In mature industries ecosystem thinking can be helpful in finding new ideas for continuing growth. From the keystone perspective, it is a way to involve other organizations flexibly and effectively to work towards their goal. (Thomas & Autio, 2012; Moore 2006) Resources, capabilities and knowledge can be shared. These can as well be transformed and new resources can emerge (Musiolik et al. 2012). Even though a keystone is typically the actor aligning visions, the entire ecosystem can be co-envisioning the innovation trajectory (Moore, 2006). Especially in technology-based ecosystems, the development is synergistic and working in isolation is likely dangerous (Santos & Eisenhardt 2005). Rong (2013) gives the example of mobile operating systems, where open-source systems have been more successful than controlled environments in the early 2000's. However, also non-technical ecosystems need multiple ecosystem actors onboard for the value proposition to materialize (Adner 2017). (Rong et al. 2013)

From a smaller firm niche perspective, acting in an ecosystem can offer stability and resources and a way to join momentum around an innovation. As the ecosystem leader is aligning values and innovation trajectories, the niche firms can trust that participating in the ecosystem will in fact lead to value creation and capture (Thomas & Autio 2012; Moore 1993). The keystone stability offers a space for creation and can simplify coordination and communication within niche firms. This can also encourage co-creativity. If the smaller firms provide keystones with outsourced knowledge and innovation, these benefits can also spill over the other niche firms. (Rong et al. 2013) These benefits can be products and technologies, but practices and social networks as well (Haarla et al. 2018). The ecosystem infrastructure can also bring tangible resources within niche firm reach, such as financing and customer feedback mechanisms and market access. From a new or small niche firm perspective, these things can otherwise be difficult to attain (Nambisan & Baron 2013). (Moore 2006; Iansiti & Levien 2004)

From the managerial point of view, business ecosystems are seen to be challenging to manage. The literature also asks that if ecosystems are self-organizing, is management even possible? (Aarikka-Stenroos & Ritala 2017) Even though the ecosystem can have a leader, it does not have a "boss" as all participating firms make the decision of participation individually. Each actor defines their ecosystem strategy themselves (Adner 2017; Anggraeni et al. 2007) and has different attributes and decision making-principles (Tsujimoto et al. 2018). If the ecosystem includes very diverse members – e.g. profit-seeking firms, customers, regulators – it is understandable that the motivations can differ. The heterogeneity of the ecosystem actors is hence a positive aspect in a sense that it adds value to the ecosystem but can complicate the managerial actions. It is thus argued that the ecosystem should be mostly coherent, so that the actors' optimal decisions would naturally fit the ecosystem (Tsujimoto et al. 2018) Another helpful aspect is the presence of symbiotic relationships (Haarla et al. 2018; Thomas & Autio 2012).

For the managerial actions, it is argued that the ecosystem leaders should be able to provide a compelling vision and goal as well as have enough legitimacy and reputation to convince other actors to join their vision (Thomas & Autio 2012; Moore 1996, 26; Anggraeni et al. 2007). The communication likely attracts actors whose behavior is naturally fit to the decision-making and principles of the ecosystem (Tsujimoto et al. 2018) thus leading to a coherent ecosystem. As there is no hierarchical governance in ecosystems, "soft factors" such as trust, commitment and participatory leadership have been found to be effective managerial mechanisms in system building networks (Planko et al. 2017). It is also argued that if ecosystem managers understand the underlying ecosystem dynamics well, strategic management is possible (Tsujimoto et al. 2018).

2.2.4 Business ecosystems for systemic sustainability

Societal transitions, such as the transition to a sustainable society, are systemic events. A system transition includes simultaneous processes on multiple dimensions and levels. A society is a sociotechnical system that consists of a cluster of elements (e.g. technology, culture, infrastructure, supply networks). In the transition these elements are co-evolving simultaneously, linking up and reinforcing each other. This can be seen as a system innovation. (Geels 2005) It has been argued that this kind of systemic view is important particularly for sustainability transitions (Musiolik et al. 2010; Jacobsson & Bergek 2011) and that the business ecosystem concept offers a suitable analysis tool to assess them (Planko et al. 2017; Lazarevic et al. 2019). The business model perspective has been suggested for the unit of sustainability transition analysis as well (Brenner 2018), but the business ecosystem is seen to better encompass the co-evolutionary logic, inter-firm collaboration dynamics and value co-creation that are necessary aspects of transition.

Innovation is a collective action and together firms and stakeholders can change their environment for such where their business can thrive (Jacobsson & Bergek 2011; Planko et al. 2017). The ecosystem literature discusses how for all innovations there are complements that benefit the customers, as well as the innovations itself, and firms are not able to produce the solutions alone (Moore 2006). Similarly, complements benefit transitions as they interlock and align developments, reinforce each other and eventually can create change in regimes (Geels 2005). The ecosystems are able to do this in a flexible and efficient manner as they are reducing transaction costs between actors and thus enabling attachment of new contributors and customers at modest incremental cost (Moore 2006; Thomas & Autio 2012).

Moore (2006) argues that business ecosystems can contribute to society by providing 8 different public goods. Four intangible public goods that inspire collective action are 1. the concept of business ecosystem as collaboration network, 2. space for business opportunities, 3. specific business ecosystem contributors and 4. innovation trajectory. Four tangible public goods that are enabling these actions are 1. campaigns, 2. infrastructure, 3. customer feedback and 4. financing. The idea is that the concept of business ecosystems provides space, mechanisms and an idea how distributed but coevolutionary innovation can be pursued. It also embraces the idea of a virtuous circle. It suggests that thinking beyond current offerings or industry boundaries, connecting different actors and reorganizing the economic landscape can help solve major economic and social problems. (Moore 1996; Moore 2006)

These ideas are recognized also by other scholars: it is argued that the keystone actors of ecosystems can act as innovation intermediaries for networks, that are sharing existing resources but as well attracting new emerging resources, knowledge and support (Musiolik et al. 2010; Lazarevic et al. 2019). It should also be pointed out that ecosystems are people and practices as well (Haarla et al. 2018). Already in the early publications, Moore (1996) has described business ecosystems are social systems that are able to create communities of shared imagination and thus co-evolve towards shared goals. Thus, the ecosystem structure can facilitate the cooperation needed for a transition.

In conclusion, business ecosystems are argued to not only bring benefits to businesses, but to the society as well. The creation of the public goods and social structures can bring actors together to work towards new innovations. For the societal impacts of ecosystems, it is argued that the benefits can spillover and benefit the society at large as new products and services (Audretsch et al. 2018). As the decision making in ecosystems is decentralized, they are able to coordinate innovation without hierarchical organization (Moore 2006; Peltoniemi 2006). This makes the nature of ecosystems emergent and self-organized, similarly as systemic transitions are emergent and uncoordinated processes (Musiolik et al. 2010). Although, it is also argued that in order to benefit sustainability transitions, at least some actors in the business ecosystem must have goals to deliver sustainability benefits. (Lazarevic et al. 2019) As a multi-level and coevolutionary perspective, business ecosystem can thus be a suitable analysis tool for systemic sustainability transitions.

2.3 Research framework: business ecosystems for CBE

This chapter summarizes the most relevant observations from the two main concepts and binds them together into a pathway to systemic CBE. Based on these observations a research framework is proposed: business ecosystems for CBE. The framework highlights business ecosystem aspects that can be seen to be beneficial for the emerging CBE. It suggests how these aspects help different actors to interact and thus enable a transition towards a sustainable CBE society. This framework is later used in the empirical section as a tool for analysis.

2.3.1 CBE as a pathway to a sustainable society

The concerns of climate change and natural resource scarcity were presented as the starting point for this thesis. CE and BE have both been suggested as solutions to these global sustainability challenges. CE stresses the circulating and efficient use of raw materials and goods and thus relieves the pressure on finite resources and produces less waste (EMAF 2013; Kirchherr et al. 2017). BE brings solutions such as renewable raw-materials and bioenergy, that can reduce the dependence on finite fossil raw-materials and result to less GHG emissions (Meyer 2017; Bugge et al. 2016). Recently, it has been suggested that these concepts should be merged into a circular bioeconomy (CBE). The concepts do have considerable overlapping, e.g. the highlighted importance of renewable energy and the principle of cascading use of raw materials. But most importantly, it is argued that they can complement each other by resolving some of the sustainability issues in the other. (Toppinen et al. 2020; Hetemäki et al. 2017) Thus, CBE can be better equipped to answer the global challenges.

One of the fundamental issues in CE is that it is restricted by the thermodynamic constraints. Every loop creates entropy – losses in either material quality or quantity – and the circulating processes consume energy. (Giampietro 2019) Consequently, perfect circulation is impossible to achieve, and new materials and energy will always be needed. While CE can reduce the pressure on finite raw materials, there remains a dependence that should be further reduced in today’s fast-growing society. Here BE can improve CE by providing renewable raw materials (Allen 2016). Vice versa, CE principles can be used to improve sustainability in BE. The sustainability in BE is debated and some scholars argue the sustainability issues do not receive enough attention (Pfau et al. 2014; Staffas et al. 2013). The principle of cascading loops is present in BE, but increased CE thinking could further improve the resource efficient and restorative nature of bioeconomy at all stages of product life (Hetemäki et al. 2017). A part of BE literature also calls for a transition to a bio-based economic-system (e.g. McCormick & Kautto 2013) but does not suggest how to get there (Bugge et al. 2016). Additionally, another beneficial crossing point between CE and BE regards the location: CE is often discussed in urban whereas BE in rural context (D'Amato et al. 2017). A merging CBE concept can thus result to a more inclusive and sustainable future.

To conclude the CBE recipe for a sustainable society, CE describes how the system should work and BE describes the materials (D'Amato et al. 2017; Giampietro 2019). It can thus be summarized that BE is the “what” should be used, while CE is the “how” these materials should be used in the economic system. Even though the combining concept of CBE is providing a more comprehensive point of view, it is argued that much of the criticism towards bioeconomy or CE is still relevant to CBE: it is not clear how the ultimate decoupling of growth and resource use is achieved, the social sustainability aspect is often forgotten or diminished into discussion of job creation and essentially CBE is just another economic model aiming to maximize efficiency (Giampietro 2019; Geissdoerfer et al. 2017). Despite the shortcomings, it is seen that the merging concept creates synergies and has the potential to better contribute to achieving sustainable development goals (Lokesh et al. 2018). (Hetemäki et al. 2017)

2.3.2 Systemic transitions and CBE

To conduct the transition to such a sustainable and circular society, it needs to be implemented simultaneously on different levels of society in a systemic manner. The CE literature examines a systemic shift on three societal levels – the macro, meso and micro – and it is highlighted that all levels must work in cooperation (Kirchherr et al. 2017; Geng & Doberstein 2008; Stahel 2016). From another perspective, in the system transition literature, the same levels are recognized. Additionally, the society is conceptualized as a sociotechnical system that consists of different clusters (e.g. technology, culture, infrastructure, supply networks). The system transition is described as a system innovation, where these clusters are co-evolving simultaneously. (Geels 2005). Thus, the change needs to happen simultaneously and in cooperation within the different levels and clusters. The elements are changing and innovating in relation to each other, linking up and reinforcing each other, finally creating new practices and new systems (Geels 2005). It has been argued that especially for sustainability transitions, which a CBE transition is, this kind of systemic perspective is important (Musiolik et al. 2012; Jacobsson & Bergek 2011).

In the CE context, the micro level refers to individuals such as consumers, firms or products. Meso level discusses the industrial symbiosis and eco-industrial parks, macro level discusses the social and structural elements of the economy. (Kirchherr et al. 2017; Geng & Doberstein 2008; Ghisellini et al. 2016) In the CE literature the perspective is economic, while in the system transition literature the perspective is socio-technical. The “socio” implies that instead of only the economy, it concentrates more on functionality, the fulfillment of societal functions (e.g. transportation). The “technical” implies that nowadays technological solutions are central part in delivering these functions. (Geels 2004) The micro level is named as the niche level, and it is seen to be formed by technological niches where new innovations emerge. The meso level is formed by socio-technical regimes, i.e. groups that follow a so-called set of rules and are interacting with each other. The macro level is the socio-technical landscape, the wider environment formed by sociotechnical development (e.g. globalization or cultural changes). (Geels 2005; 2002) To conclude these descriptions from the two perspectives, the micro level examines the individual entities: consumers, firms or groups. The meso level examines the relations between these entities, e.g. inter-firm or inter-group interaction. The macro level examines the wider context or environment which builds up with time and therefore is difficult to influence by will.

To achieve a CBE transition, cooperation is key (D'Amato et al. 2020; Temmes & Peck 2020). It is discussed that circularity within production systems needs cooperation between businesses, within and cross sectors (Ghisellini et al. 2016; EMAF 2013). Modular design, recycling of parts and materials, and repairing services are examples of circular practices where different actors along the value chain need to collaborate and share information. Similarly, in the BE point of view, the cascading use of biomass and utilization of side streams require cooperation. Joint efforts between research institutions and industry to create niches of innovations is highlighted. (De Besi & McCormick 2015; Dale et al. 2010) Collaboration between business actors and consumers and policymakers is as well important. Many activities that close or slow down the loops, e.g. using repair or collaborative consumption services or the appreciation of used items, require acceptance and participation by consumers and may need enabling or encouraging policies to support. (Stahel 2016; Abbey et al. 2015; Stegmann et al. 2020) Lack of collaboration between the societal layers, i.e. supporting policies and consumer acceptance, have been found to hinder the advancement of CE. Interestingly, lack of collaboration within business actors is noted as a barrier as well. This lack of support in network and partners, conflicting business culture, hesitant company culture and limited willingness to collaborate have been reported as some of the most pressing barriers for the implementation of CE (Kirchherr et al. 2018). (Tura et al. 2019)

2.3.3 Business ecosystems for CBE transition

To examine sustainability transitions, the concept of business ecosystems is suggested as a unit of analysis (Lazarevic et al. 2019; Planko et al.2017). The concept argues that strategic managers should view their business as part of a business ecosystem, as a larger entity than the traditional network. For all offerings there exists complements that benefit the firm and the customers. As firms are not able to produce all these solutions alone, the performance of a business derives from the success of their ecosystem. The value derives from co-creation. (Moore 1993; 2006; Iansiti & Levien 2004) Similarly from the system transition perspective, complements benefit transitions as they interlock and align developments, reinforce each other and eventually create change (Geels 2005). These complements and the surrounding business ecosystem could be seen to be important for a CBE transition as well. The capacity to create exchanging and linking patterns across sectors and product life are highly important for the circular logic. For example, the development of industry standards, match maker mechanisms and the alignment of incentives among business partners can enable cascading of materials, new business models and services to tighten and close the loops (EMAF 2013; Ghisellini et al. 2016).

The business ecosystem concept is not the only unit of analysis suggested, however, it has advantages over many others. Business models, industrial symbiosis, value chains and other network theories are all discussed in relation to circularity and cooperation. In comparison, business ecosystem is seen as a larger entity. It possibly includes these other structures but in addition broadens the analysis to encompass different societal levels and examines the intertwined relations between different actors in a dynamic manner (Wulf & Butel 2017; Rong et al. 2010). It is also argued to be better at analyzing the co-evolutionary, self-organizing nature of a systemic transition (Lazarevic et al. 2019). These characteristics of the ecosystem enable the coordination of innovation towards a shared goal without hierarchical organization in a way that is meaningful for the independent actors (Haarla et al. 2018; Tsujimoto et al. 2018). As innovations are seen to be essential for system transitions as well as for CBE, the ecosystem concept's focus on enabling innovation is fitting. Interestingly, in their article about CE, Geng & Doberstein (2008) make the metaphor between biological ecosystems and local economic ecosystems, such as industrial parks. However, they do not refer to the business ecosystem concept. In conclusion, the concept of business ecosystem encompasses many elements that are crucial from the system transition as well as from the circular perspective and therefore it could be a helpful analysis tool to examine possible CBE transition.

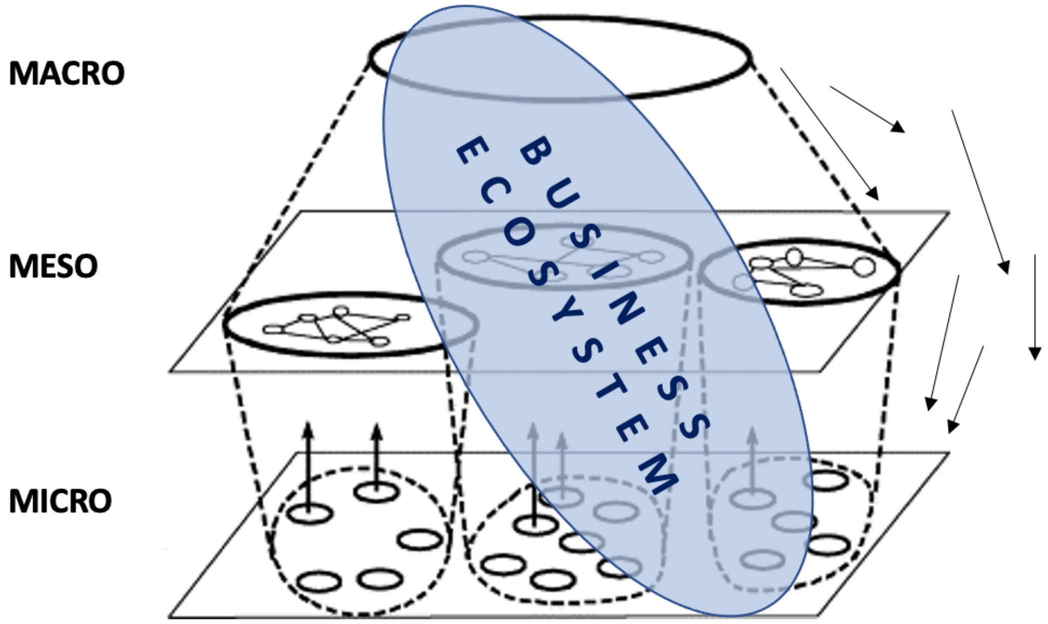

Figure 3: Business ecosystems in relation to system transition. Adapted from Geels (2002, p. 1261).

Figure 3 sketches how the business ecosystem concept could be seen in relation to a system transition. The societal layers are visualized following Geels (2002, p. 1261). As business ecosystems are typically seen to include smaller entities (e.g. Wulf & Butel 2017) and involve different types of actors (e.g. Möller & Rajala 2007), ecosystem thinking can help to understand the relations and dynamics between the societal levels. Innovations and novelties are born in the niches on the micro level. The change in the system occurs when the developments on the meso and macro level align with these novelties and reinforce the emerging development. The conceptualization of Geels (2002) argues that the levels are nested within each other, thus the micro level innovations are emerging in the context of the current reality of meso and macro level environment. Therefore, they are constricted by existing regulations, knowledge and capabilities and are aimed towards solving existing problems. (Geels 2002) The ecosystem concept could be seen to encompass all the societal layers and multiple actors within layers.

From the societal perspective, it has been argued that the ecosystems provide public goods to the society by creating a virtuous circle where different actors can be connected beyond industry boundaries to help solve major economic and social problems and reorganize the economic landscape. (Moore 1996; 2006) Both system transition- and business ecosystem literature argue that the niches on the micro level are protected spaces, so-called safe spaces for creation (Geels 2002; Thomas & Autio 2012; Rong et al. 2013). The ecosystem also aligns visions of the ecosystem actors on different clusters and levels, which could be seen to reinforce a transition. However, for this transition to realize, the individual actors are needed. They need to want to take action. Business actors are seen to be the primary actors driving the society towards a shift to circularity (EMAF 2013) and thus are an integral actor driving the transition to CBE. Figure 4 visualizes the aspects of the ecosystem structure that are beneficial from individual firm perspective and benefit the system transition as well. Hence, the figure sketches how the ecosystem can motivate businesses to take actions that reinforce a transition.

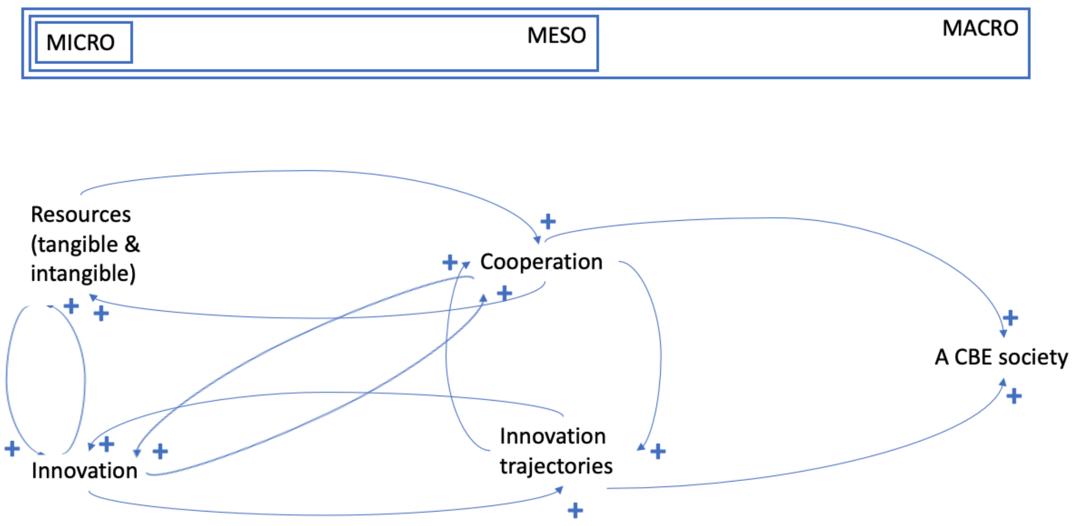

Figure 4: Research framework – Business ecosystems for CBE

On the upper left corner of Figure 4 are resources. The ecosystem literature argues that an ecosystem can provide tangible and intangible resources for the ecosystem actors. Both small and big firms may have interesting attributes to share (Thomas & Autio 2012; Moore 1996; 2006). The will to share and utilize these resources leads to cooperation between the actors, which in turn is seen to foster innovation and produce new knowledge in return, creating self-reinforcing loops between innovation, collaboration and resources. The collaboration combined with the shared ecosystem vision can foster an innovation trajectory, which offers stability and brings synergies in innovations (Thomas & Autio 2012; Moore 1996; 2006) creating more self-reinforcing loops between the micro and meso levels. These loops are the virtuous circles of ecosystem (c.f. Moore 1996). Figure 4 proposes how they link different actors on different societal levels and can eventually reinforce new development and possibly lead to can lead to a CBE society.

The proposition of this research framework is that the aspects offered by business ecosystems are beneficial for both the individual actor perspective as well as a system transition perspective. Business ecosystem thinking can thus motivate individual actors to contribute to a sustainability transition towards CBE. This proposition serves as a base to the empirical section of this thesis, which seeks to find out if the suggested ecosystem aspects in fact are motivating from the firm perspective. The suggested framework is used as a tool for analyzing the interview data.

3 DATA AND METHODS

This section discloses the data and methods of the empirical section of the thesis. For the interest of transparency and replicability, the decisions along the process are justified and explained thoroughly. As suggested by Yin (2003) the report aims to maintain a chain of evidence so that the steps throughout of the study can be traced. Thus, this chapter explains all the steps of this research. First, the choices of research method and case ecosystem are explained. The second chapter briefly introduces the case and the relevant case actors. Next, the data collection and analysis procedures are discussed. Lastly the reliability and validity of this research are addressed.

3.1 Research method

This research is conducted using the case study method. It is an empirical study method that is especially suitable to investigate new topic areas in a real-life context (Yin 2003; Eisenhardt 1989), therefore it is an appropriate method to explore the real-life motivations and issues that organizations have in relation to joining a business ecosystem. This study is an instrumental case study: it aims to illustrate a larger phenomenon through the case. Both main theoretical concepts, circular bioeconomy and business ecosystems, are still fairly unorganized and new phenomena and therefore the aim is to gain new insights into the crossing point of these concepts. Essentially to understand whether or not the concept of business ecosystems would benefit or advance CBE business and transition. The main strengths of case studies are depth and thorough understanding of the phenomena and the focus on context and dynamic interactions. Thus, they are seen to be appropriate for studying networked systems (Riege 2003) such as business ecosystems. (Flyvbjerg 2011; Marshall & Rossmann 1995) This research is conducted as an embedded single case study to thoroughly explore the phenomena. Representatives from 9 different organizations acting within the case-ecosystem were interviewed. The aim was to get multiple different point of views from different types or organizations to deeply understand the case.

The Äänekoski ecosystem was chosen as the case as it was seen to be a good example. The forest sector is argued to be central in the CBE transition as it is significant in volume, and wood-based materials hold the potential to replace almost all products traditionally made from fossil materials (Hetemäki et al. 2017). The Äänekoski ecosystem was a suitable example as it is one of the few CBE ecosystems already in operation, thus the actors were able to discuss their journey in the ecosystem. Additionally, there was already secondary material available and clearly set goals for the ecosystem. The case-ecosystem and the interviewed companies are named for the sake of transparency. However, the data is handled anonymously in the analysis to maintain some diplomacy.

The general strategy of this research is to rely on theoretical propositions, which is suggested as a preferred strategy by Yin (2003). The research questions, theoretical framework and interview questions were written based on the literature review. The nature of the process was exploratory and iterative. The research begun with identifying a chain of problems and possible solutions: the need for sustainable business, circular bioeconomy as pathway to sustainability, cooperation as means to successful CBE and lastly the question of how what motivates cooperation within CBE. Based on these assumptions, initial research questions were written and corresponding theoretical concepts identified. After a literature review a theoretical framework was built and the research questions were reassessed relying on the theoretical base. In the data gathering phase, the interview questions were based on the propositions of the theoretical framework and reassessed research questions. However, an iterative and explorative nature was allowed and as some further insights were gained during the earlier interviews, some questions were added or modified. Data analysis and discussion were as well iterative processes going back and forth between the data and the existing literature.

3.2 Case description

The establishment of the business ecosystem in Äänekoski was initiated by Metsä Group and Metsä Fibre along with the investment of the new Metsä Fibre bioproduct mill. The old Äänekoski pulp mill (started up in 1985) was nearing the end of its life cycle (i.e. continuation would have required significant repair investments) and the actors saw an opportunity in the area. The stated goal was to facilitate a business ecosystem around the new mill where new BE innovations can be born from cooperation. The idea behind the initiative was to better enable the fullest possible utilization of the wood raw material in a value adding way. In Metsä Group this is a central strategic principle. In addition, the business ecosystem aims to benefit the area and e.g. creation of new jobs in the area is mentioned as a goal. Therefore, the city of Äänekoski has been a key partner in the development of the ecosystem. In 2018, Äänekosken kehitys Oy, the development company of the city, started a project called Plänet B that aims to further enable the cooperation between different companies in various sectors at different development stages and thus helped the establishment of the ecosystem. In conclusion, the ecosystem was first a project of Metsä Fibre and its parent company Metsä Group, but it later expanded to the Plänet B entity, which is coordinated by the city of Äänekoski. (Metsä Fibre 2018;2021a; Metsä Group 2021; Plänet B 2018a; Interview data)

Metsä Group, a Finnish forest industry group, is strongly present in Äänekoski with operations form their multiple business areas. They form the basis of the industrial ecosystem and have been in the area for decades. Representatives from Metsä Fibre, Metsä Spring and Metsä Board were interviewed in this study. The new bioproduct mill is in the heart of the ecosystem and is the source of the side streams. It is the actor that fractions the wood material into a form that is possible to utilize. Over the years additional industrial actors have joined this site and form the tight industrial ecosystem. These actors have multiple direct relations and frequent communication with each other, and they form the tight industrial ecosystem. They utilize the available side stream commodities (electricity, heat, air, CO_2) and share some industrial services such as safety services and water treatments. Traditional business relationships are also present: some actors use pulp as a raw material or vice versa produce something that is needed by the other companies. Of these actors Nouryon, Specialty Minerals and Linde were interviewed. These companies are subsidiaries of large multinational companies. (Plänet B 2018b; Interview data)

The regional point of view is represented by Plänet B, Sähkötyö J. Kangas and Valio. All these organizations have a different perspective and relation to the industrial area. Plänet B is a match-making actor aiming to enable the development of the ecosystem and the regional area. Sähkötyö J. Kangas is one of the local SMEs providing services to the industrial actors. Valio is an industrial actor at the outskirts of the tight industrial ecosystem utilizing excess energy from Metsä Fibre in drying of its product. These actors have direct relations and communication with the industrial ecosystem, but not as much as the tight industrial ecosystem actors. (Interview data) Table 2 describes all the ecosystem actors interviewed in this research. The companies are briefly introduced and their relation to the ecosystem is described. All the interviewees are at an executive position and thus able to discuss participating in the ecosystem on a strategic level. A visual representation of the positioning of all actors within the ecosystem is presented later in chapter 4.1 along with the in-depth case analysis.

Table 2: Interviewed Äänekoski ecosystem actors

Company	Description
Metsä Fibre	Interviewed: VP Research Part of Metsä Group, Metsä Fibre is a producer of high quality pulp, sawn timber, biochemicals and bioenergy from Nordic wood to international markets. It is a large industrial company, the biggest producer of softwood market pulp. Metsä Fibre has been present in Äänekoski since the mid 80's. The new bioproduct mill replaced the previous pulp mill in 2017. It has been running in full capacity since 2018, with the capacity of 1,3 mt pulp/year. The Äänekoski bioproduct mill is the keystone actor of the Äänekoski industrial ecosystem, the actor who fractions the wood material making it possible to utilize it in multiple ways. (Interview no.4; Metsä Fibre 2019)
Metsä Spring	Interviewed: CEO Metsä Spring is an innovation company of Metsä Group. It is not tied to any of the 5 main business areas of Metsä Group, but instead has a group level scope. The company invests in own demo projects and promising startups that have the potential to strengthen Metsä Group's business ecosystem in the long run. In Äänekoski Metsä Spring is present in the tight industrial ecosystem via two projects: textile fibers and 3D fibre products. The textile fibre demo plant (together with Japanese ITOCHU Corporation) is currently at operational and the 3D fibre product demo plant (together with Valmet) is currently being built (operational in late 2021). Both plants are in close proximity of the bioproduct mill and use pulp as main raw material as well as other ecosystem utilities (energy, heat etc.) and shared services (safety, water treatments). (Interview no.8.; Metsä Spring 2018)
Metsä Board	Interviewed: Senior Vice President, Development Part of Metsä Group, Metsä Board produces premium fresh fibre paperboards to international markets. The products are used in food and consumer product packaging. Metsä Board is globally the biggest producer of white kraftliner and leading producer of folding boxboard and white kraftliner in Europe, thus it is a large industrial actor. Board production in Äänekoski dates back to late 1800's and through mergers and acquisitions it has become under the ownership of Metsä Group. The board mill is located in the tight industrial ecosystem and uses pulp raw material from the bioproduct mill as well as other commodities (electricity, heat) and shared services (safety, water treatments). Metsä Board also owns 24,9% of Metsä Fibre. (Interview no.1; Metsä Board 2019)

Company	Description
Nouryon	Interviewed: Operation director Nouryon is a global specialty chemicals manufacturer. The Äänekoski plant produces carboxymethyl cellulose (CMC), a bio-based water-soluble polymer that can be used as a thickener, binder, stabilizer in e.g. food-products, detergents and mining industry. The Äänekoski plant has been running since mid 40's. It used to be owned by the Metsä Group until the mid 90's, whereafter the business was sold to first J.M. Huber Corporation and then to Nouryon in early 2020. In relation to the industrial ecosystem, Nouryon Äänekoski plant is located in the tight industrial ecosystem and uses pulp from the bioproduct mill as raw material as well as other ecosystem commodities (heat, electricity) and industrial services (safety, water treatments). (Interview no. 2)
Specialty Minerals Nordic	Interviewed: Plant manager Specialty Minerals Nordic Oy Ab is a producer of precipitated calcium carbonate (PCC) which is used for fillers and coating pigments in paper and board to improve whiteness, gloss and thickness. Specialty Minerals Nordic is a subsidiary of a large multinational company Minerals Technologies Inc. The Äänekoski plant employs 11 people, thus Specialty Minerals is a rather small actor in the industrial ecosystem. The Äänekoski plant has been running since the early 90's and it is located at the tight industrial ecosystem. The plant uses CO_2 from the bioproduct mill as raw material, the ecosystem commodities and industrial services. It is typical in the field of PCC production to be located near a pulp or paper mill. Another relevant aspect is that Metsä Board (Äänekoski and other mills) is their main customer. (Interview no. 6; Minerals Technologies 2019)
Linde	Interviewed: On-site account manager Linde is a global gas and engineering company that serves a variety of different industries. Linde is the largest industrial gas supplier worldwide producing atmospheric and process gases and innovating, designing and building equipment related that produces industrial gases primarily for internal use. Linde is present in Äänekoski as an on-site supplier since the mid 2010's. The company has a plant supplying oxygen to Metsä Fibre and a plant supplying nitrogen to Nouryon. Linde is utilizing the ecosystem commodities (electricity, steam), as it is typical in on-site production to receive commodities from the customer. (Interview no. 3; Linde 2019)
Valio	Interviewed: Plant Director Valio is a dairy company producing dairy ingredients to the national and international market. The company is owned by Finnish dairy cooperatives. Valio has been present in Äänekoski since the 50's. The Äänekoski plant produces Aura blue cheese. In relation to the ecosystem, Valio is utilizing heat from the bioproduct mill. The cooperation has been going on approximately 10 years. The plant is located at the outskirts of the industrial ecosystem. Valio is also a substantive industrial actor of the region and is closely involved in many regional activities. Thus, they represent both industrial and regional point of view. (Interview no. 7; Valio 2021)

Company	Description
Äänekosken kehitys Oy / Plänet B	Interviewed: CEO / Project director Äänekosken Kehitys Oy is a company owned by the city of Äänekoski. It manages regional and business projects in the area. One of their projects is Plänet B, which aims to develop a community of global innovators and cutting-edge bioeconomy businesses in the area around the already active industrial ecosystem. The project began in 2018. In relation to the ecosystem, Plänet B acts as a match maker, supporter and enabler. The project aims to connect different actors, facilitate new cooperation and foster new competencies in the area. They also communicate the possibilities and needs of the area to attract new actors. The aim is to create a thriving ecosystem with bio-economy and clean tech start-ups, established firms and other service providers In relation to the city of Äänekoski the industrial ecosystem is located very close to the center of the city. The city also receives district heat from the industrial ecosystem. This interview represents the regional point of view and discusses both small and big business perspectives. (Interview no. 4; Plänet B 2018a)
Sähkötyö J. Kangas / Äänekosken yrittäjät	Interviewed: Owner-entrepreneur/Chairman Sähkötyö J. Kangas is providing electrical installation services in electrical automation and instrumentation in Äänekoski area. The company has been in business in the area since the 80's. The interviewee is also the chairman of Äänekosken yrittäjät, the local entrepreneurs' association. It is part of the nationwide association that aims to advance entrepreneurship in the area. It consists of mostly SMEs and has been active in the area since the 40's. Thus, the interviewee is able to provide a point of view of their own as well as a glimpse from the other SMEs in the area. In relation to the ecosystem, Sähkötyö J. Kangas operates as a contractor, offering services to many of the industrial actors in the tight industrial ecosystem as well as other industrial actors in the area. They are also frequently in contact with other SMEs in the area. (Interview no. 9)

3.3 Data collection

For case studies it is typical to combine multiple data collection methods and interpretive perspectives (Eisenhardt 1989; Marshall & Rossmann 1995) and this research as well uses both primary and secondary data. The theoretical framework is based on secondary data collected from academic journals and authoritative reports. The academic articles were sourced mostly from the Primo database offered by LUT University and Google scholar and the policy reports from Google search. An overview of the theoretical concepts was conducted with the Scopus database analytics. The secondary data for the background of the study and the analysis was collected from company websites, reports and other media. This information was sourced via Google search and navigating around company websites. The primary data for the analysis was collected via semi structured interviews with representatives of 9 companies acting in the ecosystem.

The companies were chosen based on the description of the ecosystem and its actors in the Plänet B and Metsä Fibre online materials (Plänet B 2018b; Fibre 2018). The aim was to interview actors who already are in business in the area and who could be seen to utilize CE, BE or CBE principles. Other criteria was the diversity of the actors, the aim was to interview a few actors belonging to Metsä Group, a few other industrial actors and a few regional actors. The contact information was acquired mostly from company websites and internet. To find a representative of small businesses in the area, that are mentioned as important part of the ecosystem but not named in the materials, the Plänet B representative was asked for a suggestion. The companies were contacted via e-mail or if necessary, by phone. The companies were asked for an interview with an executive level person, who would be able to discuss belonging to the ecosystem on a strategic level. For different companies this meant different things, the interviewees' positions ranged from plant director to CEO. In general, the smaller the organization, the higher the position of the interviewee. Many industrial actors in Äänekoski belong to large multinational companies and thus in these cases the plant directors were best capable of answering questions related to the ecosystem.

The interviews were conducted as semi structured thematic interviews. Gioia et al. (2013) suggest that designing interviews too tightly around existing theory and terminology might not allow new unknown insights to be found. The semi structured thematic interview protocol allowed the interviewees to first discuss the themes freely but also ensured that the same core topics were covered in all interviews. The thematic questions were based on the research question and sub questions of the thesis: What are the main motivations to join a CBE ecosystem? What other benefits there are? What kind of questions there are to be solved before the cooperation can begin? The interviewees were informed about the interview main themes beforehand via email. The supporting semi structured questions were formulated based on the theoretical framework as relying in theoretical knowledge is recommended by Yin (Yin 2003). The supporting questions addressed the aspects of circular economy, management of ecosystems, communication and sustainability. The interview preparations also included getting familiar with the company through the company websites and media coverage if available.

The interviews were conducted via video calls over Microsoft Teams or Zoom platforms. An audio of the interview was recorded with interviewees' permission to allow for accurate documentation and analysis. Most of the interviews took place in November and December 2020, but two additional interviews were conducted later in January and February 2021 due to the busy schedules of the interviewees. The durations of the interviews ranged from 30 to 60 minutes. The atmosphere of the interview was attempted to be kept neutral or positive so that the interviewees would feel good to share their thoughts. Some interviewees spoke quite freely and elaborated on the themes, whereas others answered in a shorter manner. Mostly the same questions were asked in all interviews but the order varied slightly as it was attempted to follow the train of thought of the interviewee. Also, when new insights were gathered along the process, a few questions were added, e.g. about timing and nature of process industry.

3.4 Data analysis methods

The data analysis process did not follow any predefined method, yet it was made sure that the process was similar for each interview analysis. The process is described in Figure 5. The first step of the analysis was transcribing the interview recordings. This was done manually and shortly after the interviews. Basic level of transcription was chosen as a sufficient level for this analysis as the purpose was to analyze the content of the speech. Thus, the exact expressions were written down, but some filling words, repetitive and irrelevant information (e.g. small talk) were left out. The tone of the discussion was not interpreted at the transcription stage, although it was later noticed that the overall atmosphere of the discussions had been quite positive and the attitude towards the other ecosystem actors was polite and respectful. The second step of the process was to pick up all most relevant quotes, summarized information and some remarks from each interview into an excel workbook. The third step was to code these points into the three themes suggested by the research questions: motives, added value and questions to solve.

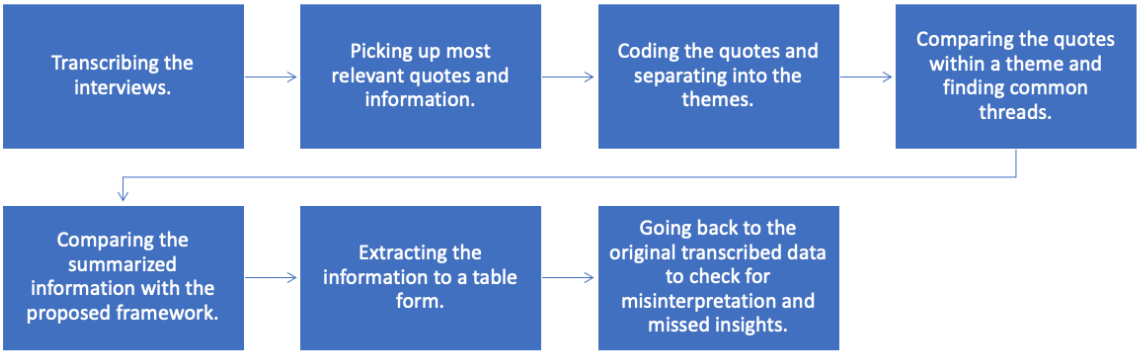

Figure 5: The data analysis process

After coding, the fourth step of the process was to gather the quotes and observations within each theme into separate documents for comparison to see if common threads could be found. Thus, at this stage the most relevant information was summarized. In the fifth step this summarized information was then compared to the proposed research framework and the observations were assigned to corresponding ecosystem aspects. After, the information was extracted into a table form. This was an iterative process: the form of the table was not predefined and multiple different styles were attempted in order to find the most clear form of presentation. In the last step the original transcriptions were read through once again to make sure the information had not been misinterpreted at some point during the analysis process or if some relevant information had been missed earlier.

Even though the case and the interviewed companies are identified and named in the research, during the writing process the interview data is handled with anonymity, so that it is not possible to connect quotes to the interviewees. This is suggested by Gioia et al. (2013) for maintaining diplomacy and transparency at the same time. However, the represented companies are grouped into three groups in the case analysis to allow for highlighting their different perspectives in the analysis.

3.5 Reliability and validity

Reliability and validity address the quality of the study. Most importantly, adequate documentation and transparency were practiced and choices along the process are justified. The report aims to maintain a chain of evidence so that reader can trace the steps of the study and follow the train of throughout from initial research question formulation until the conclusions (Yin 2003). Case study is a valid method for this research as the goal is to gain an in-depth understanding of the phenomena in a real-life context. The selected case is a good fit for the research: the Äänekoski ecosystem operates on the field of CBE and has a goal of fostering new business and innovations. Thus, the selected case resonates with both main theoretical concepts and represents a real-life CBE actor well. The organizations within the case and their representative informants were chosen based on available information on who would best be capable of answering the interview questions. The information-oriented selection aims to achieve the greatest possible amount of information from the small sample (Flyvbjerg 2011).

For general reliability and validity, suggestions by Yin (2003) and Riege (2003) were followed. It is suggested to use multiple sources as evidence and to triangulate between them in order to look at the same phenomenon from different angles and find converging lines. This study uses multiple data sources: semi-structured interviews, publicly available media and academic literature. In addition to data triangulation between these different data points, the findings are examined through different theoretical and informant perspectives. Additionally, it is suggested that the research findings are compared to existing literature to analytically generalize the findings in relation to a broader theory.

4 EMPIRICAL ANALYSIS AND FINDINGS

This section analyses the data and presents the empirical findings. The first chapter sets the scene and describes the ecosystem from an analytical perspective. What kind of ecosystem is the Äänekoski ecosystem and how did it emerge? This analysis is based on the collected interview data and observations made from company websites and media during interview preparation. If referenced to a specific expression or document, the source is mentioned in parentheses. The second chapter dives deeper into the interview findings. What do the ecosystem actors think of participating in the business ecosystem? The interview findings are reflected against the suggested research framework. The interview data is handled with anonymity, meaning no direct quotes are used and findings are not connected directly to the interviewee.

4.1 Case analysis: what is the Äänekoski ecosystem?

In the official communications (e.g. Metsä Fibre 2018;2021; Plänet B 2018a;2018b) the Äänekoski ecosystem is mostly referenced to as a business ecosystem with focus on BE. However, as the full utilization of side streams is mentioned as a central goal, the ecosystem could be seen as a CBE ecosystem as well. Even though the business ecosystem discourse in the communications is fairly recent and tied to the new bioproduct mill, the ecosystem can be seen to have self-emerged during the last centennial. Historically Äänekoski area has hosted multiple Metsä Group actors and, typically to the forest industry, the plants have operated according to the principles of industrial symbiosis: sharing side streams and services. Over the years, a couple of other industrial actors have joined. In turn the industrial activities have resulted in the emergence of a vibrant service ecosystem and a good infrastructure on the area. Thus, Äänekoski has been an active industrial region with a culture of cooperation for decades. At the moment, most of the ecosystem collaborations are what they used to be already before the business ecosystem discourse started.

However, it became clear in the interviews that the business ecosystem story is still in its infancy. It was pointed out that creating new cooperation takes time and two or three years in is definitely not enough time to judge the success of the new developments of the ecosystem. Many interviewees said that even though the business ecosystem mindset has not yet changed things for them, the increased activity and buzz around the area were seen as positive and many were keeping an eye for potential new collaborations. The new bioproduct mill was seen as a new start for the area, a shift from a regular industrial region to a place where new bioeconomy innovations are born. Compared to the old pulp mill, the new bioproduct mill is remarkably bigger in capacity and therefore the capacity of available side streams grew as well. This presented an opportunity to seek new value adding ways to utilize these streams. Therefore, it could be seen that the ecosystem was born in its own, but the recent shift has been deliberative. A few interviewees also suggested that in order for the ecosystem to reach the fullest potential, some intentional guidance and a will to make it happen is needed.

The value proposition of the business ecosystem is very much in line with the CBE principles. Metsä Fibre has vocalized in their materials that the Äänekoski ecosystem is to be the "Silicon Valley of the bioeconomy" where actors can come together to develop new innovative bioproducts that can be used to replace fossil fuels and materials. The circular economy aspect is present as it is highlighted that "*the goal is to create bioproduct concepts that use 100 percent of the wood raw material and the production side streams*" (Metsä Fibre 2018;2021). Thus, the ecosystem is aiming to create more value to be shared out of the raw material used. From the Metsä Group perspective the value of the ecosystem lies in that the partner firms can help finding new value adding ways to utilize the material in fields that are outside of Metsä Group's business areas. The value for the participating firm perspective is at the good "Silicon Valley" -like conditions to develop these new value adding ways and the available materials fractioned from the wood material by Metsä Fibre. For the local area the value is at the active business actors offering jobs and boosting the liveliness of the area.

To see if the value is perceived similarly in the field, all the interviewees were asked to describe how they see the value proposition. In their answers, the representatives discussed the viability and atmosphere of possibilities available in the area. The replacement of fossil fuels and materials were also mentioned: either as the availability of renewable production commodities, that helped achieving their own sustainability targets, or as possible new solutions that might help them to replace fossil materials in the future. Hence, there is no conflict between the proposed and perceived value proposition.

To describe the structure of the Äänekoski ecosystem, multiple overlapping ecosystems can be identified. At the beginning of this research the focus of the study was the industrial ecosystem, where in the heart of the activities is the Metsä Fibre bioproduct mill. Around the bioproduct mill are several other industrial actors in close cooperation. These actors are all located in the same industrial area and are utilizing side streams (electricity, heat, air) of the bioproduct mill as production commodities and sharing some industrial services such as safety services and water treatments. There are also some symbiotic relationships: some actors use pulp or CO_2 from the bioproduct mill as raw materials and vice versa produce goods that are useful for some of the other actors. These actors have multiple direct relations and frequent communication with each other, and they form the tight industrial ecosystem.

Further into the research the importance of the surrounding area, the regional ecosystem, became evident. These actors have fever direct relations and communication, but they are nevertheless critical to achieving the vocalized goals of the Äänekoski ecosystem. There are some direct relations and shared side streams, but perhaps the most important effects are the consequential effects. The industrial ecosystem brings demand for services and work force which are in turn provided by the local people and smaller businesses. The good availability of these assets is then beneficial for everyone in the area and creates symbiotic relationships between the regional and the tight industrial ecosystem.

Thus, it could be seen that the industrial ecosystem is embedded in the regional ecosystem. In addition to these two conceptualizations, two additional ecosystems were identified: the forest industry ecosystem and bioeconomy research ecosystem. The forest industry ecosystem can be seen to include the global forest industry cluster as well as other industries that have the potential to utilize the wood raw material or products or otherwise contribute to the forest industry development. The bioeconomy research ecosystem includes business actors working with biological raw materials as well as educational and research institutes and universities locally, nationally and globally. The Äänekoski ecosystem is located at the intersection of these four ecosystems. Figure 6 visualizes the current situation.

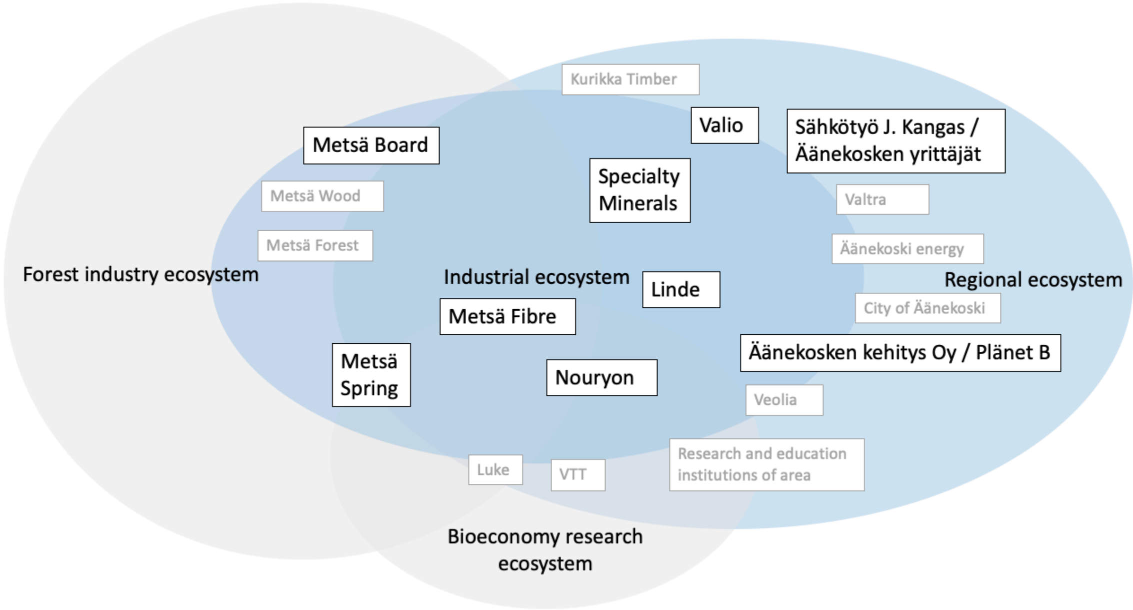

Figure 6: Overlapping ecosystems in Äänekoski ecosystem

The tightly intertwined industrial ecosystem and local ecosystem, that are the focus of this research, are presented in blue in Figure 6. The business actors that were interviewed are presented in boxes in black writing. To encapsulate the entire situation, Figure 6 presents also the other ecosystems in grey and other significant business actors of Äänekoski in grey text. It is difficult to draw precise borders between the different ecosystems, to say where they overlap or where exactly the actors are located. It could also perhaps be argued that there are additional significant ecosystems to be identified that relate to the case. However, these four conceptualizations emerged in these interviews and are definitely all integral for the development of the initiated CBE ecosystem.

In the following analysis, the ecosystem actors are grouped according to the ecosystem conceptualization to allow for analysis from different perspectives: industrial actors, regional actors and orchestrating actors. Like the ecosystems in the conceptualization, the groups overlap. The industrial actors' group include the industrial actors within the site of the tight industrial ecosystem as well as the industrial actors of the area, located outside the site. The latter can be seen to represent to the regional ecosystem as well. In addition to the groups of industrial and regional actors, a group of orchestrating actors can be identified. These include the proactive actors that have publicly stated goals about the ecosystem development and that also have specific roles in the ecosystem. Metsä Fibre can be named as the keystone actor of the ecosystem: the bioproduct mill is the source of the available side streams and is seen as the main coordinator by the interviewees. Metsä Spring is advancing and enabling the ecosystem from the new business perspective and Plänet B from the local area perspective, acting as a match maker. The orchestrators also belong to either regional or industrial groups.

4.2 Interview findings

The interviews set out to explore how the ecosystem actors perceive joining and acting in the ecosystem. They were asked about the main motives to join the ecosystem and what added value it brought to the company. Within these themes the main findings overlap slightly: some actors' motivations were seen as added value by others and vice versa. Additionally, it was asked what kind of questions or issues needed to be solved before joining the ecosystem. Within the theme of motives, the findings are most clearly divided between the three different actor groups (industrial, regional, orchestrator). Within the other two themes the groups are less unified. Most of the findings fit the suggested business ecosystem framework. The first two themes revolve around the micro level aspects, in questions and issues the meso level aspects are slightly emphasized.

Table 3 presents the motives to join the ecosystem. An overview of the table shows that the microlevel aspects are seen most important, especially different tangible resources were frequently mentioned. Not all motives matched the ecosystem framework, these are presented in the rightmost column. It is noteworthy that when asked about the motives to join the ecosystem, most interviewees said that they did not view it as they had joined a business ecosystem specifically. They had been in the area for many years and started cooperating before the ecosystem discourse had begun, because it made sense for their business. Even though in most cases the actors had not joined the ecosystem for the ecosystem per se, the question of motives was discussed in a form of "what are the main motives to be part of the ecosystem or to take part in the interactions". The motivations differed slightly between different point of views: the industrial actors discussed mostly tangible resources whereas orchestrating and regional actors discussed also other aspects suggested by the business ecosystem framework. Altogether the motives were mostly related to the micro level aspects.

Table 3: Motives to participate in the ecosystem

Motives					
Micro level aspects			**Meso level aspects**		**Other**
Resources (tangible)	**Resources (intangible)**	**Innovation**	**Innovation trajectories**	**Cooperation**	
Availability of raw materials and commodities in the area					Normal business opportunities not related to ecosystem
Cost benefits from utilizing side streams: added income or affordable commodities					Strategic placement close to business partner
Economies of scale from sharing supporting services in the area (e.g. water treatment, safety services)					
Development of area (e.g. investments, infrastructure)	Development of area (e.g. knowhow, viability of area, supply and demand for services and jobs)		Development of capabilities of the future (e.g. cross-industry capabilities)		
Willingness to get as full use of raw material as possible: existing solutions via current partners		Willingness to get as full use of raw material as possible: new business via new value adding solutions		Willingness to get as full use of raw material as possible via cooperation	

The most frequently mentioned motives were the availability of raw materials and commodities and thus related to the tangible resources -aspect. The resources derived mostly from the keystone actor, pulp and energy were mentioned most often. These were seen especially important within the industrial actors but recognized as an important attraction of the area by the other groups as well. Additional attractive intangible resources identified by the orchestrating and regional actors were available space and the supply and demand for skillful services. In many interviews the viable service infrastructure was mentioned as an added value, but especially the interviewees looking at the regional perspective mentioned that the constant demand of services from the big industrial actors created continuity and a good reason to settle into the area.

The orchestrating actors were also naturally motivated by their publicly stated goals: development of the area and willingness to get as full use of the wood raw material as possible. The development of the area referred to both development of the industrial area as well as the regional area and was related to both tangible (investments, infrastructure) and intangible (viability, knowhow, services, jobs) resources -aspect. One interviewee mentioned the development of new cross-industrial capabilities needed in the future as a motive and goal, thus the innovation trajectories -aspect of the suggested framework was present as well. The goal of fullest possible utilization of raw material is tightly connected to the suggested framework as it was to be achieved by utilizing the side streams through cooperation via existing solutions and current partners or via new partners and innovative solutions.

Another frequently mentioned motive within the industrial actors was cost benefits, that derived from two sources: utilization of side streams and the economies of scale. In this case the cost benefits and raw material availability are intertwined as the cost benefits were achieved partly through the utilization of side streams. The available commodities (e.g. energy) are generated as a side stream to pulp production, which creates a win-win situation where the producer of the side stream receives added income and the utilizers receive affordable commodities. The economies of scale were achieved through shared services (e.g. safety, water treatments) within the tight industrial ecosystem area. In addition to the shared cost, it was mentioned by a few interviewees that the knowhow and efficiency in some of these services provided by the keystone actor were valuable for them. Most interviewees from the industrial ecosystem mentioned that the achieved cost benefits were the base of their interactions.

Lastly, it was asked if the geographical proximity was seen as an important aspect. Most interviewees did not see it as highly important in the ecosystem, it was mostly viewed as an added value. One business had located in the area because of need to be close to a business partner. However, in this case it was due to other strategic reasons, not ecosystem aspects.

Table 4 presents how the interviewees viewed the added value brought by the ecosystem. In this section all findings can be classified under the proposed aspects of the ecosystem framework. An overview of the table shows that the aspect of intangible resources is emphasized and most findings are again related to the micro level aspects. However, all ecosystem aspects are present and compared to the motives, the meso level aspects are represented slightly stronger. Some value adding topics overlap with the motives, e.g. the good service infrastructure and proximity to business partners were mentioned in relation to both. Also, one actor mentioned cost benefits as added value instead of motive, unlike others. In general, when asked if the ecosystem added value to the company, all interviewees saw that it did. Even though some interviewees first said that they did not see immediate or concrete things that would benefit their business, they proceeded to discuss the atmosphere of buzz and possibilities of the area.

Table 4: Added value from participating in the ecosystem

Added value					
Micro level aspects			**Meso level aspects**		**Other**
Resources (tangible)	**Resources (intangible)**	**Innovation**	**Innovation trajectories**	**Cooperation**	
Saved resources and ease in logistics due to proximity to business partners	The dynamic nature of the area, possibility to be "in the front row seat" to witness the development	Possibility to develop new innovations	Possibility to utilize in own business the new innovations born in the area	Spillover of value: one's success can benefit the whole ecosystem.	
The consequential effects for the area: good infrastructure and services	The consequential effects for the area: good knowhow available in the area			The value of acting together and cooperating	
Cost benefits from sharing services, sides streams and affordable sustainability	Achieving sustainability targets in own business through available renewable energy			Efficiency and synergy	
	Responsible, sustainably sourced wood, the ability to know raw material origins				

Added value					
Micro level aspects			**Meso level aspects**		**Other**
Resources (tangible)	**Resources (intangible)**	**Innovation**	**Innovation trajectories**	**Cooperation**	
	The ecosystem (and the sustainability benefits) is a good story for PR				
	Trust: the ability to know and trust the partners as well as the opportunity to show one's own trustworthiness				

The dynamic nature of the area was brought up most frequently, it was seen that there was truly an effort from the orchestrating actors to develop the ecosystem. For many actors this was sort of an anticipation for some positive possibilities in the future: to develop new innovations, to utilize some of others' innovations in own production or to otherwise start new collaboration. These were mentioned mostly by the actors in the tight industrial ecosystem. One interviewee described that being part of the ecosystem gives a "front row seat" to witness the new development. It was seen that others' success can benefit the whole ecosystem and value can spillover to the ecosystem in a form of possibilities or general activeness in the area. The viability of the area was seen as a consequential effect of the active ecosystem. This was brought up specifically by many of the regional actors. Good infrastructure (e.g. road infrastructure, electricity grid), available skilled service and workforce and also available specialized tech appliances in stock were mentioned. It was also noted that these things are not self-evident in many similar sized cities in Finland. One actor pointed out that the activity likely benefited the residents of the area through taxes and investments in education or health infrastructure.

The effects of the ecosystem participation on sustainability, communication and looking for new innovations in cooperation were asked about specifically if not otherwise brought up by the interviewee. Almost all interviewees mentioned the sustainability benefits brought by the renewable commodities as added value, a few brought it up before the specific question. Sustainability and especially carbon neutrality were seen as increasingly important in the future of industrial activity. The available renewable energy helped the actors achieve their company sustainability targets, often earlier than other sites of the corporation. A few mentioned that it was especially beneficial that these targets were achieved at competitive price. One actor had thus been able to gain competitive advantage as a front runner of carbon neutrality in their industry. Additionally, the ability to know where the wood raw material comes from was mentioned by some interviewees. It was very valuable for them that they can trust that the raw material is responsibly sourced. The achieved sustainability benefits were often used in PR and in one case had helped the actor achieve some sustainability certificates.

As for communication in the area, all interviewees said that it had been very good already before the new ecosystem initiation. Most interviewees saw that not much had changed. A few mentioned that the communication platforms and events organized by Plänet B and the city of Äänekoski were a positive thing as they were looking at the big picture of what the area might need. Within the regional service providers active communication was mentioned as a highly valuable asset that created efficiency and synergy. This was due to word of mouth -phenomena within the tight industrial ecosystem actors. It was seen that the industrial actors had a desire to minimize new outside actors operating on site as new entrants have to be instructed about e.g. certain safety requirements to be able to work in the area. Therefore, it was mentioned that a well-done job might often lead to another inside the site. Communication within the service providers was also mentioned. It created efficiency to know the other service providers: in case other entrepreneurs' knowledge about previous jobs or field of expertise was needed, it was easy to know who to ask. The industrial actors mostly discussed communication in relation to the safety and every-day practicalities that came with sharing side streams or industrial services.

When asked about possible new collaborations in R&D&I, it was mostly said that some new possibilities within the "old" ecosystem actors had been tried out but had not taken flight yet. However, the possibility for new collaborations was seen to be present and valuable. One actor mentioned that the value of cooperating and acting together was something they saw as the main benefit and added value of the ecosystem. A few actors mentioned the ability to get help from others in the area, although this mostly referred to help from different units within the company or concern. In general, there seemed to be an atmosphere of respect and trust towards the other ecosystem members. One actor mentioned that the ability to really trust their supplier partner was valuable to them as it allowed them to be a trustworthy supplier for their clients. Similarly, another actor mentioned that acting in the ecosystem was a good opportunity to show one's trustworthiness and perhaps increase cooperation.

Lastly, it was asked if geographical proximity to business partners was seen as important or beneficial. It was not usually mentioned as a benefit before specifically asked about. In some cases it was a necessity of side stream utilization, in some it was a positive attribute. If the flow was in gas form (heat, CO_2), the closeness was usually a necessity. If the flow was in a wet form (pulp), the closeness provided ease and saved emissions, costs and an additional phase of work: drying the material. Thus, the benefits of geographical proximity had to do with the physical flows. In a few interviews the proximity to business partners was discussed from a strategic point of view: whether or not it made sense to be located close to the raw material or close to the client. It was asked specifically if the proximity made communication easier. Most industrial actors mentioned that it did not as most of the communication was in digital form anyway. From the perspective of the regional ecosystem, geographical proximity was seen more important. It was seen to create effectiveness for the SMEs that many clients were densely located. Also knowing the other service providers and frequently running into them made communication easier. The tightness of service providers community was seen as a valuable resource.

Table 5 summarizes questions or issues concerning joining or acting in the ecosystem. In this category, the findings had to do with all the proposed aspects of the ecosystem framework, with a slight emphasis on the cooperation aspect. Micro and meso level aspects were equally represented. Not all findings fit the suggested ecosystem framework. Some interviewees discussed this theme in depth and elaborated on general level about possible questions and issues. Some discussed from the perspective of the present interactions. It was specifically asked, based on the academic literature, if there had been some questions related to the use of side streams or management of the ecosystem.

Table 5: Questions regarding joining the ecosystem

Questions raised					
Micro level aspects			**Meso level aspects**		**Other**
Resources (tangible)	**Resources (intangible)**	**Innovation**	**Innovation trajectories**	**Cooperation**	
Finding the resources to invest in new solutions development, scaling and commercialization	Finding the capabilities to create new innovations	Finding the solutions that create win-win situations	Timing	Finding the right partner and matching actors' goals: collaboration needs to be a win-win situation	The nature of process industry: long time span
The nature of side streams: continuity, heterogenous composition, dependence etc.	Company cultures and values throughout the ecosystem, leading by example		Clearly articulated shared visions	Requirements for partnership: credibility, matching scale and values	
The nature of biological raw materials: possibly heterogeneous composition	Explicit culture of fostering cooperation		Uncertainty of policies	Orchestration: interactive coordination of independent actors	
				Bargaining powers and health of ecosystem	
				Fitting one's own actions into the ecosystem	
				Increased cooperation creates a need for more communication	

Win-win nature of collaboration was brought up most frequently. This was mentioned in some form in all interviews. It was discussed that as participating in the ecosystem was voluntary, it needed to be beneficial for all actors involved. This could mean for example finding a matching goal or need between the actors, e.g. need for a service or an excess of a side stream and good use for it. In addition to the matching goal, also a good solution to make it happen was needed. At times this would need new innovations or new capabilities, at times simply an incrementally new way of thinking, such as transferring heat further away by means of water. It was mentioned that the questions to consider before collaboration are situation specific. Some general aspects were the investment and operational costs, appropriate scale, feasibility (e.g. production conditions, markets) as well as some aspects concerning organizational culture, values and management. One interviewee mentioned that it seemed that there was plenty of opportunities, but the implementation was still a question.

When asked if the nature of side streams (heterogenous composition, lack of continuity, dependency etc.) had raised any questions, it was agreed that these are some of the situation specific questions. It was discussed that some side streams, such as energy or CO_2, were relatively easy to harness as the supply was fairly consistent. One actor mentioned that the occasional maintenance outages did create slight inconsistency and dependency and therefore a back-up solution was needed. However, this solution was still seen as the winning option, as good communication and the back-up system solved these inconveniences. Inconsistency of a side stream flow was mentioned as a problem by another interviewee, who mentioned that they had experimented with an irregular flow, but due to the inconsistency it did not make sense to use it as a strategic raw material. The heterogenous composition was not seen as a problem, and it was mentioned that it was in fact typical for all kinds of biological material flows, that the composition varies slightly between batches.

Concerning utilizing side steams in new ways, questions related to the nature of process industry were brought up by some interviewees. It was mentioned that development takes possibly years, and innovation, testing, scaling up and commercialization at large scales requires a great deal of resources. It was also discussed that the large capacity of side streams available at the bioproduct mill was perhaps challenging from a small business perspective. A small scale of utilization might not make sense for a big actor to invest in, whereas the smaller actor might not have the resources to deal with such large capacities. However, it was mentioned that with a good concept this is possible.

Additionally, perhaps due to the need of time and resources in process industry, uncertainty was brought up as an issue. For example, one interviewee mentioned the change in policy trends within the last ten years from BE to CE as an uncertainty factor. Another interviewee described how the focus of the ecosystem had changed from BE towards CE and carbon neutrality. From the regional ecosystem perspective, the question of timing was brought up as well. It was mentioned that the need for different services varies during the different development phases of the ecosystem. Thus, the ecosystem story was yet in the beginning and both the industrial and regional ecosystem still at developing stage.

For the question of management of the ecosystem, all interviewees agreed that management per se was neither needed nor possible. It was seen that the actors were independent and made their own decisions based on their own strategies. If there was to be some management, it needed to be interactive. However, it was mentioned that some kind of coordination, or orchestration, was needed. It was agreed in general that the main coordinator was the keystone actor as it was the source of the utilized side streams and a large actor in the area. The questions of power came up once during the interviews through possible fluctuation in the demand of certain materials and its effect to changing bargaining powers. Nevertheless, it was seen more as a coordination issue, and it was seen that the bargaining powers should not be used excessively as the health of the entire ecosystem was perceived more important. In general there seemed to be an atmosphere of respect towards the other actors and a consensus that success of one actor would be beneficial for the entire ecosystem.

The way of acting and communication as means of management were highlighted by all of the orchestrating actors. It was mentioned that the closest partnerships could perhaps be managed but in general it was hoped that by acting responsibly and leading by example, the desired values would carry through the whole ecosystem and last until the end clients. A few actors from all point of views mentioned the importance of setting direction. It was seen that if the goals were similar, the ecosystem would self-direct towards a desired outcome in an efficient manner. The question of fitting ones offering to the puzzle of others in the ecosystem was mentioned by one interviewee and another discussed the importance of clearly communicated visions: what the ecosystem has to offer for the actors and vice versa, what kind of actors are needed. Thus, clear communication of the vision was seen as important from multiple perspectives. It was also mentioned that to encourage the free cooperation within the ecosystem, the wish for a culture of cooperation should be explicit and supported by the initiator. As one interviewee put it, someone must want the ecosystem.

Lastly, in a more practical and everyday sense, it was mentioned that increased cooperation requires more communication. Especially the industrial actors utilizing side streams or sharing industrial services mentioned that it was essential to be informed what is going on in the area. Scheduled maintenance outages, or other irregularities as well as unexpected situations were mentioned as examples of issues to be aware of for strategic and safety reasons.

5 DISCUSSION

This section answers the research questions and discusses the findings in relation to the existing academic literature. The first chapter addresses the findings for main and sub questions individually and answers the research questions. The second section examines how the most relevant findings interact with each other and what it could possibly mean for CBE. The last section addresses the limitations of this research and suggests avenues for further research.

5.1 Discussion of the findings

This chapter discusses the findings and answers the research questions. The first question was addressed to the literature review and it laid the background for the empirical part of the study: Is the concept of business ecosystems useful for advancing CBE? The research framework suggested a theoretical interpretation. This section discusses how this is illustrated through the case of Äänekoski ecosystem. The next questions were addressed to the empirical section of the research. If it is assumed that CBE ecosystems indeed offer a possible pathway to sustainability, action from multiple actors is still needed. Thus, the main research question asked what motivates actors to participate in a CBE ecosystem. The sub questions broke it down to three separate topics: the main motivations, added value and issues.

5.1.1 Business ecosystems advancing CBE in Äänekoski ecosystem

The multifaceted problems of climate change and resource scarcity were mentioned as the starting point of this thesis. While the global middle-class population is growing, new perspectives are urgently needed to conquer these issues. For a more sustainably functioning society, the concepts of circular economy (CE) and bioeconomy (BE) have both been discussed. Recently, a merging concept of circular bioeconomy (CBE) has been suggested (e.g. Toppinen et al. 2020). Even though CBE is subject to some of the same criticism as CE and BE, it does offer a more holistic point of view for a regenerative, sustainable society. (D'amato et al. 2017). It also offers more information on how the sustainability goals would be achieved: CE describes the ‘how’ the economy works, while BE is the materials, the ‘what’ is exchanged in the economy.

If it is assumed that CBE is a good recipe for a sustainably functioning society, a transition should be examined. The transition literature discusses a socio-technical change as an interaction of different societal levels. Innovations are born on the micro level and as the developments between different actors align and reinforce each other, these innovations can break through to meso and macro levels and thus create change (Geels 2002; 2005). Similarly, it is argued that a systemic CBE needs simultaneous action on all societal levels and the importance of cooperation between different actors is highlighted (e.g. Ghisellini et al. 2016; Hetemäki 2017). The concept of business ecosystems discusses loose networks of different independent actors that are coevolving towards a shared goal. Thus, it is argued in the sustainability transition literature that business ecosystems provide a suitable concept for analysis of sustainability transitions (Lazarevic et al. 2019; Planko et al.2017).

The Äänekoski actors had found cooperation that creates symbiotic win-win situations already before the business ecosystem discourse was initiated by the orchestrating actors. This collaboration, self-emerged during decades, has mostly served efficiency or specialization. As suggested by the ecosystem theory (e.g. Thomas & Autio 2012; Moore 2006), the collaboration has brought the actors more resources, both tangible and intangible: the industrial firms have gained efficiency and affordability by sharing side streams and have enjoyed the specialized capabilities offered by the regional service providers, whilst providing jobs and stability to the local area. The ecosystem could have been called a CBE ecosystem already at the early stage, as side streams from pulp production were a significant aspect. However, the common value proposition would likely not have been related to sustainability but rather to efficiency. A better definition for this kind of cooperation would be industrial symbiosis.

The newly initiated ecosystem vision does include CBE and sustainability. The value proposition describes a community where actors come together to develop new innovative bioproducts that use 100 percent of the responsibly sourced wood raw material. For ecosystems to benefit sustainability transitions it is suggested by Lazarevic et al. (2019) that at least some actors in the business ecosystem must have goals to deliver sustainability benefits. In Äänekoski the orchestrating actors have taken this role and have started advocating for sustainability. Even though the communications do not mention a transition to a CBE society as a goal, the aim to innovate new bioproducts to replace fossil alternatives would indeed benefit a transition to a biobased society for its part.

The initiated ecosystem discourse also pushes for ecosystem aspects mentioned in the ecosystem theory. In the communications the ecosystem is called a "Silicon Valley of bioeconomy", where capabilities and production commodities are available. As multiple actors are committed to the same vision, that can bring synergies within the new innovations and practices (c.f. Thomas & Autio 2012). The ecosystem offers a space for creation and business opportunities (Rong et al. 2013) as well as stability and a possibility for innovation trajectories (Moore 2006). The transition literature argues that it is difficult for the new innovations to break out from the niches (Geels 2002). Due to the synergies and innovation trajectories the ecosystem structure can possibly help lift niches to the meso level and thereby enable a transition.

The ecosystem structure additionally provides elements that could be beneficial for CBE specifically. The literature argues cooperation and innovations are especially needed for CBE (e.g. DeBoer et al. 2020; Näyhä 2020). However, willingness to collaborate and lack of network support have been reported as a barrier for CE (Kirchherr et al. 2018; Tura et al. 2019). It is argued that the concept of ecosystem can be seen as a complementary collaboration network and an infrastructure to adhere to (Moore 2006). The keystone structure could act as innovation intermediary that attracts existing and new emerging resources, knowledge and support and then brings them to the reach of other collaborators (Musiolik et al. 2010; Lazarevic et al. 2019). Ecosystems are also characterized with flexibility (Thomas & Autio 2012) as they are composed by independent actors who voluntarily coevolve towards the shared goal. Thus, the concept of business ecosystems could ease collaboration from company perspective.

The independence combined with a shared vision of business ecosystems offer an interesting pathway to a CBE transition. In the case of Äänekoski, it was recognized that the actors could be classified belonging into one or more "sub ecosystems". Four different and overlapping ecosystems were recognized. This conceptualization helped to understand the different nature of interactions within the Äänekoski ecosystem. Additionally, it highlights the different perspective to the ecosystem goals. The industrial ecosystem focus is generally more on the present, in practicalities and costs. The others are more future oriented. The local ecosystem is interested in the development of the area, forest industry ecosystem is focused on the future of forest industry, and the research ecosystem on the bioeconomy innovations. These goals could then be seen as different sides of the same shared vision: a vibrant ecosystem producing goods for the sustainable future in an efficient manner. This implements the definition of business ecosystem concept: *"the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize*" (c.f. Adner 2017, p. 40). Thus, the case illustrates a situation when the "focal value proposition" of the ecosystem supports CBE, and consequently the ecosystem structure is useful in advancing CBE in Finland.

5.1.2 Main motives for ecosystem participation

As described in the previous chapter, business ecosystems can be a good way to forward CBE in a holistic manner. However, for this assumption to actualize, action from organizations is still needed. The main research question of this thesis asked what motivates business actors to participate in a CBE ecosystem and the first sub question asked specifically about the main motives. What makes the actors want to join the ecosystem?

Based on the interview data, the main motivations fall into two sections. It is not surprising that the orchestrating actors had further reaching macro level motivations and the other actors' motivations were related to the micro level aspects, mostly resources. The orchestrating actors had motives related to development, which is understandable as they are the ones who have initiated the ecosystem. Thus, the development of the ecosystem likely benefits their own development as well. All interviewees mentioned motives related to the micro level, but especially the industrial actors emphasized the tangible resources and the achieved cost benefits when using side stream commodities. The regional actors highlighted the viability of the area and the constant demand for services as an important motive to stay in the area.

The ecosystem theory suggests that from the orchestrator perspective, an ecosystem structure is a way to involve other organizations flexibly and effectively to work towards their goal

(Thomas & Autio 2012; Moore 2006). Along the same lines, one of the orchestrating actors mentioned that the ecosystem allows them to find new value-adding use for the wood material without themselves stepping too far further in the value chain. This gives them the flexibility to focus on their own core business and simultaneously benefit from the innovations and development on different fields. In exchange for this flexible involvement, the participating firms, e.g. small niche firms, can get access to some resources, otherwise possibly out of their reach as suggested in the ecosystem literature (e.g. Nambisan & Baron, 2013). The literature discusses resources such as financing, customer feedback mechanisms and market access. In this case the interviewees highlighted commodities, space and capabilities.

From the perspective of the other participating actors, it is not surprising that the motivations are mostly related to economic aspects, affordability and efficiency. In this research, most actors whose motives fall into this category, were the ones who had started cooperating before the ecosystem initiation. Hence, this cooperation was built on an industrial symbiosis mindset. It should also be noted that these companies were subsidiaries of larger, often international companies, and this possibly limits their potential to act in the ecosystem. One interviewee mentioned that they could have more interaction and collaboration with the ecosystem if they were an independent actor. However, these actors had nevertheless found collaboration in win-win nature that aligns with the corporation strategy.

Hence, regardless of the different motivations the ecosystem structure allows the actors to find alignment in their goals. For some actors important is cost savings, for some it is the new innovations and coevolving. If the motivations do not conflict but are part of advancing the same vision, participating in the ecosystem is beneficial for all the actors. The win-win collaboration creates virtuous circles where resources are saved, multiplied or used more efficiently, as suggested in the ecosystem literature (e.g. Moore 1996). Through the virtuous circles the micro level goals simultaneously benefit the whole ecosystem on the meso level. It seems that for CBE an ecosystem organization can be a way to enable collaboration of different actors. It seems that not all actors need to have goals for sustainability if an influential actor and the overall vision of the ecosystem do. Hence, as long as the individual goals are not conflicting to the ecosystem vision, the ecosystem structure can be a way to engage also the not-so-motivated actors to work towards sustainability.

5.1.3 Additional benefits from ecosystem participation

The second sub question aimed to further understand why the business ecosystem concept was interesting to organizations. It was asked what other benefits the actors see, beyond the main motives. For this question the answers were not clearly divided between the different types of actors. Compared to the motives, the value adding elements were more related to the intangible ecosystem aspects. Another general observation was that while some benefits derived from single interactions, others derived from the entire ecosystem acting as a group.

The added value that was often mentioned first was the buzz and atmosphere of possibilities in the area. Even though the ecosystem story was still at the beginning, the possible new innovations were anticipated with excitement. A few interviewees mentioned that they were interested in seeing if some new innovations could be used in their own production to replace fossil raw materials. Thus, the innovation trajectories, as suggested in the ecosystem theory (Moore 2006) were anticipated. In general, it was seen that another actor's success would benefit the entire ecosystem and the benefits can spillover, as suggested by Audretsch et al. (2018). The consequential effects for the area could be seen as one of these spillovers. Many interviewees mentioned the viability of the area as an added value: because of constant demand of industrial services, many skilled service businesses had settled into the area and formed a viable service ecosystem. If was also mentioned that the activeness likely benefited the area through job creation, taxes and local investments.

The interviewees also reported sustainability benefits. Frequently mentioned was the ability to fulfill carbon neutrality targets due to the use of renewable production commodities. Thus, CBE did relieve the pressure on climate change and scarce resources, as suggested by the literature (Velte et al. 2018; D'amato et al. 2017). It was seen especially valuable that the targets were achieved in a cost-effective way. One actor mentioned how using surplus heat, instead of oil, helped them to avoid some price shocks of the market, as the side stream heat had been available on a rather constant and affordable price. Thus, as suggested (EMAF 2013; European Commission 2015), CE had the ability to avoid volatility of resource prices. The geographical proximity saved costs and emissions as some transportation was avoided. These efficiency benefits brought competitive advantage to the actors and created a win-win situation between the environmental sustainability and economic benefits. Additionally, the ability to trust that the wood raw material was sourced in an environmentally and socially sustainable way was mentioned. However, this was not due to the CBE or ecosystem aspects but instead to the keystone actor's practices and values.

Another added value was the trust between the actors. This was discussed in different forms. A few mentioned the trust of timely delivery and quality in supplier relationships, others mentioned the trust in the origin of raw materials. In general, the other actors were appreciated, and there was interest in developing collaborations further. Hence, the ecosystem structure had helped overcome some reported CE barriers: plenty of network support and willingness to cooperate were found in this case (Kirchherr et al. 2018; Tura et al. 2019). It seemed that the trust stemmed from the long cooperative relationships and it could also be put forward via recommendations or through the match making actor. This suggests that as argued in the ecosystem literature, the benefits of the ecosystem structure can also be practices and social networks (Haarla et al. 2018).

Discussing the added values revealed some meso level ecosystem benefits that only realize when a group of organizations are acting together. The multilateral relationships created viability, possibilities, trust and anticipated innovation trajectories. These attributes multiply when shared and perhaps interest new actors to join the ecosystem. These benefits also possibly helped actors to identify as ecosystem members, even though some of the dyadic relationships were quite regular business exchanges. It seems that as suggested by Moore (1996), business ecosystems are social systems that are able to create communities of shared imagination and thus co-evolve towards shared goals. This can help bring actors together to cooperate or innovate as needed for CBE transition.

5.1.4 Questions and issues to be solved before ecosystem participation

As discovered, the CBE ecosystem structure brings benefits to the participating actors and could enable transition to CBE by encouraging cooperation. The third sub question asked whether there had been some specific issues or questions to solve. What needs to happen before participating? Most interviewees discussed that the questions are mostly situation specific and similar to the usual requirements for cooperation. The questions of ecosystem management and nature of side streams were asked about specifically, as these topics are discussed as challenges in the literature.

The nature of side streams was identified as some of the situation specific questions. Some streams were relatively simple to harness, others more difficult and needed new practices. In contrast to the literature, low level of homogeneity of material per se was not mentioned as a problem (c.f. Tura et al. 2019). In fact, one interviewee pointed out that in biological raw materials some level of heterogeneity between batches was very common. Thus, BE materials in general had this disadvantage compared to fossil materials, circularity did not increase the problem. Further, in relation to a possible transition to a biobased society (e.g. the topic of bioplastics), the interviewee mentioned that the heterogeneity of material could be an issue in e.g. chemical industry, that is accustomed to work with characteristically very homogenous fossil materials.

The question of ecosystem management was posed as a challenge in the literature (c.f. Aarikka-Stenroos & Ritala 2017), but the interviewed ecosystem actors agreed that management per se was not needed, due to the self-organizing nature. Ecosystem participation was seen to be voluntary. All the interviewees highlighted win-win situations as requirements for cooperation. However, it was recognized that some coordination was needed. The importance of a good communication structure for practicalities and unusual situations was mentioned. Communicating a compelling vision was also mentioned both in literature (e.g. Moore 2006) and by the interviewees. The orchestrating actors discussed the need to clearly communicate what the ecosystem offers and needs. It was mentioned that someone must want the ecosystem and lead the way. As discussed in the motives section, a clear vision helps the actors to find alignment in their goals and to arrive to the win-win collaboration. For managerial mechanisms, the literature discusses “soft factors” such as trust, commitment and participatory leadership as effective (Planko et al. 2017). Similarly, the interviewed orchestrating actors discussed leading by example and orchestration as a type of management where the initiated culture, communication and way of acting proposes the direction for the ecosystem.

Additionally, the realization of the anticipated possibilities was discussed. One interviewee mentioned that there was an abundance of ideas in the air, but the execution, scaling and commercialization were yet to be solved. On the other hand, a few interviewees mentioned that the ecosystem story was still at the beginning. Due to the nature of process industry, around which this ecosystem is centered, the time span of innovation and development is typically long. However, it seems that the ecosystem structure was prepared to conquer some anticipated difficulties of the development phase. The establishment of multiple orchestrating actors supported the keystone actor's role as an innovation intermediary (c.f. Lazarevic et al. 2019). These actors helped to tailor the communications and aim to smoothen the process of finding the matching goals, scales and resources to bring the new innovations to life.

5.2 Contributions and implications

This section discusses how the most relevant findings interact with each other and what it means for CBE. Table 6 summarizes the answers to the main research questions. Starting from the motives to participate in the ecosystem, most interviewees discussed resources. The orchestrating actors additionally had further reaching motives, such as development of area or business. It seems to be true that as suggested in the literature, the ecosystem structure brings resources, tangible and intangible, to the reach of firms (e.g. Moore 2006) and from the keystone perspective it is a way to flexibly involve others to work towards their goals (e.g. Thomas & Autio 2012). The flexible involvement of others allowed the keystone actor to concentrate on their core business, whilst still pursuing new innovations and development on different fields. The effect of the ecosystem is that it allows the alignment of these different, individual motives as different sides of one big vision. The Äänekoski ecosystem actors highlighted the win-win nature of collaboration.

The multilateral relationships, that are seen as a distinct ecosystem characteristic, were not mentioned as motives for ecosystem participation. However, they were recognized as an added value. The actors discussed trust and viability of the area. It was seen that another actor's success would benefit the entire ecosystem and that the benefits can spillover, as proposed in the literature (e.g. Audretsch et al. 2018). Some interviewees expressed an interest in being an early adopter of the new anticipated innovations. Thus, there was an emerging innovation trajectory (c.f. Moore 2006). Also, the actors seemed to have high respect for one another. As suggested in the literature (Moore 1996), it appears that business ecosystems are indeed able to create communities of shared imagination, kind of an ecosystem mindset.

Table 6: Summary of research findings

Motives for participation	Business ecosystems for CBE
Orchestrating actors: flexible involvement of others working towards own goals	Enabling collaboration by creating an ecosystem mindset
All actors: resources	Aligning individual goals through win-win collaboration
	Creation of innovation trajectories

The right side of Table 6 summarizes the findings regarding how the concept of business ecosystems can enable CBE, and possibly ultimately a transition to a CBE society. In the literature review the business ecosystem concept was defined as "*the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize*" (c.f. Adner 2017, p. 40). Hence, if the "focal value proposition" of the ecosystem supports CBE, the ecosystem structure can be useful in advancing CBE. The ecosystem mindset created by the multilateral nature of an ecosystem can further encourage cooperation. As it is argued that current CBE practices as well as needed new innovations require close cooperation of different fields, coherence in technologies and practices, and good communication (Stegmann 2020; Lokesh et al, 2018; Näyhä 2019), a structure that encourages cooperation is likely beneficial for CBE. From a systemic transition perspective, a challenge is that it is difficult for the new innovations to break through (Geels 2002). The ecosystem's ability to create possible innovation trajectories (c.f. Moore 2006), could support the diffusion. Hence, the ecosystem structure and mindset can create a favorable ground for CBE to develop further.

Figure 7 visualizes how the suggested ecosystem aspects from the research framework– resources, cooperation, innovation and innovation trajectories – interact and build up towards the ecosystem vision. On the first layer in Figure 7 is the virtuous circle of resources and collaboration. This circle supports the actors' development towards their own goals, which is the main motive for participation. Simultaneously, the synergies between different individual goals bind them together as different sides of the common ecosystem vision. The ecosystem vision is set by the orchestrating actors. The individual purposes of participating actors (e.g. the purpose of an organization) do not necessarily need to be supportive to the ecosystem vision, the ecosystem actors can be very different. In the case of Äänekoski the participants range from big industrial companies to small service businesses, and they have very different individual purposes. As long as the motives are compatible, as suggested by Adner (2017), the actors can align and co-evolve together.

In practice, in Äänekoski the alignment seems to realize through collaboration of win-win nature and clear communication of the ecosystem vision. The literature (e.g. Moore 2006) and many interviewees argued for the importance of clear communication of the ecosystem vision: what the ecosystem has to offer and what it needs. The communication steers the ecosystem on the meso level. The win-win nature harnesses the individual, micro level actors to participate. Because ecosystem participation is voluntary and each actor defines their own ecosystem strategy (e.g. Adner 2017), the interviewees highlighted that the participation needs to be beneficial for all. Said self-organizing nature is seen as a managerial challenge in the literature (Aarikka-Stenroos & Ritala 2017), but it is also argued that strategic management is possible if the underlying ecosystem dynamics are understood by mangers and the actors' decision-making is naturally fit to the ecosystem (Tsujimoto et al. 2018). Hence the win-win collaboration.

The second layer in Figure 7 is the ecosystem mindset that develops from successful collaboration and good culture. The orchestrating actors mentioned that someone in the ecosystem must want the ecosystem and initiate a culture where collaboration is fostered. It was hoped that "doing the right thing" as well as clear communication and leading by example can propose a direction for the ecosystem. Likewise, the literature discussed "soft factors" such as trust, commitment and participatory leadership as mechanisms of ecosystem management (Planko et al. 2017). This seems to foster an ecosystem mindset and a sense community The built trust and buzz seem to inspire the actors to seek further collaboration between the other ecosystem members and seize the new possibilities creating a virtuous circle between innovation, collaboration and innovation trajectories.

Aligned goals and the shared mindset build up towards the ecosystem vision on the top layer of Figure 7. It is argued that if one or more ecosystem participants are engaged in value creation for sustainability (Lazarevic et al. 2019), the ecosystem can contribute to advancing sustainability, e.g. CBE. In Äänekoski the orchestrators do have goals for sustainability: the creation of "Silicon Valley of Bioeconomy" that utilizes 100 percent of the wood raw material would indeed advance CBE. In practice, they have found a way to incentivize actors to join in advancing the vision through the win-win situations. It is additionally noteworthy, that this can also motivate those actors who are not necessarily very interested in advancing CBE. This is allowed by the synergies between different individual goals. For example, in Äänekoski the efficiency in utilizing side streams is an economic and environmental goal at the same time. Hence, the ecosystem structure can be a good way to involve actors towards CBE, if the entity is guided by an influential actor (or actors) who is aiming to advance CBE.

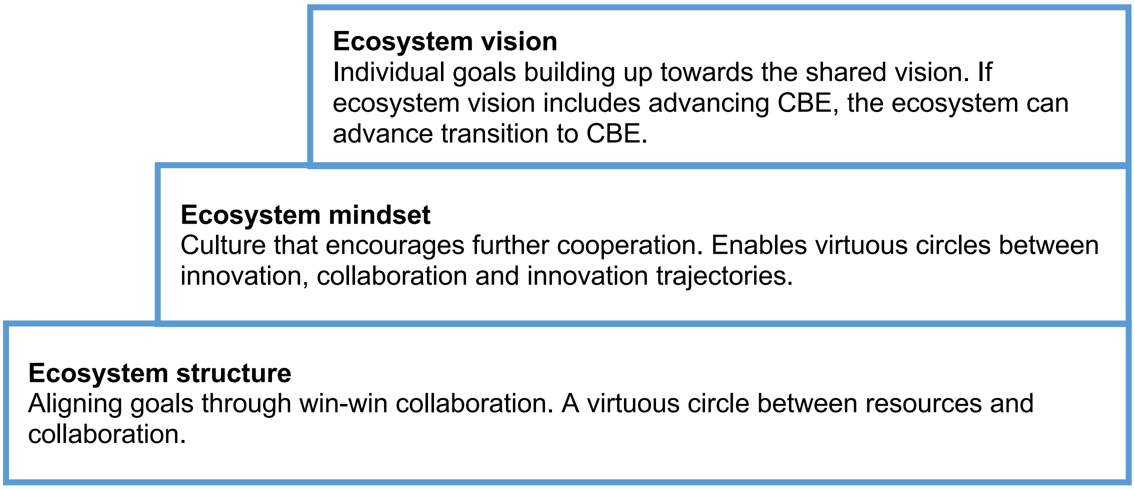

Figure 7: Business ecosystem concept building towards the ecosystem vision

To reflect on the starting point of this thesis – the multifaceted problems of climate change and resource scarcity – the possible sustainability effects should be examined. The effects of CBE and the ecosystem structure to these issues were not measured during the research process. However, these surface level of these themes were discussed in the interviews and the findings are examined in relation the academic literature.

Firstly, it should be noted that at the moment most of the side streams are utilized as energy. In CE and BE context it is repeatedly argued that materials should be circulated at highest possible utility, and energy recovery should be the last option (e.g. Näyhä 2019; EMAF 2013). However, the goal of the Äänekoski ecosystem is indeed to find new higher value-adding solutions and a few interviewees pointed out that the ecosystem story is still only at the beginning. Many of the current ecosystem interactions started before the newly initiated ecosystem and are based on the industrial symbiosis mindset. Hence, it is too early to address this question. Nevertheless, the availability of renewable energy had enabled many actors to fulfill and exceed their own corporate sustainability and carbon neutrality targets. One interviewee also had noticed an interesting consequence of how the availability of renewable energy had increased the electrification of some industrial actors. It seemed that most steps of the process that used to be fueled by oil had been updated to run on electricity. Hence, the ecosystem in its early stage has already contributed to solving the identified issues.

One criticism for CE and CBE discourse is that it overlooks the social sustainability aspects, and if discussed, topics are mostly diminished to job creation (e.g. Murray et al 2017; D'Amato at al. 2020). Job creation is indeed the most communicated social aspect also in the case of Äänekoski. However, the interviewees discussed job creation in relation to the added viability of the area. It was seen that the activity had likely benefited the local infrastructure and had increased the attractiveness of the area from business and social perspectives. Similarly, it has been argued that as the BEaspect often boosts activity in rural areas, CBE could lead to a more balanced and socially equitable economic growth (Hetemäki et al. 2017, 19).

Globally, a social issue discussed both in CE and BE context is how the social issues might be exported (e.g. Korhonen et al 2018b; Sheppard et al. 2011). Importing raw materials often shifts the environmental problems to poorer countries where the ownership of resources is not socially inclusive, and income and job benefits do not spread widely to local communities. Hetemäki et al. (2017) suggest that compared to fossil-based resources, in BE context the ownership base typically is more socially inclusive. Similarly, in Äänekoski the added value of responsibly sourced wood was brought up frequently. However, the responsibility was not due to the ecosystem structure. It stemmed from the principles and ownership base of Metsä Group, where Metsäliitto Cooperative – a cooperative of forest owners – is the highest decision-making body in the Group. (Metsä Group 2021b;2021c)

Thus, it seems that the merging concept of CBE gives a rather holistic outlook for sustainability dimensions. Based on the case of Äänekoski ecosystem, it seems that the ecosystem structure can further boost viability or rural areas. The ecosystem structure does not necessarily affect the socially inclusive ownership base. However, if the influential ecosystem actors actively advocate for holistically sustainable practices , it seems that the values and principles can be passed through the ecosystem. In general, it seemed that the ecosystem mindset fostered a respecting atmosphere towards the other actors in the ecosystem. The overall health of the ecosystem and its' actors was perceived as important, and it was even mentioned that bargaining powers over others should not be used excessively. Hence, the business ecosystem concept could be beneficial for the development of more socially equitable business.

To summarize the contribution and implications, it was found that the business ecosystem concept can benefit CBE. The literature suggested that business ecosystems offer a great opportunity for the CE research (Hsieh et al. 2017) and sustainability transitions (Lazarevic et al. 2019; Planko et al 2017), and the findings of this research amplify and expand these suggestions to CBE. Based on the case in question, the nature of CBE is very physical, the ecosystem revolved around physical flows of the keystone actor. Even though the business ecosystem research is dominated by intangible digital ecosystems (e.g. Adner 2017), the business ecosystem concept was useful in capturing the dynamics and synergies of the collaboration of physical kind as well.

For practical implications, it was found that actors are interested in participating in a CBE ecosystem. Main motives were added resources and flexible involvement of others working towards own goals. The ecosystem structure allows for the alignment of different individual goals in a way that advances the ecosystem vision. If the vision includes CBE, the ecosystem structure is a way to also engage actors without own CBE goals. The ecosystem mindset encourages cooperation and innovation trajectories, which are needed in the development of systemic CBE. From the managerial perspective, in practice the ecosystem collaboration is born through win-win collaboration and ecosystem management happens through communication and culture. With increased cooperation comes an increased need to communicate and establishment of a good communication structure was highlighted. No recurring barriers for ecosystem participation was found.

5.3 Limitations and further research

To address the limitations of this research, it should be noted that it is a single case study. Thus, it explores the phenomena in only one setting. Even though the findings do resonate with existing theory, the results should not yet be generalized. The further generalizability calls for further research in other CBE ecosystems on other fields and countries. Are the motives for participation similar across fields? Is win-win collaboration perceived as the most important mechanism for goal alignment? It should also be noted that the Äänekoski ecosystem is still at an early phase. Thus, the actualization of the current possibilities – new value adding solutions and innovation trajectories – should be examined later.

Another interesting avenue for further research is through the sustainability effects of ecosystems. This research discussed a few sustainability implications based on presumptions and matching suggestions with the literature and interview discussions. However, the effects were not measured. Regarding the social sustainability aspects, it would be interesting to measure the ecosystem spillover effects, e.g. if the well-being of Äänekoski area follows the development of the ecosystem. Alternatively, are other rural cities with buzzing ecosystems generally more viable than other similarly sized rural cities? Another interesting sustainability topic could be to examine the effects of participating in a sustainability-oriented business ecosystem into the sustainability targets of big industrial actors belonging in these ecosystems. Do they have more ambitious sustainability targets than other similar actors? Do they host a more holistic sustainability-oriented culture, i.e. has the sustainability-oriented ecosystem culture been absorbed to the participating companies?

6 CONCLUSIONS

This thesis studied if the concept of business ecosystems is useful in advancing circular bioeconomy (CBE) and if so, what motivates business actors to participate in a CBE ecosystem. The first question was addressed to the literature review: Is the concept of business ecosystems useful for advancing CBE? The question was studied by conducting a literature review of the two main concepts, CBE and business ecosystems. Based on the literature review, a research framework was proposed: business ecosystems for CBE. This framework suggested how the business ecosystem structure can benefit both individual actors and a system transition towards CBE through self-reinforcing causal loops. The business ecosystems can thus help facilitate collaboration, which is critical for the innovations and new practices needed for CBE.

The first question and the proposed framework laid the base for the empirical part of the study. If the business ecosystem is seen as a structure that can advance CBE, it raises the question: What motivates business actors to participate in a CBE ecosystem? This question was studied with case study method in the Äänekoski ecosystem. Nine business actor representatives from the ecosystem were interviewed. Firstly, it was found that actors see that CBE ecosystems do offer interesting possibilities for them. The sub questions broke it down to: What are the main motivations to join a CBE ecosystem? What other benefits there are? What kind of questions and issues there are to solve before cooperation can begin?

The motives for participation varied slightly depending on ecosystem position. The main motives were resources and flexible involvement of others to advance own goals. The effect of the ecosystem was that it allows for the alignment of the different individual motives. It helps to find the synergies between these different individual goals and view them as different sides of the same ecosystem vision. It was also found that in practice the mechanism that binds the ecosystem together is collaboration of win-win nature and clear communication of the ecosystem vision. The question of other benefits reveled the multilateral nature of the business ecosystem that only realize when a group of organizations are acting together. The multilateral relationships created viability, possibilities, trust and anticipated innovation trajectories. From the perspective of advancing CBE, these intangible aspects are beneficial as they enable collaboration by creating an ecosystem mindset.

Additionally, creation of innovation trajectories can enable a macro level transition to CBE. For the last sub question, no recurring issues regarding CBE ecosystem participation were found. The questions to solve before participation were seen to be situation specific.

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