Collaboration in Circular Oriented Innovation

Why, How and What?

Brown, P.D.

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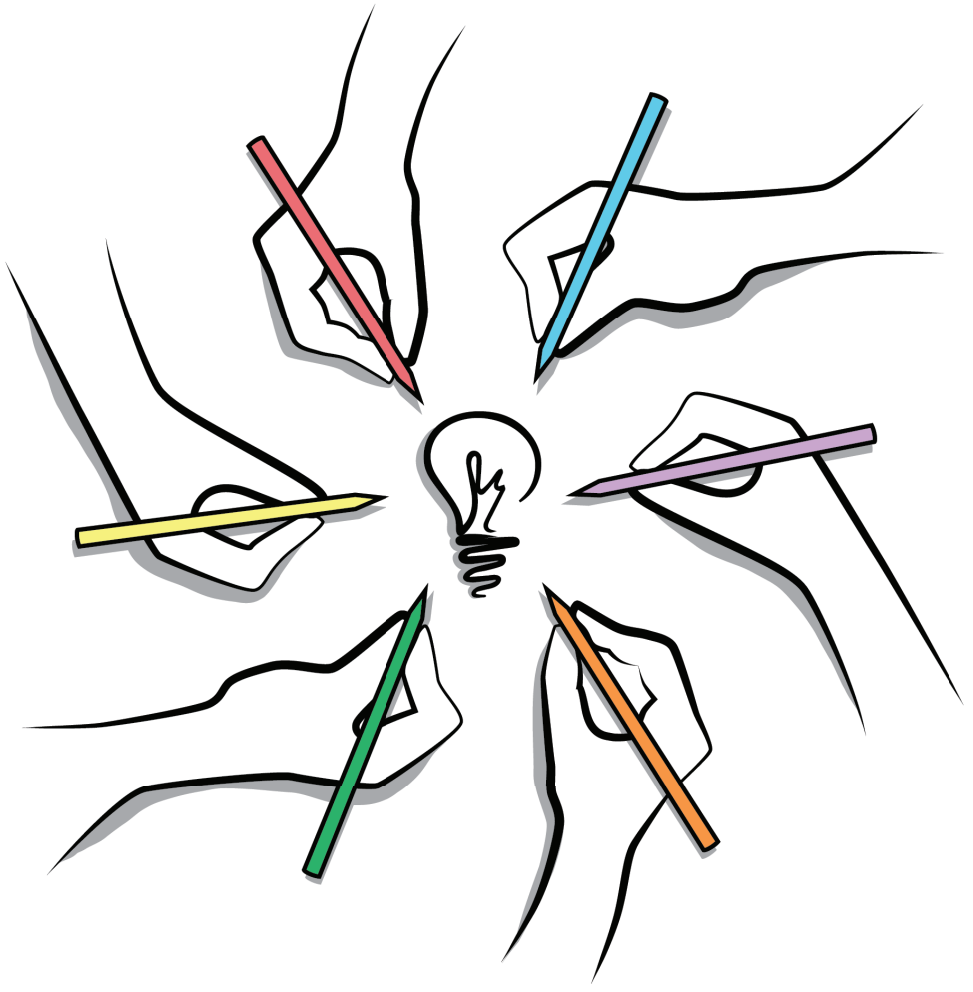

Phil Brown

Collaboration in Circular Oriented Innovation

Why, How & What?

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By

Phil Duncan BROWN

Master of Science in Environmental Management for Business, Cranfield University, The United Kingdom

Born in Huddersfield, The United Kingdom

This dissertation has been approved by the promotors

Prof. dr. A.R. Balkenende	Delft University of Technology, promotor
Prof. dr. N.M.P Bocken	Maastricht University, promotor

Composition of the doctoral committee:

Rector Magnificus	Chairperson
Prof. dr. A.R. Balkenende	Delft University of Technology, promotor
Prof. dr. N.M.P Bocken	Maastricht University, promotor

Independent members:

Prof. dr. T. McAloone	Technical University of Denmark
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Prof. dr. H.J. Hultink	Delft University of Technology
Dr. ir. J.C. Diehl	Delft University of Technology
Prof. dr. ir. C.A. Bakker	Delft University of Technology, reserve member

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Phil.D.Brown@gmail.com

www.circularstrategies.org

To my family, friends and colleagues (past, present and future) you inspire me to do better

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Publications

Journal Publications in this thesis:

Chapter 2: Brown, P., Bocken, N., Balkenende, R., (2019). Why Do Companies Pursue Collaborative Circular Oriented Innovation? Sustainability 11, 635.

Chapter 3: Brown, P., Bocken, N., & Balkenende, R. (2020). How do companies collaborate for circular oriented innovation?. Sustainability, 12(4), 1648.

Chapter 4: Brown, P., Von Daniels, C., Bocken, N., Balkenende, .R (In publication). A process model for collaboration in circular oriented innovation. Journal of cleaner Production

Chapter 5: Brown, P., Baldassarre, B., Konietzko, J., Bocken, N., Balkenende. R., (In Publication) A collaborative partner ideation tool for circular value proposition design. Journal of cleaner Production –

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Baldassarre, B., Konietzko, J., Brown, P., Calabretta, G., Bocken, N., Karpen, I.O. and Hultink, E.J., 2020. Addressing the design-implementation gap of sustainable business models by prototyping: A tool for planning and executing small-scale pilots. *Journal of Cleaner Production*

Konietzko, J., Baldassarre, B., Brown, P., Bocken, N., Hultink, EJ., 2020 Circular Business Models Experimentation: Demystifying Assumptions. Journal of Cleaner Production

Book Chapters:

Brown, P., Bocken, N. and Balkenende, R., 2018. Towards Understanding Collaboration Within Circular Business Models. In *Sustainable Business Models* (pp. 169-201). Springer, Cham

Conference Papers:

Brown, P., Bocken, N. and Balkenende, R., 2018. Towards an understanding of the collaborative processes and dynamics in circular networks: Integrating Literature and Practice. Proceedings of the International Symposium on Cross-Sector Social Interactions (CSSI 2018).

Brown, P., Bocken, N. and Balkenende, R., 2018. Exploring collaborative innovation within emergent circular economy innovation ecosystems – evidence from 12 cases. Proceedings of the European Academy of Management (EURAM).

Brown, P. Baldassarre,B., Konietzko,J., Bocken,N., Balkenende,R., 2019. Developing and testing a collaborative partner ideation tool for circular proposition design : Evidence from a circular innovation festival'. Proceedings of the European Roundtable for Sustainable Consumption and Production (ERSCP).

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Preface

This PhD thesis represents a journey to develop knowledge, learn how to conduct research, and develop professionally. Beyond this, it represents a personal journey to align my future work opportunities with my core personal values and desire to pursue a purposeful life. This purpose for me is to try to leave the world a little (and probably tiny) bit better than I found it. Through this doctoral study, I wanted to apply my energy towards understanding how to change our current system and ways of doing things to be more fair, equitable and ultimately sustainable (both now and for the future). We are all the sum of our values, experiences, ambitions and what we ascribe value to. This for me culminates within the personal goal to try to turn ideas into action. My aim is to inspire others to join or start their journey towards increasing sustainable actions and taking responsibility for a sustainable transition that we all need.

This journey for me has many roots and beginnings. My engagement with sustainability began as a child and young adult. My first memory and understanding of a grand sustainability challenge was the global drive to eliminate CFCs to avoid a collapse within the Ozone layer. I cannot remember where or why, but someone somewhere gave me a book. In this book you role played the main protagonist (a scientist); whose mission was to save the planet. The book required you to make choices along the way and directed you to turn to a corresponding page. This results in different narratives playing out whereby you can fail (and need to start again) or advance to 'complete' the book, by saving the world from an Ozone disaster. I loved this book, I must have read it 10 times before I was able to complete it, then read it some more to explore the different paths one could to take towards solving the problem. This showed me firstly the power of books to inspire, and secondly that throughout the book you needed to work together with many other characters to solve the problem. This also showed me that books, and by proxy the ideas and concepts held within them, have the power to stimulate people to change the way they think and act.

Later, as a young adult I spent time in China (2004-2005), which further stimulated my ambition and desire to pursue sustainability. Living in Guangdong, I saw first-hand the pace of change and gained an understanding of the size of our problems. When visiting Guangzhou, Shanghai or Beijing, I was firstly hit by the scale of these megacities, then the pollution, then the material throughput. Specifically, on this latter aspect, when returning to my adopted home after spring festival while looking out of the train window I noticed a massive open landfill site. Then, when I left the station in the city I was living in I noticed a new building that was just being finished. It had only been foundations when I left; 4 weeks earlier. This rate of change was new to me and left an impact upon me.

I returned to the UK to study a BA Hons in philosophy and social sciences at the University of Manchester. My time in China had inspired me to focus my studies onto understanding the philosophical, political, and economic theories related to international relations, development, and sustainability. In my thesis, I explored why Neoliberal political and economic systems create an unsustainable pursuit for growth that ultimately leads to boom and bust cycles; which commonly leaves those worst off in society in a more precarious position. I graduated in 2009 into one of these busts and the aftermath of the global economic crisis of 2008. I applied to (and thankfully won) a scholarship to the University of Manchester Business school high flyer graduate programme. In this course, my mentor Geoff asked me one day what I wanted to do afterwards. I responded that I wanted to work for a company that developed sustainable change, maybe I would try to become a sustainability consultant. Geoff highlighted that since a recession was in full swing and many of the business school graduates who also wanted to go into sustainability were struggling to get jobs in this sector due to a lack of experience. He suggested using my skills with people to work in business development to gain experience and an understanding of how companies function. Geoff stated “every company in a recession needs a good business development team and if you can survive and thrive in the current crisis you can thrive in any situation. Plus, you will learn a lot about how to position a

proposition and sell an idea, and isn't that half the battle with sustainability, to get people to buy into it and see the value in the ideas?".

When looking for a job afterwards I remembered this advice and yes I found that business development organisations were hiring, while many others were not; especially those within the sustainability sector. So I got a job within business development. Firstly, for a communications software company and then I moved to a company more aligned with my desire to develop sustainable change. I started working for Ecometrica, who had developed carbon calculation and environmental mapping software. Yet, still in the business development process once the really interesting implementation part started I had to move onto the next business development process. This brought me back to my desire to work for an organisation where I could personally implement sustainable change. This ultimately directed my decision to pursue an MSc in Environmental Management for Business at Cranfield in 2013. Before I started my MSc I researched as many different sustainability approaches, topics and concepts I could find. This is when I first came across the circular economy. This was being promoted by the Ellen MacArthur Foundation (EMF) within their first Massive Open Online Course (MOOC). This inspired me to understand how I could play a role and contribute my energy, effort, and ideas towards such a systemic transition. Some of these elements I have shared at the EMF Circular Economy summit in 2017. Follow the QR code below to see the full video.

The decisions that led to this doctoral study and resulting thesis grew out of my MSc studies at Cranfield; I actually wrote the original proposal for this doctoral study while finishing there. The intention was to explore and understand collaboration within a circular economy system. The interest in this topic came from my MSc thesis, whereby I wanted to know if it was feasible to reuse plastic materials from waste electronics for 3D printing. I found that it was possible and I wanted to turn this idea into action, but this required to collaborate with many actors to do something as simple as recover, reprocess and extrude a single plastic material that would be suitable for an FDM desktop 3D printer. My desire to turn ideas into action brought me to the Netherlands in 2015 and to work with the Better Future Factory, whereby we delivered 100% recovered ABS 3D printing material to the market. While presenting this work at Resource 2015 in London (a circular economy focused trade show) my ideas caught the attention of the High Speed Sustainable Manufacturing Institute (HSSMI). They approached me with an opportunity to join their circular value chains team, to research circular business models, remanufacturing processes, and the implications of circular economy ideas for closed-loop and reverse supply chains. Our team conducted research, consulted and developed tools and methods to support companies to understand and learn how to implement circular manufacturing ideas and operations. The aim was to support them to turn their ideas into actionable steps. Yet, here the underlying message throughout this research was again the need to collaborate.

Everything I could find at the time on circular economy research stated and advised that companies should collaborate, but then very quickly placed a full stop. However, for me, this full stop was more a black hole since I was not seeing or experiencing that companies knew why and how to collaborate; or whether they knew if they had to do things differently or not. Collaboration was just seen as something that companies should do and that it would somehow magically happen and result in circular systems being created. This challenged me since we have known about sustainability and resource challenges for decades, but I did not see that companies were collaborating effectively to overcome these longer term and sustainability challenges. So, I went back to my old proposal

and thought since I could not find answers to my questions on collaboration within a circular economy, I would try a little harder to turn my ideas into action. This brought me to Delft, via Dave Peck whom I had met on the EMF fellowship, to present my ideas to Ruud Balkenende. Ruud offered me the funding to explore this topic within a doctoral study as part of the design for circular a economy research team. My desire and his support to turn my ideas into action have resulted in this thesis that you are now reading.

I invite you to read this thesis with an open, explorative and inquisitive mind. The intention for writing this thesis (which is no small task) is firstly to show an academic audience and peers that I have provided sufficient contributions and knowledge to circular economy research to be able to defend my work and gain a degree and be granted a title. Yet, I personally did not start this journey to gain a title. Rather, I wanted to focus my research and energy onto something that could be practical and useful to practitioners. I wanted to create something that people can use to turn ideas into action or at the very least something that I could use to stimulate others to action. My previous experiences showed me the complexity of trying to turn even simple ideas into action and how complex collaborating with people can be; especially when the goal is circular economy and sustainability. This is just harder to do. We need to fundamentally change what we value, what we take into account, and understand what the wider impacts could be of any decisions we make; while being aware and prepared for potential unintended consequences of these decisions. This is especially true if one is trying to adapt or create systems. This research and resulting thesis, therefore, aims to explore the current and future challenges that increased collaborative innovation for a sustainable and systemic transformation (via turning circular economy ideas into action) can hold.

This thesis builds upon and is supported by existing and emerging circular research to explore ways to design a tool to aid collaborative circular oriented innovation. Through this approach, I find that our problems are not technical, but social. We need to think, work and collaborate with a more open, longer-term and more systemic mindset. Yet, this can fundamentally challenge our existing

ways of working, modus operandi and even how we define value and success. We will all need to ask ourselves what we value, what is our purpose and motivation; and do we really want to solve the problems that we see in the world.

If you answer yes, then you also probably realise you cannot do it by yourself, so you will need to collaborate with others. So, if we are to really change how our system operates; yes it will require collaboration on a scale we have not seen before, because we have not encountered problems on this scale before. Therefore going forward we will likely need to change how we collaborate, what we are willing to share and ultimately what we expect back in return for our efforts.

Through the medium of my thesis (a book), I would like to share with you how I am trying to turn my ideas into action. I hope that it effectively communicates to you new ideas and inspires you to take action. If we can all be inspired by ideas to change what we do or make moves towards a sustainable transition - and share this with and inspire our neighbours - we can and will solve the global sustainability problems that we all face. By turning ideas into one actionable and collaborative step at a time!

Ideas + Collaborative Action = Change

'An idea that is developed and put into action is more important than an idea that exists only as an idea.'

Edward de Bono: Serious Creativity - Using The Power of Lateral Thinking to Create New Ideas. Page 47

Summary

Our society faces many global sustainability challenges. Many of these challenges we have either created or exacerbated by not thinking about how the scale of our actions impacts the planet. We have however entered the Anthropocene, an epoch in time whereby human activity is now the dominant force upon the planet's climate and environment. It is abundantly clear that our actions, if not changed, will result in the collapse of many crucial life support systems that will affect our society. A key contributing reason for why our current actions are unsustainable and are ultimately creating negative impacts on the planet is how we produce, use and consume products and services. This highlights that resource flows are out of balance with ecological systems. The way we have structured our economy simply does not account for the finite and limited nature of resources or the ecological systems capacity to renew resource stocks. It is clear we need to change how our production, consumption and economic system functions, especially if we are to avoid the worst or reverse anthropogenic impacts. This requires creativity and the operationalisation of new ideas to come up with new ways of doing things. In another word, it requires us to innovate. But, to do so with increasing sustainable impacts as the key driver and rationale for innovation activities. The role of innovation for stimulating and creating sustainable change is widely recognised in academia and practice. Both see that we need to increasingly pursue collaborative innovations that take a systemic perspective to mitigate or solve the sustainability challenges we have created.

The circular economy (CE) concept is seen as a promising approach since it proposes taking a systemic perspective on how resources (materials and energy) can flow, cascade and cycle within systems to change how our economy functions; and to align it more with the way natural systems function. The core idea of the CE is that through innovating circular systems the intention is to extend the use and crucially reuse of the valuable resources that are brought into the system. In doing so the idea is to maximise value capture and retention opportunities and at the end of life have a clear plan for recovering the

resources. The ideas and innovations required within the development of a CE represent many challenges and unknowns; but, also it is thought many new opportunities for companies to both increase their value capture potential and increase their resilience towards future resource scarcity whilst reducing their environmental impacts. Yet, to create circular systems and operationalise increased circular flows of resources requires the integration of circular strategies. These are the combination of design, business model and value network arrangements intent on narrowing, slowing and closing resources flows. This thesis defines this as the development of a circular oriented innovation (COI) process.

COI is a problem-centric approach towards innovation intent on overcoming systemic sustainability challenges by integrating combinations of circular strategies. The identified problem aids in defining the aim, objectives and scope of the COI process. In turn, this frames and stimulates ideas and combinations of circular strategies that could mitigate or solve the problem. COI thus requires organisations to design new products and develop new business models that take into account extending product-use phases and where possible aim to incorporate multiple life-cycles. This means that companies need to focus on recovery systems to maintain through repair, reuse, refurbishment, remanufacturing and the recovery of resources. This needs a more systemic approach than most companies are used to or have the skills, capabilities, resources or know-how to develop. COI, therefore, requires collaborative innovation across all stages of a products life-cycle from its initial idea and design to its end of life and material recovery. This means actors who may not have traditionally collaborated need to do so to create and integrate circular strategies to explore value creation, capture, retention and crucially recovery opportunities. Such a process represents a shared learning journey into the unknown that can challenge the existing ways of doing things and working together. Despite the widely acknowledged need to collaborate to develop circular systems, little is known about how collaborative COI unfolds and how companies actually design and implement collaborative innovation within the CE context. Furthermore, it is unclear whether the collaborative COI process

represents specific differences or challenges compared to other collaborative innovation pursuits.

Transitioning to a CE will require both a top-down (government, policy and legislative) and bottom-up (companies, grass-roots and people-centred movements and customer demand) approaches. Collaboration plays a critical role within both top-down and bottom-up approaches, and their interconnections. Collaboration can thus be studied at or across multiple levels of analysis incorporating; micro (individuals or teams), meso (between companies, organisations, networks, or regions) or macro (International & National policy, legal or economic systems) levels of analysis to explore and understand how collaboration unfolds. All levels of analysis are important for developing a CE. Furthermore, collaboration is context-specific and adapts over-time. The decision has been taken to adopt a process perspective to research collaborative innovation across multiple collaborative COI processes between companies who are jointly developing circular products and services. The rationale for this selection is that companies are key actors within the implementation of COI strategies and therefore the development of the circular products, services and the circular recovery systems that are required. The focus of this explorative research is to understand how companies collaboratively innovate and the challenges presented within the COI process. This research is directed by the main research question; *"How can companies be supported when pursuing collaborative COI?"*

To research this question this thesis is separated into two parts. Each part presents explorative studies that engage with literature and practice to answer a specific sub-research question developed to answer to the main research question. COI activities not only need to show that they can demonstrate and justify that the circular idea is desirable, feasible and viable; but from the collaborative perspective, a challenge is how do companies ideate, develop, test and advance such COI processes. The studies within part one build upon literature to identify what is already known about collaborative innovation and then uses these insights to analyse case data to explore why, how, and what

processes unfold within collaborative COI. The explorative studies in part one aim to gain a deeper understanding of the nature of collaboration within the circular context. The aim is to identify the initial conditions, management approaches, and process steps conducted within collaborative COI. Thus, developing a deeper understanding of the collaborative process, challenges and the potential differences the CE context can generate for collaborative innovation. This informs part two by identifying the key challenges that are present within the collaborative COI process. The aim in part 2 is to develop a tool to support companies to overcome such challenges and to integrate circular and more systemic thinking into their collaborative innovation process.

An overview of the remaining chapters follows. Firstly, chapter 1 expands upon the research rationale, key concepts, scope, gaps, questions and presents the structure of this thesis. Then, chapters 2 through 5 are published papers or submitted papers under review. Chapter 6 discusses and concludes the contributions of this thesis.

Chapter 2 – WHY: Asks 'What are the motives, barriers and drivers that stimulate or hinder collaborative innovation within the circular economy context?'

The aim is to understand why collaborative innovation starts and explore the initial conditions that can lead to collaborations within a circular economy context. This chapter develops the literature foundation to define and situate COI upon an increasingly collaborative, radical, and systemic spectrum of innovation practices. From the literature foundation 'Hard' (technical and market-based) and 'Soft' (cultural and institutional) drivers and barriers for COI are developed. These are then tested against practice-based case-studies derived from semi-structured interviews. This analysis highlights that it is predominantly the 'soft' challenges that can inhibit collaborative COI. This work identifies 'why' practitioners and their respective companies decide to initiate collaborative COI. It shows this process combines normative, intrinsic, and extrinsic motivations for both the individual and companies involved.

Additionally, it shows a crucial development within collaborative COI is that an entrepreneurial source becomes motivated by an identified system failure, but is also aware of the interdependencies inherent in approaching a possible COI process. Thus, this actor is stimulated to actively pursue collaborative innovation and experimentation.

Chapter 3 – How: Asks 'How do companies collaborate for COI?'

This builds upon the 'why' to explore and understand the 'how'. This chapter engages strategic management literature to explore what is known about how collaborative innovation management can be conducted. This identifies the strategic decisions that can represent degrees of openness within collaborative innovation, the different knowledge management approaches and the potential tensions that can arise, and the different types of innovation. These are then used to understand the implications of how collaborative innovation can be managed. A resulting and crucial framing applied is whether the COI scope and activities represent incremental or systemic intentions. These literature foundations are then tested against multiple practice-based case-studies to assess similarities and differences. This analysis shows that different collaborative approaches and degrees of collaborative openness (internal and external) within COI projects result from the scope of innovation activities. This can dictate the need for competitors or increased numbers of collaborative partners. The challenges presented around the number or type of partners (chiefly whether competitors are present or not) within a project is shown to affect knowledge management approaches and how collaborative projects can be structured. For incremental innovation, we observe phases of collaboration, whereas, for more systemic innovation, we observe a more collaborative portfolio and layered approach. This advances our understanding of the different reasons that lead to different collaborative COI approaches.

Chapter 4 – What: Asks 'What processes do companies undertake when designing and implementing collaborative COI?'

This builds on the 'why' and the 'how' to explore the 'what'; specifically to understand what design and implementation processes are undertaken within COI. This chapter engages strategic management research to synthesis what is known about collaborative processes to identify and propose process 'building blocks'. These literature foundations are then used to investigate COI cases building on three research cycles; to 'explore', 'validate', and 'deep-dive' into the collaborative design and implementation process. This study produces a collaborative COI process model. This advances our understanding of the key processes undertaken when designing and implementing collaborative COI. This analysis is used to derive a future research agenda, support the identification of current challenges and identifies possible areas whereby tools could offer solutions to support and advance the collaborative COI process. One of the primary challenges within the process (which can impact the latter process steps and overall collaborative success) is how to identify and select the 'right' partners for a collaborative COI project. This is needed to support the creation of a working collaborative architecture to advance the exploration of the circular idea.

Chapter 5 – Tool: Asks 'How can a tool support companies to ideate to identify partners and collaborative value for circular proposition design?

This chapter presents the tool development process that uses a design science research approach to iteratively design, demonstrate and evaluate the ease-of-use and usefulness. This builds upon the insights from part one, whereby an initial challenge is how to think of and select partners when designing a circular proposition. This chapter engages the literature on sustainable and circular tool development processes to identify and present design criteria. The tool builds upon this literature foundation and integrates effectual decision-making principles to propose trigger questions within a canvas to map and visualise the

challenge, resources, customers and potential collaborative partners. The aim is to stimulate ideation on the design of a desirable, feasible, and viable circular proposition. The tool design and development cycles, tested through participatory workshops with academic researchers and practitioners, are conducted across multiple industrial and geographical contexts. The evaluation cycles form the basis for iterations of the proposed tool to support early and quick ideation, identification and selection of potential collaborators to craft and design the circular proposition. The chapter presents the main learnings and benefits the participants experienced through using the tool. The tool aids; 1) an increased focus on mapping and visualisation that supports moving from abstract and creative ideation towards assumption testing and concrete action planning, 2) the creation of an initial shared vision, and 3) deep-diving into a circular proposition or highlighting the need to pivot or adapt it. The tool supports the ability to quickly think of the desirability, feasibility, and viability of their idea by bringing in a focus on collaborative partners. Further it highlights any assumptions, challenges or potential testing that might be required to improve it. This chapter advances upon the main research question by proposing a possible solution to support companies when pursuing collaborative COI.

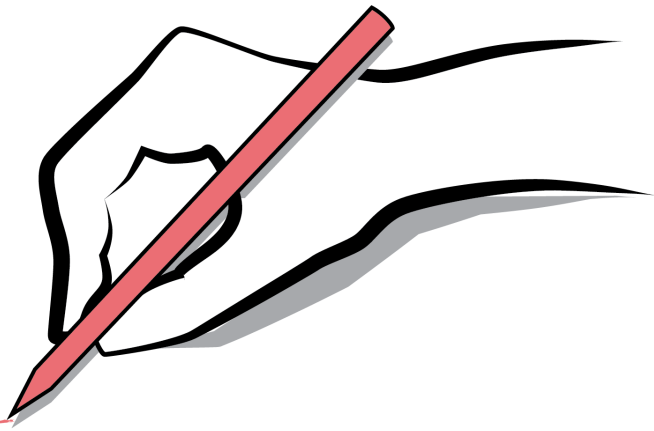
Chapter 6 – Discussion and Conclusions:

This chapter discusses the sum of the findings presented in the above chapters to give our conclusions, contributions, limitations, and implications for practice and theory. Two main contributions stand out from this research; 1) the tools developed and the insights produced from this process, and 2) the finding that collaborative COI needs to focus more on the ‘soft’ side of collaborative innovation.

The tool developed helps frame the discussion to support the COI ideation process. The trigger questions direct and aid users to think of wider perspectives. The canvas then acts as a physical space to map and visualise these perspectives. This supports ideas to emerge, or presents gaps within the idea and current knowledge, to help the users move from an abstract idea to

planning concrete actions. Further, this research shows the value of situating combinations of specific tools within the wider COI process; to support each step, one step at a time. But, we also show how a knowledgeable facilitator is needed to act as a 'circular conscience' to help maintain the focus on circularity or help the users to advance through the use of the tool.

This chapter discusses how tools and methods that support the COI process will only go so far. We show the 'soft' side of collaborative COI represents a key challenge to truly adapt or create new circular systems. More specifically, we have the technical solutions or the ways to develop these, but we need to overcome our learned behaviours and predominant mindset around the maximisation of individual benefits. Thus, a key focus here is the required mindsets and organisational capacity needed to adapt or create new systems that are intent on producing sustainable impacts. But, above all, actors need to be ready to collaborate and be clear that meeting an identified sustainability challenge will likely not be easy. And, the actors involved should all want to achieve a sustainable impact and have the leadership and foresight to maintain commitment even insight of the risks or challenges inherent within a more systemic COI process. Thus, the actors involved need to engage and work with partners who have the right mindset. Here, we identify that collaborators should have a mindset that is; effectual, experimental, systemic, and responsible. Otherwise, the collaborative COI process could be consistently frustrated; due to the lack of a functioning collaborative architecture. This might then result in the wider sense that circular strategies and systems do not work. Rather, than assessing that it is the mindset needed to collaborate effectively to conduct a systemic COI project that is lacking.



1 Introduction

Introduction

1.1. Research rationale

Humans are an inherently collaborative species. You, me, and our society at large are all here (wherever here is for you while you read this thesis) because our ancestors reasoned that working together can bring greater advantages than can be achieved alone. We can collaborate effectively due to our abilities to think of, combine and communicate ideas. This allows us to create concepts and imagined future scenarios with possible returns and crucially think about how we intend to share such returns to incentivise others to work together with us (this sets humans apart) (Melis, 2013). We collaboratively explored our surroundings and developed solutions to problems such as; how to live in climates and habitats we never evolved to be in, how to cross oceans, or how to find and use resources to meet the needs of our population. Collaboratively working together, we produced group actions that resulted in new ways of thinking and doing. This allowed humans to live, thrive and move across the planet. We have been so successful that we now control or have influence over many habitats and resources of the planet.

Our global success has however also sowed the seeds for many of the acute and 'wicked' sustainability challenges our society currently faces, such as; climate change, habitat and biodiversity loss, increasing pollution, and resource depletion. Sustainability challenges are characterised as 'wicked' problems since no single optimal or preferred solution is available; rather the priority is to select between multiple possible better, worse or good enough solutions (Waddock, 2013). A further complication is that wicked sustainability challenges are inherently systemic, multi-scaled, and context dependant; they hold complex interdependencies that can only be truly understood through the formulation and implementation of a potential solution (Conklin, 2006; Rittel & Webber, 1973). It is also only possible to assess whether the selected solution is actually better or worse based upon analysis of how the system responds to the implemented solution (Waddock, 2013).

Scientists are clear that human activity is creating our current environmental and sustainability crises (IPCC, 2018; Masson-Delmotte, Pörtner, & Skea, 2018). Biodiversity and natural systems are under extreme and increasing pressures (IPCC, 2018; WWF, 2018). The World Wildlife Fund reports that wildlife populations have declined by 60% between 1970 and 2014, due to increased consumption patterns and over-exploitation of natural systems (WWF, 2018). The dominant trend is that the human activity that are creating these challenges is accelerating. This is termed the 'great acceleration', which has been argued to define a new epoch in time, the 'Anthropocene'; whereby human impacts are so great they are now the dominant force on the planet's climate and environment (Steffen, Broadgate, Deutsch, Gaffney, & Ludwig, 2015) and affects the carrying capacity of the planet (Boulding, 1966; Meadows, Meadows, Randers, & Behrens, 1972; Meadows, Randers, & Meadows, 2005; Raworth, 2018). Steffen et al (2015) signifies that in the future we will either create a great decoupling of human development and activities from environmental impacts or potentially face a great collapse of our society.

There are many factors that contribute to why our current system challenges planetary boundaries (Meadows et al., 1972, 2005; Raworth, 2018; United Nations, 2019). One such factor is that our current production and consumption system is unsustainable, using finite and non-renewable resources (energy and materials) in an inefficient linear 'take', 'make', 'use', and 'dispose' manner (Ghisellini, Cialani, & Ulgiati, 2016). Global material use has grown from 27 billion gigatons in 1970 to 89 billion gigatons in 2017 (OECD, 2018). Further , this is set to double by 2060 to 167 billion gigatons, which will increase greenhouse gas emissions, leakage of toxic materials and environmental damage; if changes are not made (OECD, 2018; United Nations, 2019). The effects on material throughput and how our current system operates is exacerbated by a growing global population, expected to reach 8.5 billion people by 2030, which increases consumer demand for goods and services (United Nations, 2019). Yet, to date the global sustainable development model and agenda has predominantly been focussed on creating growth through increased global consumption of materials, goods, and services. This is no longer

sustainable or viable since we need to rapidly and drastically change the way materials flow and how the global economy works (United Nations, 2019). Thus, to meet the needs of our current (and especially future) population, whilst respecting planetary boundaries and the needs of natural systems and wildlife, we need to explore ways to improve how we use resources. This requires producing and consuming products and services in ways that account for, mitigate or remove environmental externalities throughout their production, use phase and end of life (EoL).

The United Nations (UN) global sustainability report emphasises the need to increase collective action, exploration of co-benefits and cross-disciplinary collaborations to achieve systemic and sustainable transformations (United Nations, 2019). The UN has put forward the sustainable development goals (SDGs) to frame how challenges should be approached. The circular economy concept is central to the SDGs, especially SDG 12 to ensure sustainable consumption and production patterns. Furthermore, circular economy is seen as a key lever and decision-making approach to stimulate actions that intensify the interconnections between the SDGs to create transformative change, jobs and reduce environmental impacts (United Nations, 2019).

The circular economy (CE) concept has seen a rapid growth in interest and research from academic, industry and governments as a potential solution to transition our production and consumption system (Geissdoerfer, Savaget, Bocken, & Hultink, 2017; Ghisellini et al., 2016). Many scholars have produced frameworks and research to describe 'what' a circular economy is (Andersen, 2007; Blomsma & Brennan, 2017; Geissdoerfer et al., 2017; Ghisellini et al., 2016; Merli, Preziosi, & Acampora, 2017; Millar, McLaughlin, & Börger, 2019; Prieto-Sandoval, Jaca, & Ormazabal, 2018). The underlying idea within the CE concept is to mirror natural systems; in which energy and resources flow, loop and cascade and where wastes become inputs for other parts of the system (W. Stahel, 1982; Webster, 2015). This builds on the assessment that industrial systems can aim to act more like natural ecosystems (Frosch & Gallopoulos, 1989) by increasing awareness for the need for closed systems and finding

equilibrium (Boulding, 1966). Multiple scholars have contributed to the development of CE thinking with the most relevant being; environmental economics (Pearce & Turner, 1989), cradle-to-cradle (McDonough & Braungart, 2002, 2013), regenerative design (Lyle, 1994), Industrial ecology (Allenby, Graedel, & Cohen, 1995; Chertow, 2000; Jelinski, Graedel, Laudise, McCall, & Patel, 1992), Biomimicry (Benyus, 1997), Blue Economy (Pauli, 2010). Recent consolidation and promotion has been made by the Ellen MacArthur Foundation (EMF, 2012, 2013, 2014). Yet, scholars have also noted challenges present within the CE idea, specifically the challenge and focus upon; maintaining material and energy flows (Sauvé, Bernard, & Sloan, 2016), securing reduced environmental impacts (Korhonen, Honkasalo, & Seppälä, 2018; Murray et al., 2015), potential rebound affects (Zink & Geyer, 2017), and the lack of a social dimension within CE (Geissdoerfer et al., 2017; Moreau, Sahakian, van Griethuysen, & Vuille, 2017), or how CE can support sustainable developments over the long-term (Millar et al., 2019).

To overcome such challenges and advance our understanding and the implementation of a CE, Lieder & Rashid (2016) indicate a circular transition requires both top-down governmental policy, legislation, and support in combination with bottom-up competitive strategies led by businesses. From a top-down perspective governments are rapidly investigating the potential for a CE transition through preparing road maps, actions plans, targets and international memorandums of understanding (IenM, 2016; European Commission, 2015, 2016, 2019; European Commission & National Development and Reform Commission of the People's Republic of China, 2018; Ministry of Infrastructure and the Environment, 2016; Potting, Hekkert, Worrell, & Hanemaaijer, 2016).

From a bottom-up perspective the sustainability of a companies' operations is seen as linked to its performance and is integral to business strategy (Boons & Ludeke-Freund, 2013; Evans, Vladimirova, et al., 2017a; Gimenez & Tachizawa, 2012). Collaboration between organisations is central to the innovation and sustainability potential of a company (Chin, Tat, & Sulaiman,

2015; Lozano, 2007, 2008; Zimmermann, Ferreira, & Moreira, 2016). Yet, sustainability increases the boundary of responsibility for environmental and social impacts beyond the focal company, which means taking into account wider stakeholders, environmental and sustainable externalities that previously have not been considered (Blome, Paulraj, & Schuetz, 2014; Pagell & Shevchenko, 2014; Seuring & Müller, 2008; Wendy Stubbs & Cocklin, 2008; Vachon & Klassen, 2008). Research into sustainable oriented innovation identifies that when the aim is to mitigate or overcome sustainability challenges and to maintain future abilities of companies to operate they need to increasingly pursue collaborative, radical, and system-oriented innovation strategies (Adams, Jeanrenaud, Bessant, Denyer, & Overy, 2016; Ceschin & Gaziulusoy, 2016; Keskin, 2015; Klewitz & Hansen, 2014).

This assessment is shared by the majority of CE research, which has advanced understanding about 'what' the different circular strategies are and their potential combinations (Blomsma et al., 2019a; Bocken et al., 2016; Florian Lüdeke-Freund et al., 2019; Masi et al., 2017). The idea is that implementing circular strategies will result in more sustainable innovation via the design of products, technologies, business models and the supporting recovery systems to improve resource (material and energy) flows, whilst reducing impact and environmental challenges. Circular strategies propose reengineering the way we do things by incorporating systems thinking to pursue mutually desired objectives to improve efficiencies across operations. This represents a push towards more intelligent and intentionally designed innovation systems intent on producing sustainable impacts. This means companies (and their networks) are central actors to include CE concepts to change the modes of innovation and value creation logic (Geissdoerfer et al., 2017; Oskam et al., 2020; Valkokari & Rana, 2017). This process requires increased inter-organisational collaboration to create networked approaches (Blomsma, 2018; Ghisellini et al., 2016; Ünal, Urbinati, & Chiaroni, 2019; Waller, Fawcett, & Johnson, 2015).

A recent circularity gap report indicates that the global economy has a long way to become fully circular, currently only 8,6% circular of resource flows and

extracted material inputs are cycled back into the economy. The report proposes that increased and improved collaboration across innovation networks is needed to improve this percentage and create joint value and transformative change (Circle Economy, 2020). This adds to the growing call and emphasis for increased collaboration across sectors to realise circular business models and recovery strategies (OECD, 2019; WBCSD, 2015). This links to the argument brought forward by Roberts (2000) who proposes that the only way to deal with 'wicked' and systemic problems (and their inherent complexity) is to do so collaboratively.

Collaborative innovation led to our global hegemony but is also consistently seen as the solution to solving our current (and future) circular and sustainability challenges (Barbara Gray & Stites, 2013; Heuer, 2011; Lozano, 2007, 2008; Niesten, Jolink, Lopes de Sousa Jabbour, Chappin, & Lozano, 2017; Niesten & Lozano, 2015; Quist & Tukker, 2013). This requires setting clear strategic commitments to a sustainable vision delivered by leadership able to re-think relationship management strategies and change business practices to account for the wider system dynamics (Klassen & Vereecke, 2012; F Lüdeke-Freund, Gold, & Bocken, 2016; Romero & Molina, 2012; Waller et al., 2015). Yet, Korhonen et al. (2018) and Khitous et al. (2020), indicate CE research needs to increasingly engage managerial perspectives on collaboration to advance understanding of 'how' to develop a CE. The focus of this thesis is on advancing our understanding on how to conduct and support collaborative COI.

1.2. Understanding how companies can go from the design of collaborative circular oriented innovation to implementation

This section briefly presents the background concepts that are relevant to understand collaborative innovation within the CE context. These are; 1) collaborative innovation and its benefits and challenges, 2) the challenges within the design and implementation of a circular economy, and 3) the methods and practices companies can use to go from ideation to exploration of collaborative circular economy innovation.

Gold et al. (2010) describe collaboration as a higher order strategic process that requires specific behaviours, operations and sustained strategic investments. Collaboration and collaborative innovation are widely researched across many disciplines such as: strategic management, supply chain management, innovation management, and strategic design, to name but a few with many sub-divisions within each discipline. Collaborative innovation research can explore the underlying dynamics, performance, learning and knowledge development, and how to create or bring new technologies, products, or services to market. Collaborative innovation benefits are produced from the differences in perspectives, knowledge, capabilities and problem solving approaches (Gray & Purdy, 2018). These generate an increased quantity and diversity of ideas for innovation, value creation, and the opportunity to engage with different markets and customer segments. Yet, challenges can arise due to the context and the potential for tensions, between actor's motives and goals, which can increase when the focus is upon sustainability (Gray & Purdy, 2018). This confronts business-as-usual and current operations and means that (at least in the short-term) most potential solutions will likely cost more (time, money, research and development, or risk) than the current situation. This can challenge an actor's incentives to pursue the collaborative innovation activities.

To implement CE strategies requires changes to 'how' companies design products, implement business models and collaboratively operate and maintain resource flows. CE strategies take a systemic view and focus upon the end-of-life (EoL). This requires designing reuse and cascade systems that cycle products and materials by integrating recovery strategies such as; reuse, repair, refurbishment, remanufacturing to achieve product integrity; and at EoL recycling to achieve material integrity. These recovery strategies are integral to circular business models; which focus on how resources (biological and technical) flow and how to integrate and combine product design, business model, and value-network configurations to create new circular propositions (Blomsma & Brennan, 2017; Bocken et al., 2016; Stahel, 1982). A circular proposition is the combination of circular strategies that intentionally narrows (use less), slows (use longer), and closes (use again) resource loops. The aim

is to maximise integrity (both product and material) to keep value capture opportunities at their highest levels throughout multiple life-cycles (Blomsma, 2018; Blomsma et al., 2019b; M. Den Hollander, 2018). Yet, this generates complexities (Geissdoerfer, Morioka, de Carvalho, & Evans, 2018; Velte et al., 2016), firstly, due to the need to overcome linear lock-in to be able to explore new product design, business model, and value network combinations; then by the challenge to understand whether negative impacts are actually minimised (Bocken et al., 2016; Linder & Williander, 2017; Florian Lüdeke-Freund et al., 2019; Rizos, Behrens, Kafyeke, Hirschnitz-Garbers, & Ioannou, 2015; Zils, Hawkins, & Hopkinson, 2016). To overcome these challenges requires new or altered collaborations between partners to deliver circular business models, recovery strategies and novel circular propositions (Aminoff & Kettunen, 2016b; N. Bocken et al., 2016; Kraaijenhagen, Van Oppen, & Bocken, 2016; Oskam et al., 2020; Schaltegger, Hansen, & Lüdeke-Freund, 2016; Velte et al., 2016). Yet, many companies are inexperienced or do not have the full capabilities to innovate circular propositions (Blomsma et al., 2019b; Bocken, Ritala, & Huotari, 2017; Linder & Williander, 2017). Therefore, companies need to conduct collaborative innovation that experiments with and explores how to implement viable circular propositions and recovery systems (Blomsma et al., 2019b; Bocken, Schuit, & Kraaijenhagen, 2018; Geissdoerfer, Morioka, et al., 2018; Kraaijenhagen et al., 2016). This thesis defines this as the collaborative circular oriented innovation (COI) process – see Chapter 2 for further detail.

To understand how companies can go from the ideation and the design of collaborative COI projects to the exploration of viable implementation requires understanding of the methods and practices companies can adopt. Below, collaborative foresight and experimentation are presented as ways that companies can use to collaboratively develop COI to explore new circular propositions.

Firstly, within a COI process companies need to think of and understand possible future scenarios. Strategic collaborative foresight presents ways to ideate within new and uncertain business fields; such as a CE (Weigand,

Flanagan, Dye, & Jones, 2014; Wiener, Gattringer, & Strehl, 2018a). It proposes using forward-looking methods and practices that deal with uncertainty to explore possible future situations. The aim is to collectively identify trends or signals of change to ideate, define problems, and plan appropriate strategic responses (Gattringer, Wiener, & Strehl, 2017; Rohrbeck, Battistella, & Huizingh, 2015; Weigand et al., 2014). One key success factor is that collaborators need to create a common language (Heger & Rohrbeck, 2012). Iden et al (2017) identify, through systematic review, other critical success factors. At the project level the conscious selection of stakeholders, levels of trust, top management support, and incentives to maintain processes are important, but also the role of the facilitator is crucial. At the process and method levels, actors need to tailor these to fit the context. To build a convincing picture of the whole-system or scenario. This requires using multiple types of design-led workshops, tools and methods of analysis across; product, technology, societal properties, competitive market and financial analysis (Heger & Rohrbeck, 2012; Iden et al., 2017; Weigand et al., 2014).

Collaborators also need the right mindset and competencies to overcome uncertainty to help planning and decision-making (Vecchiato, 2015). Further, to avoid cultural resistance plans based upon scenarios need to be made tangible (Hines & Gold, 2015). Wiener et al (2018a) argue collaborative foresight can be a key tool to support radical COI by generating tangible insights that foster 'out-of-the-box' thinking to overcome linear mindsets and explore circular opportunities and risks. However, using the right processes and methods is only half the challenge; the other is getting the 'right' number and mix of collaborators (diversity, knowledge, and culture) around the table. This should be linked to the intended aim. Engaging fewer experts within deeper collaborations can promote increased radical innovation ideas, whereas increased numbers and diversity can provide a breadth of knowledge, more ideas and creativity (Gattringer et al., 2017; Wiener et al., 2018a; Wiener, Gattringer, & Strehl, 2018b). Understanding how different collaborative foresight processes and how the partners involved within a collaborative COI can interact is important.

Secondly, within a COI process companies need to understand whether an idea or future scenario can work. This requires experimentation and the testing of different variations to gain proof of concepts to support validation and decision-making within a COI process. Experimentation is iterative and context specific (McGrath, 2010; Teece, 2010). Experimentation in a business context investigates uncertainties, assumptions and obstacles that might require collaborative activities (Weissbrod, 2019) and is done in conjunction with customer discovery, creation, and validation activities (Blank, 2013; Weissbrod & Bocken, 2017). It also indicates the need to assess where, when, and what value is created, consumed, captured, recovered and cycled between partners (Oskam et al., 2020; Schenkel, Krikke, & Caniëls, 2016). Testing variations is done by exploring value propositions (what is offered to which target group), creation and delivery (how value is created and the offering provided), and capture (how is value captured or missed by whom) and crucially within COI how it is to be shared (Bocken et al., 2018).

From the perspective of design and specifically strategic design such experiments explore the feasibility (what resources or who needs to be involved), the viability (what are the conditions to operate profitably), and the desirability (do customers want it and does it solve the intended problem) (Brown, 2008; Calabretta, Gemser, & Karpen, 2016; Karpen, Gemser, & Calabretta, 2017). This means to test and validate COI ideas one needs to find a suitable context and partners to design experiments in the real-world (Bocken et al., 2018). The need to assess sustainability impacts and unintended consequences of scale complicates COI experimentation, whereby actors need to be able to separate larger systemic ideas into core testable assumptions (Bocken et al., 2018; Weissbrod & Bocken, 2017). Furthermore, experimentation requires creating internal buy-in to secure resources, which is exacerbated when conducted collaboratively as each collaborator needs to do so separately (Weissbrod & Bocken, 2017). Experimentation methods such as ‘probe and learn’ (Lynn et al., 1996) or more recently ‘lean-experimentation’ support this process by creating low resource and quick ‘build-test-measure-learn’ cycles to support pivoting or changing ideas (Blank, 2013; Ries, 2017).

Experimentation also requires specific 'soft' competencies, culture, and a mindset for entrepreneurial risk-taking that values lessons from failures, as much as from successes (R. Antikainen, Alhola, & Jääskeläinen, 2017; McGrath, 2010). This process also requires balancing between the normative aim to create sustainable impact and the need for collaborative business modelling that defines value creation, delivery, and capture to incentivise collaborators (Oskam et al., 2020; Ranta, Aarikka-Stenroos, & Mäkinen, 2018; Rohrbeck, Konnertz, & Knab, 2013). This requires a deeper understanding how to design and conduct collaborative experimentation within a COI context.

1.3. Scope of this research:

This section firstly, presents the scope of the research conducted within this thesis. Secondly, it presents the background to position the boundaries of the research within this thesis.

The focus of this thesis is on collaboration within the circular economy context, specifically the investigation into collaborative circular oriented innovation. The analysis within this thesis is of the collaborations between companies. Companies are selected as the focus of investigation due to their key role within implementing innovation strategies to develop new products, services and business models. Emphasis within this thesis is placed upon the collaborative interactions and innovation activities between companies who are jointly innovating to explore how to create and bring circular products and services to market. This thesis views such collaborative innovations as a joint learning process. The focus is therefore drawn to the design and implementation of collaborative innovation activities between companies' with specific reference to the collaborative process and actions undertaken.

The research in this thesis explores why, how and what processes companies engaging within collaborative COI can undertake. This goes beyond the analysis of individual products or business models. Therefore, we do not look into the specific product level changes or firm-level business model adaptions that can be created or might be required. This thesis also does not take a specific focus

upon a sector or product category, but rather assesses a wide range of product categories along the lines of the transition agendas taken by the EU (European Commission, 2015, 2019) and Dutch CE action plans (IenM, 2016) to provide a broad-view of collaboration within current COI activities. Furthermore, the predominate geographical scope of this research takes a Dutch focus when engaging with practice to understand collaboration within the circular economy context (part one – see below). Yet, part two (see below) takes a wider focus when designing, demonstrating and evaluating the tool presented within this thesis.

Collaboration can be studied across multiple levels; micro, meso or macro (Austin & Seitanidi, 2012b; Valkokari & Rana, 2017). The micro level of analysis can investigate internally within groups of individuals, within companies or organisations. The meso level explores across organisational boundaries to understand how groups, networks, sectors, or cross-sectoral organisations collaborate together to achieve collective actions and aims. The macro level explores the overall system that can bring in analysis of collaborations within and across the wider aspects of policy, society, and legislation to understand how the whole context or landscape can be involved or requires adaption. These levels of analysis are permeable and not distinct. This thesis focuses on collaborative actions at the Meso level, i.e. between companies. Within this thesis the scope is on how companies design and conduct collaborative innovation for COI.

1.4. Research gap

Circular economy research is relatively young, but already contributions have come from many fields (Ghisellini et al., 2016; Merli et al., 2017; Murray et al., 2015). The majority of circular research either implicitly asserts or explicitly states the importance of collaboration to advance, operationalise and implement circular economy strategies. This is due to the increased focus on recovery strategies, longer term revenue models (Linder & Williander, 2017), and systemic impacts (Manninen et al., 2018; Pieroni, McAloone, & Pigosso, 2019). Yet, research into collaboration clearly indicates it is not easy to do, requires

active management and does not happen without clear strategic decisions being made (Gray, 1989; Senge, Lichtenstein, Kaeufer, Bradbury, & Carroll, 2007; Wood & Gray, 1991); whereby potential challenges are increased when the focus is on sustainability (Gray & Purdy, 2018; Gray & Stites, 2013; Lozano, 2007, 2008; Niesten et al., 2017). As such, many theoretical and practical elements remain uncertain; especially regarding the design and implementation of collaborations between companies who jointly pursue circular oriented innovation activities. Two main knowledge gaps for collaboration in circular research are identified that require investigation; 1) to advance our understanding of the nature of collaboration in the circular context, and 2) the ability to apply this knowledge to support collaborative circular oriented innovation.

Firstly, CE research has to date not empirically investigated in-depth collaboration. This represents a knowledge gap and creates uncertainty as to whether the CE context affects collaboration and our understanding of why, how and what collaborative processes can unfold within a circular economy context. Understanding 'why' collaborative activities start requires empirically investigating the motivations, drivers, and barriers to indicate the necessary conditions that initiate collaborations. Another crucial element is to understand 'how' the potential management of collaborative activities between actors might be conducted. Especially, the relationship between a CE vision and the scope of collaborative activities and the potential organizational and management impacts on knowledge across the product design, business models and network arrangements (Kraaijenhagen et al., 2016; Rohrbeck et al., 2013); and how such collaborations connect to slowing or closing resource loops across multiple product life-cycles (Bocken et al., 2016). The literature indicates that to achieve slowing or closing strategies will commonly require moving beyond buyer/supplier or dyadic relationships to engage more networked innovation, but this increases the potential complexity of collaborative relationships (Allee, Schwabe, & Krause Babb, 2015; Aminoff, Anna, Valkokari, & Kettunen, 2016; Geissdoerfer, Morioka, et al., 2018; Masi et al., 2017; Velte et al., 2016).

A key challenge that remains underexplored is understanding how collaborative learning within networks can be managed, which is crucial to collaboratively ideate and test circular strategies (Aminoff et al., 2016; Bocken et al., 2018; Schaltegger et al., 2016; Weissbrod & Bocken, 2017). Finally, this leads to uncertainty on 'what' collaborative processes unfold and whether there are inherent similarities, differences or challenges presented within the design and implementation of collaborations within the circular economy context. Especially, in comparison to 'linear' collaborations or collaborations that pursue sustainable innovation, since the need for collaboration is not unique to a CE.

The second gap pertains to practical challenges to implement CE strategies. There are limited real-world examples of implemented circular oriented innovations (Bocken et al., 2017; Linder & Williander, 2017). This can be described as a 'design-implementation gap', which requires increased focus on tools to support practitioners (Baldassarre et al., 2020; Ceschin, 2013; Geissdoerfer, Vladimirova, & Evans, 2018; Keskin, 2015). Many tools and methods have been developed to aid specific innovation process steps or provide an overview and guidance for an overall innovation process (Hidalgo & Albors, 2008; Idil Gaziulusoy, 2015; Taticchi, Garengo, Nudurupati, Tonelli, & Pasqualino, 2015; van Boeijen, Daalhuizen, van der Schoor, & Zijlstra, 2020). A notable academically researched and developed example is the business model canvas (Osterwalder, 2004; Osterwalder & Pigneur, 2010). Yet, many of these tools are not specific to circular oriented innovation; since they do not incorporate a focus on recovery or multiple life-cycles that are required to implement circular strategies. A growing number of CE researchers have integrated academic knowledge to develop tools that offer practical support to practitioners (Bocken, Strupeit, Whalen, & Nußholz, 2019; Kalmykova, Sadagopan, & Rosado, 2018; Pieroni et al., 2019). But, systemic reviews by Pieroni et al. (2019) and Bocken et al. (2019) show the majority of these are focused on circular design and business model innovation, whereby few tools have yet been developed to specifically support the collaborative aspects required in COI. This means gaps remain within tool development to provide support to practitioners on how to conduct collaborative COI (Hofmann, 2019;

Kirchherr & van Santen, 2019). Korhonen et al (2018) argue understanding the why, how and what of collaborative processes and approaches is a crucial blind spot for CE research. Furthermore, Pieroni et al. (2019) state there is a need for increased focus within tool development upon the design-implementation gap; whereby they indicate a crucial challenge to do this is to develop tools that expand inter-organisational boundaries.

1.5. Aims and Questions

The research within this thesis is directed by our main research question:

"How can companies be supported when pursuing collaborative circular oriented innovation?"

Based on the identified gaps outlined in the previous section, this thesis has two aims; 1) to understand collaboration within the circular economy context, and 2) to design and test a tool to help practitioners and their respective companies to conduct collaborative circular oriented innovation.

To meet the first aim, this thesis takes an explorative research approach throughout to analyse both current literature and practice insights. Analysis of the literature is conducted to aid understanding with regards to 'why', 'how' and 'what' collaborative design and implementation processes can be conducted. Since, there is limited empirical investigation into how collaborative COI is conducted this thesis engages with practitioners throughout to explore and empirically investigate the collaborative processes that have been conducted, the current challenges and how this aligns or differs from what is identified within the literature.

Sub-RQ 1: 'What are the motives, barriers and drivers that stimulate or hinder collaborative innovation within the circular economy context?'
Sub-RQ 2 : 'How do companies collaborate for circular oriented innovation?'

Sub-RQ 3 : 'What processes do companies undertake when designing and implementing collaborative circular oriented innovation?'

To meet the second aim, this thesis takes the position that since collaborative innovation is needed (to explore radical systemic circular solutions) and that circular propositions can require new collaborations to build feasible recovery systems and viable business models, yet since real-world implementation examples are still rare. Companies may require support for their collaborative COI endeavours. Thus, this research seeks to provide a solution and offer recommendations for companies.

Sub-RQ 4 : 'How can a tool support companies to ideate to identify partners and collaborative value for circular proposition design?'

The sub-questions (Sub-RQ 1 to 4) form the basis of the subsequent chapters within this thesis. These chapters present the empirical work that has resulted in published and submitted papers under review. This supported the advancement of the research to meet the aims and answer the main research question. The development of the research and approaches taken are shown in table 2.

1.6. Thesis structure:

This thesis is structured in two parts. Part one, chapter 2 through to chapter 4 aim to understand the collaborative circular oriented innovation system. The intention is to identify and define the problem space and objectives for a potential solution. Part two, chapter 5 presents the design, demonstration, and evaluation cycles conducted as part of the tool development process. Chapter 6 reflects upon and discusses these findings in relation to understanding collaboration within the COI context and presents our conclusions and contributions towards practice and theory. The thesis structure is presented in Figure 1.

Table 1. *Overview of Thesis Chapters*

Chapter / Knowledge Gap	Sub-RQ	Research Approach		Publication
		Literature	**Practice**	
2 WHY	1	Sustainable oriented innovation and circular innovation drivers and barriers	Desk-based research and semi-structured interviews to conduct retrospective qualitative analysis across multiple case-studies	Why do companies pursue collaborative circular oriented innovation? (Brown, et al 2019)
3 HOW	2	Strategic management and open innovation collaborative knowledge management approaches	Desk-based research and semi-structured interviews to conduct retrospective qualitative analysis across multiple case-studies using process research	How do companies collaborate for circular oriented innovation? (Brown, et al 2020)
4 WHAT	3	Strategic management process research on collaborative 'building blocks'	Three research cycles using desk-based research and semi-structured interviews to conduct retrospective qualitative analysis across multiple case-studies using process methods	A process model for collaboration in circular oriented innovation (Brown, et al., n.d.)
5 TOOL	4	Literature review into sustainable and circular tool development	Tool design, demonstration and evaluation cycles using a design science research approach to conduct multiple participatory workshops	A collaborative partner ideation tool for circular value proposition design (Brown, et al n.d.)

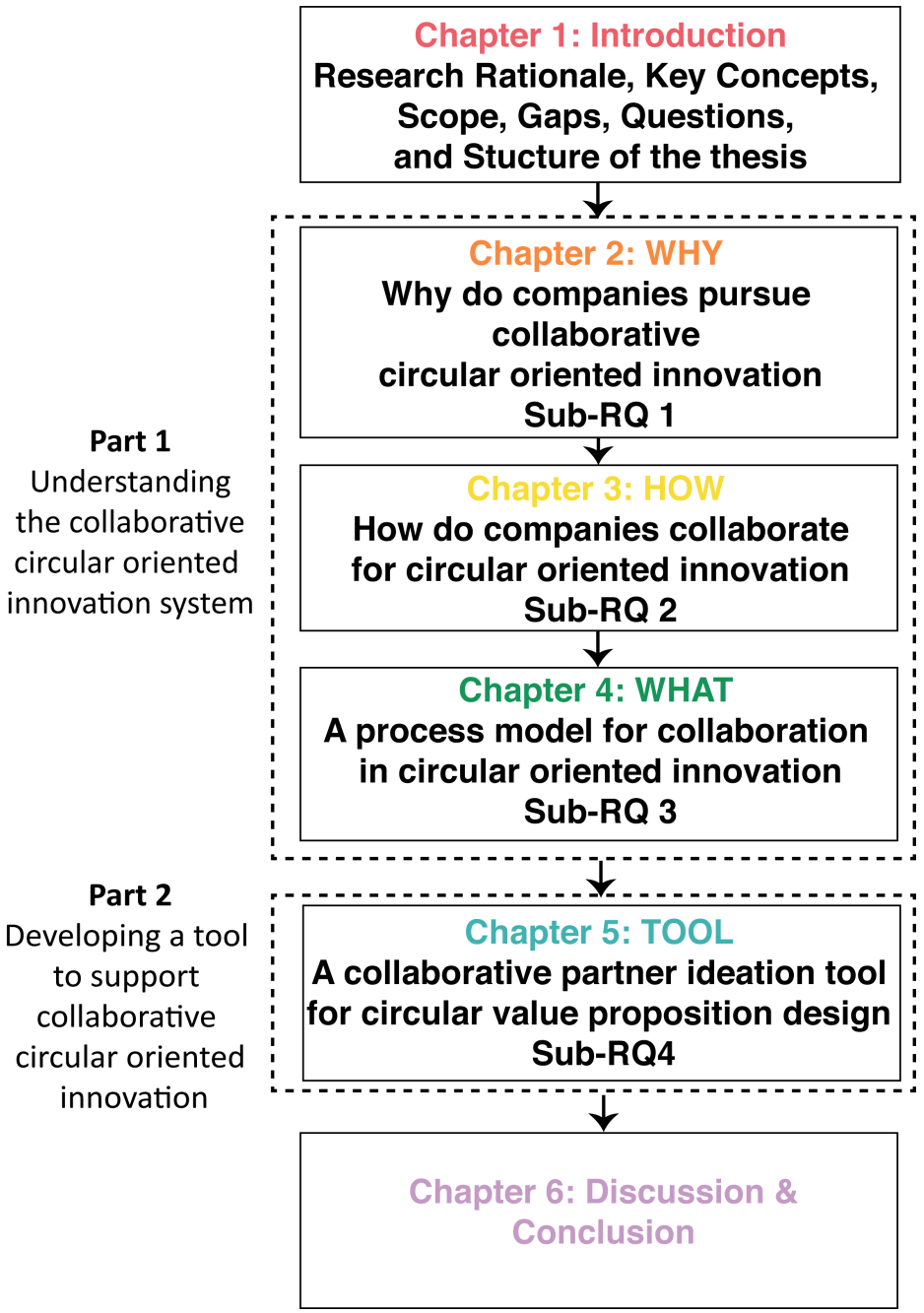
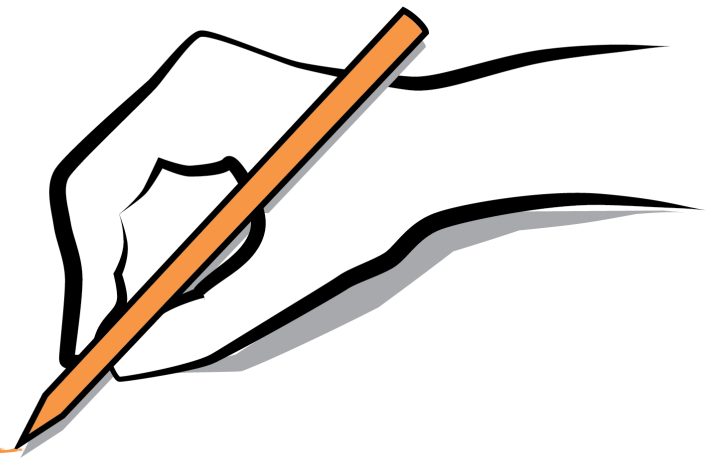


Figure 1. *Thesis structure*



2 Why

Why do companies pursue collaborative circular oriented innovation?

Chapter 2 - WHY

Asks ‘What are the motives, barriers and drivers that stimulate or hinder collaborative innovation within the circular economy context?’

This chapter is based on the publication: Brown, P., Bocken, N. and Balkenende, R., 2019. Why do companies pursue collaborative circular oriented innovation?. *Sustainability*, *11*(3), p.635.

The aim is to understand why collaborative innovation starts and explore the initial conditions that can lead to collaborations within a circular economy context. This chapter develops the literature foundation to define and situate COI upon an increasingly collaborative, radical, and systemic spectrum of innovation practices. From the literature foundation ‘Hard’ (technical and market-based) and ‘Soft’ (cultural and institutional) drivers and barriers for COI are developed. These are then tested against practice-based case-studies from semi-structured interviews. This analysis highlights that it is predominantly the ‘soft’ challenges that can inhibit collaborative COI. This work identifies ‘why’ practitioners and their respective companies decide to initiate collaborative COI. It shows this process combines normative, intrinsic, and extrinsic motivations for both the individual and companies involved. Additionally, it shows a crucial development within collaborative COI is that an entrepreneurial source becomes motivated by an identified system failure, but is also aware of the interdependencies inherent in approaching possible COIs. Thus, this actor is stimulated to actively pursue collaborative innovation and experimentation.

2.1. Introduction

Growing concerns about the over-consumption of finite resources contributes to increased calls for a transition to a more sustainable society. Sustainable oriented innovation (SOI) research (such as Altenburg & Pegels, 2012; Hansen, Grosse-dunker, & Reichwald, 2009; Hellström, 2007; Seuring & Gold, 2013), explores the process, decisions, and the transition potential that is related to integrating a holistic view of sustainability into innovation. Innovation here is defined as the act of creating significant change or novelty through the "development and implementation of new ideas by people who over time engage in transactions with others" (Van De Ven, 1986). Implementation, diffusion and acceptance within markets distinguishes innovation from pure invention (Klewitz & Hansen, 2014). Innovation success is therefore dependent upon both the technical advancement and the creation of markets, which requires active learning and creative entrepreneurial processes (Allen & Potts, 2016; Dougherty & Dunne, 2011). Freeman (1991) shows that such activities produce waves of emergence and consolidation that can lead to network-building. Dougherty and Dunne (2011) further propose that such organisational networks should be actively encouraged to connect disparate ideas that support market creation activities. The rationale for SOI compared to traditional innovation is that businesses can become key actors within sustainable transitions. This requires strategically changing their operations to create beneficial impacts from their economic activities that seek sustainable growth through innovation (Adams et al., 2016; Klewitz & Hansen, 2014; Schaltegger et al., 2016). SOI, therefore, goes beyond traditional innovation by changing a company's values to purposively create environmental, social and economic value. This is achieved through combinations of innovations in process, product, organisation, business model and market (Adams et al., 2016; Klewitz & Hansen, 2014; Pouwels & Koster, 2017). A key identified success factor is interorganisational collaboration (De Medeiros, Ribeiro, & Cortimiglia, 2014; Lozano, 2007), as increased sustainability impacts also require increasingly to innovate at the system level, which cannot be done alone. Yet, this increases complexity and the pursuit of radical innovation and learning approaches, which therefore also requires the

'unlearning' of established ways of doing things (Adams et al., 2016; Seebode, Jeanrenaud, & Bessant, 2012).

The circular economy (CE) concept, which is emerging within the sustainability field (Blomsma & Brennan, 2017; Blomsma, Kjaer, Pigosso, McAloone, & Lloyd, 2018; Geissdoerfer et al., 2017; Ghisellini et al., 2016; Kirchherr, Reike, & Hekkert, 2017; Merli et al., 2017) is systemic and commonly seen as collaborative, and is argued to hold the potential for radical solutions for a sustainable society. Although Blomsma and Brennan (2017) identify growing excitement about the CE concept, they argue that this needs to translate into the validation of claims to overcome uncertainties, and to prove that it can be operationalised. Here, collaborative innovation is seen as being required to create sustainable system impacts, which is supported through increased experimentation and the upscaling of CE solutions to contribute towards sustainable transitions (Adams et al., 2016; Aminoff & Kettunen, 2016a; Kraaijenhagen et al., 2016; Lieder & Rashid, 2016; Niesten et al., 2017). Collaborative circular oriented innovation (COI) is also central to both the European Union (EU) and Dutch government's sustainable future vision and strategies (IenM, 2016; European Commission, 2015; Sautter, 2016; Vanner et al., 2014). Collaboration is also central to the recent memorandum of understanding for the CE signed between China and the EU (2018). The assumption is that such collaborative COI activities will drive radical sustainable changes within research and innovation actions, create jobs, economic value and reduce environmental impacts (Sautter, 2016; Vanner et al., 2014). Understanding why such collaborative COI activities begin, how they relate to other sustainable oriented innovation approaches, and what the associated challenges are, is paramount if CE is to endure and not become another sustainability buzzword. However, only a few studies empirically engage with understanding the motives for why companies engage collaboratively within the CE context; it is usually simply seen as an inherent element. Our intention is to unpack this process.

Recent SOI literature has delineated specific drivers, barriers and success criteria that provide insights into how collaboration relates to such innovation actions (Adams et al., 2016; Albino, Dangelico, & Pontrandolfo, 2012; Dangelico & Pujari, 2010; De Medeiros et al., 2014; Klewitz & Hansen, 2014; Williams, Kennedy, Philipp, & Whiteman, 2017). However, the literature does not explain the extent of differences or similarities, which raises the question, of whether CE innovation is an emerging subset within sustainability. “What are the motives, barriers and drivers that stimulate or hinder collaborative innovation within the circular economy context?”. Answering this will develop an understanding of the rationale, conditions, and collaborations to promote increased circular oriented innovation. The purpose and scope of this study is therefore explorative in nature.

The remainder of the paper is structured as follows. First, we review current literature on CE and SOI, with specific reference to the associated drivers and barriers. A categorisation of ‘hard’ and ‘soft’ drivers, and barriers to innovation is used. Second, to find out from practice why companies have sought collaboration, we investigate 11 CE-oriented companies operating within the Netherlands. Finally, we propose a framework to describe why companies collaborate, based on our findings, which is used to support the discussion and conclusions that are subsequently presented.

2.2. Literature Background

This section introduces the key concepts and the development of the academic discussion on sustainable oriented innovation and the circular economy to first conceptualise the notion of circular oriented innovation. Their relations to collaborative innovation are discussed. Subsequently, the current drivers and barriers related to collaborative circular oriented innovation are discussed, based upon literature findings.

2.2.1. What Is Circular Oriented Innovation?

Circular oriented innovation represents a new area of research drawing upon sustainable oriented innovation literature, and incorporating developments

within circular economy (CE) research. CE has grown quickly, with many scholars aiming to define what it is, and why it challenges the status quo. The dominant view is that the concepts within CE are not new in themselves, but it is their specific combination and scope that creates challenges to present a unified vision and implementation (Blomsma & Brennan, 2017). As such, CE can be categorised as being pre-paradigmatic, where no single paradigm exists, with guidance and consensus still forming (Ghisellini et al., 2016). Recent analysis by Kirchherr et al. (2017) of 114 CE definitions, with 95 uniquely given, indicates this clearly. To overcome this challenge, Masi et al. (2017) deviate focus from the specific antecedents and definitions to the interconnecting goals and principles that are central to support a common CE vision. They include: (1) replacing linear systems with intentionally designed regenerative and restorative circular systems, (2) decoupling economic growth from non-renewable material throughput and environmental degradation, (3) increasing system resilience and (4) maximising value creation, capture and recovery across economic, social and ecological values. These four goals indicate the necessity for a systemic approach. Bocken et al. (2016) propose to achieve this through developing a CE vision in conjunction with combinations of CE product design and business model innovation strategies to design systems that slow, narrow or close resource loops. Den Hollander (2018), advances this by developing a heuristic design framework that combines CE strategies linking potential product use and lifecycle stages to associated business models. The aim is to maximise the product integrity and manage obsolescence through design. This requires up-front knowledge of specific CE design strategies and product criteria that are linked to recovery operations such as reuse, reparability, refurbishment, remanufacturing and recycling, hereafter termed CE recovery strategies (Balkenende, Bocken, & Bakker, 2018; Bocken et al., 2016; Den Hollander, 2018; Den Hollander, Bakker, & Hultink, 2017). This essentially means that innovators need to design with the knowledge and requirements of such a potential value network early, and plan for engagement across the full life-cycle. Circular oriented innovation (COI) is therefore defined here as the coordinated activities that integrate CE goals, principles, and recovery strategies into

technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product integrity and value capture potential across the full life-cycle.

2.2.2. How Does Circular Oriented Innovation Fit within Sustainable Oriented Innovation?

Sustainable oriented innovation approaches interact with all levels of business strategy and manifests in different dimensions (e.g., product, process, organisation and business model) and levels of 'radicalness'.

First, a systematic review by Adams et al. (2016) distinguishes three dimensions that are related to the integration of product design, business models and a systems approach. They explore whether sustainable oriented innovations are: insular or systemic, going beyond immediate stakeholders, either stand-alone or integrated with regard to sustainability within the organisation, or whether the innovation focus is technological or socio-technical. Using these dimensions, they propose three approaches, which are operational optimisation, organisational transformation and system builders. The system builder approach is considered to be the highest order, but the least found approach, where the innovation objective is the creation of net positive impact and societal change [17]. Work by Ceschin & Gaziulusoy (2016) on the design for sustainability also distinguishes strategies across the product, business model, and systems level, demonstrating increasing sustainable transformations. These authors position CE at the highest systemic level within SOI, and emphasise how CE thinking has evolved from, and builds on other SOI approaches. They also identify that increased potential sustainability impacts are linked to increasingly systemic innovation. Here, both systemic SOI approaches and COI requires active leadership that pursues business motivations, whilst recognising interdependence and actively engaging with new and diverse networks of actors to create sustainable business models at the network level (Fichter, 2009; Lüdeke-freund, Gold, & Bocken, 2018; Seuring & Gold, 2013; Stubbs & Cocklin, 2008; Williams et al., 2017).

Second, SOI may be incremental or radical, based upon strategic choices, and the context and scope of the intended innovation activity (Klewitz & Hansen, 2014; Szekely & Strebel, 2013). The key distinction is whether the innovation is a modification of a previously accepted process, product, service or technology, or whether it is wholly new and disconnected from the current context (Dahlin & Behrens, 2005; Szekely & Strebel, 2013). Although both forms of innovation activities are important for SOI, radical innovation has a higher potential for influencing sustainable development across industries and systems, but it is more challenging to predict the impacts (Adams et al., 2016; Klewitz & Hansen, 2014; Szekely & Strebel, 2013). This correlates to an increasing requirement for inter-organisational and cross-sectoral collaborative activities, which De Medeiros et al. (De Medeiros et al., 2014) identified as a critical driver for SOI success. Further work by Hojnik & Ruzzier (2016) shows this to be especially true within the development/innovation stage. These relationships are summarised in Figure 2, with SOI approaches and design strategies listed in Table 2. This shows that like other systemic SOI strategies, COI requires innovations at all levels (e.g., process, product, organisation, business model) to enable systemic change, but it also requires changes from the firm's strategy, engagement with society, and the way in which value is created. However, it is unclear whether there are further differences for why companies engage collaboratively or whether COI has reached the systemic level.

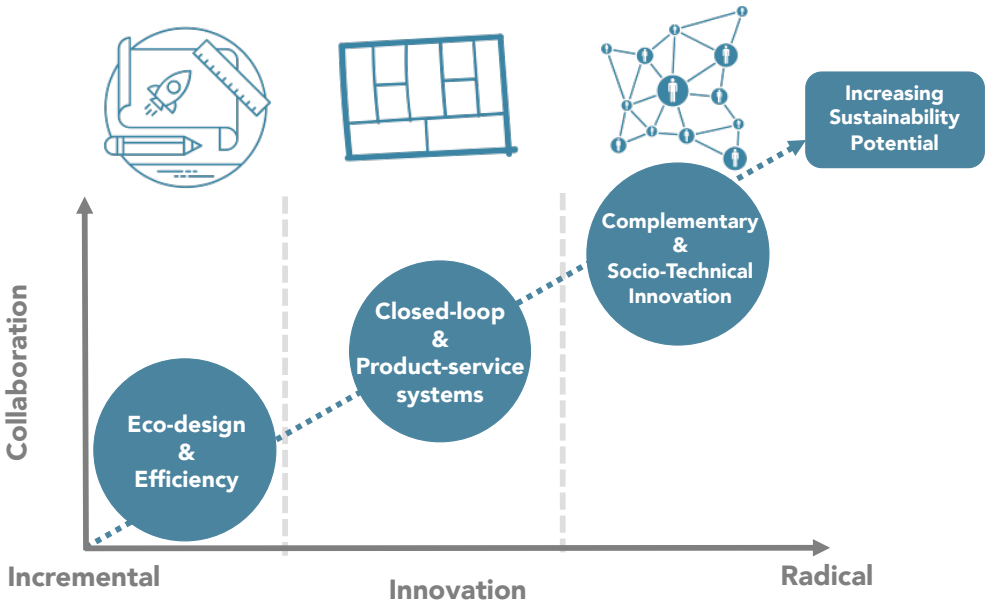


Figure 2. *Evolution of sustainable oriented innovation and collaboration (adapting and integrating Adams et al., 2016; Ceschin & Gaziulusoy, 2016).*

Table 2. *Sustainable oriented innovation and design approaches adapting and integrating (Adams et al., 2016; Ceschin & Gaziulusoy, 2016).*

	Product Focus	**New Market Opportunities**	**Systemic Innovation**
Sustainable Oriented Innovation Approach	Operational optimization: Eco-design and efficiency	Organisational transformation: New market/sustainable opportunities	System Building: For positive societal change
Objective of Innovation	Compliance & efficiency to do better	Novel products, services and business models to do good	Novel products, services and business models that are impossible to do alone

Outcome of Innovation	Reduce harm	Create shared social, environmental and economic value	Derive new and shared net-positive value configurations to drive societal change
Innovations relation to firm's strategy	Incremental improvements to business as usual	Shift in the firm's purpose—to do good and to create wider benefits	Extension of firm's purpose—to be a part of society and to drive institutional change
Design Approaches	Product level—e.g., Eco, emotionally durable or base of pyramid product design	Product-service, servitisation or closed-loop systems	Systemic design for innovation and transition, Circular product design and business models
Organisational learning	Mobilising existing innovation capabilities—mainly firm level	Importance of leadership to engage value chain and stakeholder network to gain and generate knowledge	Novel (cross/multi-sector) collaborations generating dialogues, foresight and experimentation

2.2.3. Towards Understanding the Motives for Collaboration in Circular Oriented Innovation

Circular oriented innovation is a novel and little understood concept. However, we can learn from collaborative innovation literature to incorporate existing insights, as COI is collaborative by nature. The literature shows that the primary motive for exploring collaborative innovation is the increase of knowledge flows (Adams et al., 2016; Ceschin & Gaziulusoy, 2016). Other commonly held motives include considerations for increased competitiveness and the market share of

innovations, as well as access to resources, new markets, or enhanced skills. Additionally, such pursuits may relate to: increased performance, as well as the reductions in costs and the time to market (Bititci, Martinez, Albores, & Parung, 2004; Pouwels & Koster, 2017; Ritala & Hurmelinna-Laukkanen, 2009). Collaborative innovation also allows for the ability to share associated risks (Bititci et al., 2004; Pouwels & Koster, 2017). However, collaborative innovation has many challenges to overcome, such as the potential loss of control, or opportunistic behaviour that results in issues of trust that raises the need for robust partner selection (Pouwels & Koster, 2017; Ritala & Hurmelinna-Laukkanen, 2009). These elements are increased for sustainable and COI activities. This is due to specific motives that are identified for engaging in radical sustainable innovation, which can be to seek a reputation as a green company, or a sense of ecological responsibility (Dangelico & Pujari, 2010). This shows that SOI holds normative values, going beyond traditional innovation, through a focus on why innovation is sought to overcome societal and environmental problems, and to propose solutions. Potential collaborating partners in SOI therefore need to be aligned more closely (Dangelico & Pujari, 2010; Lozano, 2007; Rohrbeck et al., 2013). Dangelico and Purjari (2010), however, put forward two caveats, one being that motivation alone is not enough, but that an organisation needs to translate its motives and vision into internal sustainability policies and targets. This also acts as a signal to potential partners on the suitability to collaborate. The other caveat is the potential market success of the proposed innovation, which acts as an important feasibility maker. These elements are also linked to findings from Klewitz et al. (2014) and Adams et al. (2016), who both indicate that pursing increasingly radical SOI requires organisations to integrate and root sustainability into all levels of innovation, especially the business model.

2.2.4. Drivers and Barriers for Collaborative COI

Research on COI drivers and barriers is nascent, but it can build upon research into collaborative innovation, SOI and early research on CE. Based on this, they can broadly be categorised along ‘hard’ and ‘soft’ dimensions (Table 3), which are essential for understanding collaborative activities between companies. Our

categorisation expands upon the dimensions proposed by De Jesus and Mendonça (2018), whereby we include further explanation of what is included within the analysis.

Table 3. *Hard and soft drivers and barriers.*

	Dimension	Explanation
Hard	Technical	Technology, technical knowledge and skills, data, supply network operations, infrastructure, material and product design
	Market	Business model, contracting and accounting processes, economic and financial assessment
Soft	Social/Cultural	Organisational, individual and societal—mindsets, ideas, customs, values, behaviours or norms
	Institutional/Regulatory	Legislative, taxation, regulations, policies

The 'hard' drivers and barriers for COI derive from the required systems perspective which increases the level of complexity and interdependency, which motivates increased collaboration. Collaboration increases the ability to assess the feasibility or suitability to integrate CE recovery strategies, business models, value network combinations, and the required processes to operationalise COI (Blomsma et al., 2018; Ghisellini et al., 2016; Ranta, Aarikka-Stenroos, & Mäkinen, 2018; Zucchella & Previtali, 2018). Such explorations are motivated by the desire to understand and develop circular resource flows, and potential new value capture opportunities or reduced impacts, but these are hard to assess or quantify (Bocken et al., 2016; Curley & Salmelin, 2018; Kirchherr, Hekkert, & Bour, 2017; Lieder & Rashid, 2016; Rizos et al., 2016). These activities also need engagement across the value network to explore potential tensions (Den Hollander, 2018). COI therefore motivates experimentation and

collaborative learning styles (Bocken et al., 2018), as the resources, knowledge, capabilities and infrastructure are dispersed across interdisciplinary actors (Aminoff et al., 2016; Sauvé et al., 2016). Thus, the complexity of the problem, coupled with the availability and distribution of knowledge, are key factors that motivate the collaborative innovation strategy and the intensity (Bogers et al., 2017; Felin & Zenger, 2014). This idea builds upon Powell (1996), who showed that networked learning and innovation are sought when there is a fast pace of transition, a distributed nature of knowledge and when required changes are industry-wide. As COI represents a fast, radical, and system-wide innovation and transition process, we assume that access to such CE-oriented networks are crucial for sourcing partners for experiments. This will additionally present the need to access suitable contexts for experimenting and scaling up ideas within and across value networks, to gain insights into feasibility, which is expected to further motivate collaboration (Aminoff et al., 2016; M. Antikainen & Valkokari, 2016; Bocken et al., 2018; Weissbrod & Bocken, 2017; Zucchella & Previtali, 2018).

The skills and competencies that are required for undertaking COI represent ‘hard’ drivers and barriers, but the ‘soft’ dimension also plays a role. This is reflected in two connected findings of recent work by Sumter et al. (2018), that focus upon the required competencies for designers within CE. They identify that designers need increased ‘hard’ capabilities of foresight and the assessment of impacts across multiple life-cycles and the system level. However, crucially, they identify the need for increased ‘soft’ skills to collaborate with stakeholders who are able to operationalise the CE business model. Such requirements to develop new competencies for COI are likely reflected across the whole network, as De Mederios et al. (2014) shows that in SOI, the development and maintenance of an innovation-oriented learning culture is critical to success. This is described as an organisation’s ability to adapt its own vision, develop competencies, and allow critical reflective analysis through innovation. Such learning is required to overcome barriers, especially cultural barriers to exploring sustainable opportunities. We propose this is increasingly true for COI. Furthermore, having the ‘soft’ skills to translate and communicate

CE complexity into a clear future vision that identifies the desired circular impact is crucial. This is needed for the internal strategic processes, but it is also essential for developing the external collaborations that are required (Bocken et al., 2016; Hallstedt, Ny, Robèrt, & Broman, 2010; Klewitz & Hansen, 2014; Pearce & Ensley, 2004). A sufficiently clear CE vision allows potential collaborative partners to assess the feasibility of such a collaboration, and to crucially determine whether the proposed vision and objectives align with their own (Bititci et al., 2004; Rohrbeck et al., 2013). Here, Adams et al. (2016) note that one of the key barriers for 'system builders' is to involve the right partners to co-develop insights into the specific challenge, and to co-define what the problem actually is, or whether it is shared. This indicates that potential collaborators are required to balance both the 'hard' and 'soft' drivers and barriers.

An analysis of CE literature against these 'hard' and 'soft' dimensions is conducted, with focus being drawn to COI and collaboration to present the CE drivers (Table 4) and CE barriers (Table 5).

An overarching driver for CE innovation is shown to be the desire to become a 'CE front-runner'. This is linked to reputation-building and the pursuit for new innovation, business opportunities, and emerging markets through experimentation. This in itself creates a driver for CE, as Kirchherr et al. (2017) suggest that an increase in front-runner pilots, proof of concepts and the marketisation of CE innovations could motivate others to follow suit. Additionally, Fischer and Pascucci (2017) identify that the creation of new contracting procedures, such as dynamic earning models and collaborative contracts that share risks and rewards, are needed to mitigate 'hard' barriers. Masi et al. (2017) argue that these are needed to create new collaborative supply chain configurations to facilitate circular transactions. Indeed, 'soft' dimensions of the company culture, current risk aversion, mindsets, and the 'hard' dimension of the position within the value chain are shown to affect the ability to develop these effectively. The majority of other drivers and barriers presented are 'soft' policy-oriented, and they aim to change the landscape through incentivizing circular

activities in relation to traditional linear processes. These include discussions around the creation of favourable CE subsidies, regulations, legislation and capital support in the form of public funding or CE procurement (Kirchherr, Hekkert, et al., 2017; Whalen, Milios, & Nussholz, 2018).

Table 4. *CE Drivers for circular oriented innovation (1) and collaboration (2) as assessed from the literature.*

	Drivers	Ref.	Relates to	
			1	2
Hard				
Technical	Increased availability of information and communication technology (ICT) facilitating resource optimisation for CE strategies	(Jesus & Mendonça, 2018)	√	
	Development of platforms for sharing/reusing solutions for products, materials and data	(Jesus & Mendonça, 2018)	√	√
	CE enthusiasm and pilots generating the desire to experiment, generating proof of concepts at scale	(Kirchherr, Hekkert, et al., 2017)	√	√
Markets	Anticipated cost reduction and financial profitability	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Masi et al., 2017; Ormazabal, Prieto-Sandoval, Puga-Leal, & Jaca, 2018; Rizos et al., 2016)	√	

		Material criticality. Increasing the desire for stable, resilient and sustainable purchasing	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Masi et al., 2017; Ormazabal et al., 2018; Rizos et al., 2016)	√	√
		Recognition of awards or favourable treatment in government tenders linked to sustainability	(Rizos et al., 2016)	√	
		Soft			
Social/	**Cultural**	Increasing awareness and literacy from the demand side (customers). Brand reputation gains, and protecting the future right to operate	[34,50,54,69]	√	
		Desire to be CE front-runners, successfully installing the environment and CE culture	[54,55]	√	
		CE front-runners joining like-minded networks for CE development	(Rizos et al., 2016)		√
Institutional/	**Regulatory**	Awareness of new standards, and increased environmental and waste legislation and regulations	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Masi et al., 2017)	√	

Table 5. *CE Barriers for circular oriented innovation (1) and collaboration (2) assessed from the literature.*

	Barriers	Ref.	Relates to 1	Relates to 2
Hard				
Technical	Lack of CE technical knowledge and skills, e.g., product design	(Jesus & Mendonça, 2018; Kirchherr, Hekkert, et al., 2017; Ormazabal et al., 2018; Ritzén & Ölundh, 2017; Rizos et al., 2016; Whalen et al., 2018)	√	
	Position within the value chain, coordination, contracting and existing distribution channel arrangements, creating lock-in	(Fischer & Pascucci, 2017; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ritzén & Ölundh, 2017; Rizos et al., 2016; Whalen et al., 2018)	√	√
	Take back/reverse logistics—quality, access and attractiveness of recovered products and materials. A lack of clear responsibility or ownership across the value chain	(Fischer & Pascucci, 2017; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ritzén & Ölundh, 2017; Whalen et al., 2018)	√	√
	Lack of data reducing the assessment of CE impacts, decision making and the validation of environmental impact	(Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Rizos et al., 2016)	√	

	Complexity to integrate technical innovations across the product, supply chain and BMs, creating technology gaps	(Jesus & Mendonça, 2018; Masi et al., 2017; Ritzén & Ölundh, 2017)	√	√
	Current limited proof for CE technology and business models	(Fischer & Pascucci, 2017; Kirchherr, Hekkert, et al., 2017)	√	
Markets	Lack of resources or access to capital for high up-front costs and administrative burdens, creating lock-in or a lack of ability to engage with CE	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ormazabal et al., 2018; Ritzén & Ölundh, 2017)	√	√
	Uncertain or misaligned returns and/or incentives for investments into CE across the value chain—reducing the willingness to change or collaborate	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ormazabal et al., 2018; Ritzén & Ölundh, 2017)		√
	Financial assessment, accounting and return on investment (ROI) based on linear concepts of rapid returns—Circular business models not seen as profitable or generating split incentives and returns	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ormazabal et al., 2018; Ritzén & Ölundh, 2017)	√	√

	CE contracting to share value across actors	(Fischer & Pascucci, 2017; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017)		√
	Low virgin material or new products prices, creating unfair competition	(Kirchherr, Hekkert, et al., 2017; Whalen et al., 2018)	√	
	Soft			
Social/Cultural	Limited support/slow acceptance from the demand side (customers) for CBMs; e.g., the product as a service, and the supply side (supply chain), slow acceptance of lease agreements	(Jesus & Mendonça, 2018; Kirchherr, Hekkert, et al., 2017; Ormazabal et al., 2018; Ritzén & Ölundh, 2017; Rizos et al., 2016; Whalen et al., 2018)	√	
	Company culture and a mindset for sustainability or CE value within the company and value chain	(Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ritzén & Ölundh, 2017; Rizos et al., 2016)	√	√
	Risk aversion, inertia or conservatism (internally/across the supply chain). Preference for incremental over radical experimentation and innovation	(Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ritzén & Ölundh, 2017)	√	

	Relationship power dynamics and costs, based upon the position within the value chain	(Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ritzén & Ölundh, 2017)	√
Institutional/ Regulatory	Legislation, regulations and taxes favouring linear processes	(Fischer & Pascucci, 2017; Jesus & Mendonça, 2018; Kirchherr, Hekkert, et al., 2017; Masi et al., 2017; Ormazabal et al., 2018; Rizos et al., 2016; Whalen et al., 2018)	√
	Lack of vision and consensus from governments for CE	(Kirchherr, Hekkert, et al., 2017; Whalen et al., 2018)	√
	Limited circular procurement	(Kirchherr, Hekkert, et al., 2017)	√

2.3. Research Design

We adopted an explorative case approach to investigate the motives, drivers and barriers that stimulate or hinder collaborative innovation within the circular economy context. We used multiple cases, with data being collected through desk-based sources from company websites, reports, press releases and other external communications. Primary data was collected through semi-structured interviews (Bryman & Bell, 2011). This approach was chosen to ask 'why' questions from practice (Yin, 2009). The purpose of the study was to explore insights into the motives of the interviewees, their respective companies and the different contexts whereby collaborative innovation was pursued. The interview protocol was constructed following recommendations from best practice (Bryman & Bell, 2011), with interview topics and questions derived from the literature and from previous work (Brown, Bocken, & Balkenende, 2018). The objective of the study and the unit of analysis was to explore inter-organisational collaborative relationships, their motives and the resulting actions undertaken

within the context of CE innovation. We chose to explore case companies selected from the Netherlands, which are considered to be a circular hotspot where COI actions are actively supported. Additionally, the Dutch government has put forward an ambitious target to be 'fully circular' by 2050, and it has identified five priority sectors, including biomass and food, plastics, manufacturing, construction, and consumer goods (IenM, 2016). Thus, the Dutch economy offers potential insights from within state-of-the-art practice. We chose to explore front-running CE companies; those who have instigated CE actions within the Netherlands. Case companies were selected based upon a stated circular economy vision, and the external communication of circular product and/or service innovations where collaborations were undertaken. We engaged with a range of sectors and product categories in an attempt to mirror the Dutch government's priority sectors. We chose this breadth of sample to assess whether the motives for collaboration presented similarities or differences from a broad base of cases. Additionally, the accessibility of key managers who led the development and implementation of COI activities was a contributing criterion. This supported the understanding of the reasoning behind the decisions required to engage with our research question. This resulted in 12 semi-structured interviews ranging between one to two hours, with 11 companies. The key aspects of the case companies and interviewees are presented in Table 5. The interview topics focused on CE concepts, circular strategies and vision, and collaborative circular innovation and motives. Appendix A provides sample questions.

Table 6. *Case companies and interview participant.*

Case	Length of Interview	Interviewee Position	Industry/ Sector	Product Category/ Type	No. of Employees
A	1 hr 25 min	CSR Consultant, CO_2 & Circularity	Energy	Infrastructure	>5500
B	1 hr	Director of Sustainability	Electronics	Household, consumer, healthcare and lighting products	>70,000
	1 hr	Senior Manager Sustainability			
C	1 hr 15 min	Circular Economy Manager—Plastic Cycle	FMCG	Food, drink and health products	>100,000
D	1 hr	Lead—Global Centre Circular Economy	ICT	Hardware, software and consulting services	>350,000
E	1 hr	Supply Chain Manager	Furniture	Beds, mattresses and bedroom accessories	>200
F	1 hr 10 min	Director of EMEA Regulations & Environmental Affairs	ICT	ICT hardware and IT services	>100,000
G	1 hr 20 min	Co-founder	Electronics	Smartphone	>75

H	1 hr	Circular Economy Specialist and Strategic Consultant	Real Estate	Consulting and development services for sustainable construction	>20
I	1 hr 30 min	Circular Economy Manager	Furniture	Office and workspace furniture	>150
J	1 hr 45 min	Director of Sustainability	Flooring	Carpet	>350
K	1 hr 30 min	Sustainability Marketer	Chemicals	Health, nutrition and materials (plastics and resins)	>21,000

Interviews were transcribed ad verbatim, and subsequently forwarded to interviewees to assess the validity. These were then coded using NVivo software. To answer our research question, and to explore why companies pursue collaborative circular oriented innovation, we looked for the circular economy strategies, evidence of collaborative approaches, and circular oriented innovation activities, and specifically, we explored the motives, drivers and barriers. Coding was initially conducted deductively by using a coding scheme that mirrored the interview topics of circular strategies, collaboration and innovation that were derived from the literature. Inductive coding was followed with additional codes added iteratively, based upon key insights derived from the coding process. A presentation of our iterative codes and their explanations can be found in Appendix B. During the coding process, we actively referred to, created and updated the code definitions to maintain focus upon the codes' meaning, and to ensure that the text was coded accurately. We present in Table 7 a specific example of how we coded 'motives' for circular economy strategies. We also provide an explanation of why the illustrative quotes reflect the example code. The researchers actively interpreted codes through grouping the categories and assessing the findings against the 'hard' and 'soft' dimensions,

as shown in Table 3. We compared these to the literature findings presented in Table 4 and Table 5. The data derived from practice was then assessed to explore the differences and similarities. Finally, we combined the insights to present a framework that proposes a description of why companies collaborate, based upon our explorative cases. This is subsequently used to support the discussion of the findings.

Table 7. *Example code and illustrative quotes from cases*

	Example Code	Illustrative Quotes from Cases	Explanation of Why the Quote Illustrates the Code
Circular Economy Strategies	Motives	B "It is very important to find people who have internal drivers. Can be business driven or sustainability driven. Find people who have an intrinsic belief with what they want to do. Find your CE champions."	The need to understand people's internal motivations to act towards CE.
		E "Apart from being profitable and delivering value to the business … I am here, to be able to make a difference."	Highlights both the personal and organisational reasons to explore CE
		G "It is also really important and linked to the motivation of individuals and how much they are willing to push certain objectives.	Highlights the process of engaging with a person's motives to drive CE. Represents how the intrinsic and extrinsic are important
		K "It is sustainability in general but CE is developing in such a way that, I personally find it fascinating, that if you are just supplying the product you are have only done half of your job."	Presents the personal engagement with CE due to interest/internal excitement to learn and a sense of responsibility

H	“So he (CEO) came to the realisation that if you are building tomorrow’s world, as a building/project developer, it should be better than the one we are currently in. Whereby you need to add more than you take out of the system. Otherwise your life has a negative result. If there is a purpose to existence it might just be that you do things better than people did before you or you leave the world with more in it than you took out. You add value.”	Presenting personal normative views of responsibility to pursue CE. This also shows how such normative values are involved within the development of the CE vision

2.4. Results

Through an analysis of our cases, we first present distinct aspects of collaborative COI activities in Section 2.4.1. In Section 2.4.2, Table 8 and Table 9 summarise the key drivers and barriers that are identified through the case studies, these build upon those identified from the literature presented in Table 4 and Table 5.

2.4.1. Case Findings: Insights into Collaborative Circular Oriented Innovation

2.4.1.1. Collaborative COI Intensity and Excitement

Collaboration is not unique to COI, but all interviewees discussed from their experience that they see a need for earlier, more intense and wider collaborations than previously, due to the new and systemic nature of COI. Case E stated: “Collaboration becomes increasingly important as you cannot assume that a certain cause of action will take place because that is the way it has always been. But because it is new you have to collaborate and on a larger scale than you have before to make it happen”. Case H advances this line of thought by stating “But you see with a linear project you work from chain to chain, link to

link to link. Here we try to look at the entire system. So, we try to look at everything at the same time". Another common theme discussed was the excitement of participants to engage and go beyond existing roles. Case A stated: "People are more thrilled, and their ideas open up. The peaks are higher and the valleys are lower. So, in a normal collaboration, people tend to stick to their roles … I have to say only some got excited about it as others also see and realise how complex it is". This was echoed by Case F who stated: "the level of excitement is generally higher. So, when people realise that they are working on cutting edge stuff that benefits the environment. They get excited. Because it is something new, you need to think more, put more things in and it is more complex". Yet, interviewees argued that this sense of excitement should only be needed currently to mitigate the current barriers, complexity, and the linear mindset. However, there was a common recognition for the need to find partners who are willing and excited to do COI, regardless of the complexity. Here, a key factor is the current premature state of COI, resulting in the fact that actors that are involved need to be more open and creative.

2.4.1.2. Basis for Collaboration, Partner Selection and Balancing Informal Processes

Another key difference presented by our cases is the basis for collaborative COI. This is commonly instigated either by an identified problem that generates a sense of responsibility, or by an existing proof of CE that inspires actors to develop a CE vision and engage with COI. Our cases indicated that this impacts decisions with regards to partner selection. Most interviewees indicated that when engaging externally, they started discussions with their vision. This is most clearly presented by Case C who said: "once I set my vision and what I want to achieve then whatever challenges I can face for me to achieve my vision I can look for partners that can help me … So when starting those initial discussions it is the vision that you lead on to get enthusiasm and engagement". Case E was more explicit with regards the role of a CE vision for partner selection by stating: "If you can find each other in that future vision then everything else is relatively easy. If you only talk price, then everything else is relatively difficult". Yet, Case I highlights how such a partner selection process is not optimal and presents: "a

messy approach and is sometime based more on a gut feeling, a good place/person to work with to achieve the aim. But business-wise it is sometimes difficult to explain to the CEO or a colleague. I find it difficult due to the types of parameters to choose from, this is the struggle I have". Furthermore, a common theme within the partner selection process discussed by the cases was how such discussions are linked to the need to develop levels of trust. This initially can be an informal process, but levels of trust also affect the management of collaborative COI projects. This presents a challenge for the actors who engage with COI, as they need to balance the formal and informal processes with challenges remaining around how to do so. Case G highlights how: "there are lots of informal chats. I would pretty much say we are friends also. So there are a lot of conversations when we need something from each other. I think a lot of things just come by".

2.4.1.3. Systemic, Connected and Collaborative Innovation

The type, depth, radical nature and connections between innovations were raised as another key element that is different within the collaborative COI activities. Interviewees commented that when starting COI activities, collaborators' initial interpretations of the challenges are focussed upon material throughput, but they can quickly assess deeper complexities. This raises the need for deeper engagement across the supply chain, as presented by Case A, who stated: "first we had the core group, we had sessions where we went all through the supply chains for the first time. We had on (sic) the same table the designers, us as owners and the waste treatment guys. This really opened the (sic) eyes. The material recovery participants came along with an old product and put it on the table and asked what do you expect me to do with this? How do I get to the pure materials? … So that type of conversation was illuminating and really helped".

Additionally, the connection between the product design and business model was a theme raised by all interviewees, as shown by Case E who stated: "naturally if you look into B2B and not giving up ownership and also adding services upon the product you are delivering to move towards a service model.

Then you have to change the design of your product completely. It is a totally different approach". Furthermore, the learning style presented by all parties was through a process of learning as you go via collaborative experimentation and piloting ideas with on-boarding clients. Case I highlights this: "We have learnt a lot from the refurbishing of all kinds of products. The next step is I think the business model. We also know how the business model links with the design. If you want to change the whole design then it could be more expensive. Then you have to go to your customer and ask if this is what you want to pay or whether they want a reused or more sustainable product. So every step we take you need to engage with and get along with someone else". The integrated nature of the innovation actions and associated challenges that this brings was a common theme.

2.4.2. Collaborative Circular Oriented Innovation Drivers and Barriers

Analysis of our cases is conducted along the 'hard' and 'soft' dimensions, with focus being drawn to COI and collaboration to present the CE drivers (Table 7) and CE barriers (Table 8).

Table 8. *COI Drivers assessed within case studies (findings relating to circular oriented innovation (1) and collaboration (2)).*

	Drivers	**Case**	**Relates to**	
			1	2
	Hard			
Technical	Increasing proofs of concept, stimulating others actions to test assumptions, experiment and pilot at scale	A/B/D/E/F/I/J	√	
	Accomplishing product improvements generated by CE innovation	A/B/D/E/I/K	√	
	Increasing material specifications, the exploration of new or altered functional needs for materials within CE innovation	B/C/F/G/H		√

	Cross-sectoral or common societal challenges, e.g., ocean plastic	C/F/J	√	√
	CE expertise outside core operations, e.g., CE recovery strategies or reverse logistics	C/D/G		√
Market	Innovation potential and the development of CE strategic capabilities and the knowledge for CBM	All	√	
	Anticipation of financial return, new business opportunities and efficiency savings within circular strategies	All	√	
	Access to new market: sales channels, customers (B2B + B2C) or to forward or reverse integrate product offerings (B2B)	E/G/I/J/K	√	
	Pursuit of CE-oriented tendering or procurement processes	A/I	√	
	Soft			
Social/Cultural	Enthusiasm and desire to be a CE front-runner to develop new knowledge, attract talent and to realise personal and company motivations	All	√	
	Growing sense of urgency and need for networked innovation to develop CE/sustainable transitions: linked to increasingly internal sustainable decision models and processes	All	√	√
	Search for and/or creation of credibility and acceptance via CE networks: Aim to find active companies pursuing CE to collaborate with	B/D/E/F/ J/H/I	√	

	Increasing demands from customers (B2B) for sustainable products and experience	E/I	√	
Institutional	Increasing lobbying for CE legislation	A/C/E/H/ J	√	
	Need for/awareness of creation and the acceptance of cross-industry standards	D/H/K		√

Table 9. *COI Barriers assessed within case studies (findings relating to circular oriented innovation (1) and collaboration (2)).*

	Barriers	**Case**	**Relates to**	
			1	2
	Hard			
Technical	Lack of technical knowledge/skills for CE: Current linear dynamics, training and skills stopping CE development	A/B/C/D/ E/F/H/I/J	√	
	Legacy of linear products/material challenge identification for secondary materials	A/B/D/E/ F/H/I/J	√	√
	Sourcing materials: quantity, quality, fairly/environmentally produced for both virgin or recovered	A/B/C/F/ G/H	√	
	Complexity to integrate CE knowledge	A/H/I/J		√
	Sectorial differences in the specification and the variation of material requirements: impacting selection and reuse options	B/F/H/J	√	

	Position and power within the regional vs global supply network, and pre-existing contracts and distribution, creating lock-in	F/G/K		√
	Alignment of skills, capabilities and resources to collaborate effectively	A/D/H		√
Market	Financial assessment and accounting based on linear concepts of rapid returns vs longer-term returns—CBMs challenged by short-term profitability or generating split incentives	A/B/C/D/E/H/J/K	√	√
	Contracting for collaborative actions to align incentives, risk vs reward across the value chain	A/B/D/E/G/H/J/K		√
	Balance formal vs informal. Flexibility and adaptability within contracting and project management procedures	A/B/G/H/J		√
	Reverse logistics costs for closed loops + low virgin material and product prices, creating unfair competition	B/C/F/J	√	
	Higher administrative costs and investment required. e.g., time, money and resources to collaborate	A/B/H/I		√
	Soft			
Social/Cultural	Balancing company culture, mindset and sustainable value internally or externally, for opening up to create the right environment for collaboration.	A/B/E/F/H/J/K		√
	Trust and transparency of information flows, motivations and goals to collaborate freely with partners—especially pre-competitive vs competitive collaboration with regards to knowledge sharing	A/B/F/G/H/J		√

	Finding and selecting partners—how, where and who to start collaborations with that are feasible and scalable	A/D/E/H/I/J		√
	Demand side (B2C) limited perception, education, the desire or access to information for sustainable or circular BMs	B/C/H/J/K	√	
	Lack of desire, fear of change or blocking activities by supply chain members to maintain the linear status quo or the preference for incremental changes	A/C/H/J/K		√
	Lack of a common language across sectors/life cycle stages	A/B/D/E/I		√
	Generating sufficient commitment to CE collaborative innovation	B/H/J/K		√
	Common/shared understanding for CE vision across collaborating partners and internal motivations	A/B/J		√
Institutional	Lack of certifications, standards, taxes regulation across life-cycle stages	A/D/H/J	√	

2.5. Discussion

Our research set out to explore why companies collaborate within COI. Through combining our literature and case analysis, we propose a framework that distinguishes such motives across different levels, as depicted in Figure 3. Here, we show multiple intrinsic motives (activities that are pursued for their own sake) and extrinsic motives (activities that earn external rewards or avoid punishment) (Reiss, 2012), which originate from both the personal and organisational levels. These manifest from the norms and values of the actors and the CE system context. An example is the growing sense of responsibility for sustainability, which can be both a personal and organisational intrinsic motive, and presents

a feeling that pursuing sustainability is the right thing to do, but it can also lead to extrinsic motivations, such as external recognition. Such motives act as a trigger to collaborate with others, if the actors feel alignment between their motivations. Other triggers that motivate collaboration result from the identified tactical and operational requirements that are derived from the COI strategy. These motives are the increased focus upon resources, and the need to find suitable contexts to experiment and mitigate the complexity of operationalising circular business models throughout the value chain and across life-cycle phases. The awareness of interdependences, resulting from the problem complexity and the distribution of knowledge drives this process, as well as the combinations of intrinsic and extrinsic motives, such as the motivation to secure supplies of materials, develop CE innovation capabilities, competencies, or gain recognition externally.

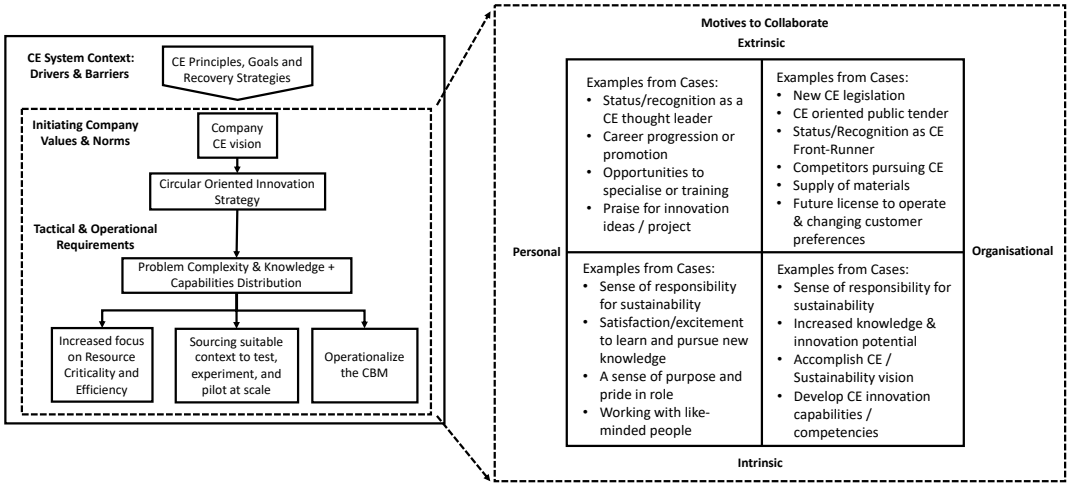


Figure 3. *Motives to collaborate within circular oriented innovation*

The remainder of the discussion is structured, following this framework to highlight crucial insights, and to answer our question with regards to what motives, drivers and barriers are present in relation to collaborative COI.

2.5.1. Personal Motives of Actors to Collaborate

The combination of intrinsic and extrinsic motives goes beyond purely economic drivers towards normative values for sustainability, a sense of responsibility and desired recognition. The actors themselves and their characteristics are therefore important factors for understanding why collaborations develop. The case studies indicated that personal enthusiasm and perseverance are needed to face obstacles within the COI process. Additionally, our cases highlighted a need for collaborative actors and organisations to have the right mind-set and motivations to pursue CE, which can also act as a key motive to collaborate. This is due to many collaborations being built via relational means, whereby participants had met at a specific event or already knew each other. Through developing a feeling of alignment between their organisation's future visions and themselves, as direct potential collaborators, the actors can decide to explore CE challenges together, initially on a small-scale, but with active participation and gradual proofs of shared alignment, the collaborative relationship and activities can deepen. The potential for such personal connections to result in collaborations is increased by the assessment of complimentary culture, capabilities, CE approach and suitable position within the value network. Thus, active participation by actors involved within the development of the CE vision or COI strategy in specific CE networks facilitates data gathering. In addition, this also supports partner selection, and can motivate potential collaborations through inspiration or identification of opportunities. Yet, we find that this requires discussions to be at the appropriate strategic level, usually between directors, who hold credibility and decision-making power.

2.5.1.1. Capabilities of Actors to Build and Support Collaboration

The central role of actors involved and their ability to drive innovation is well-established and researched within the innovation literature (Fichter, 2009; Schumpeter, 1947). Our cases expand upon this central role of the entrepreneurial actors and their traits by showing that abilities to build trust, credibility and envision COI opportunities supports collaborations. These capabilities also play a role within the challenge to create and maintain the right environment for collaborations to flourish. Here, all partners need to recognise

the benefits quickly, which requires active leadership in order to develop early gains and to highlight internally, and across the collaborative partners, the increased value of inflows of knowledge produced via collaboration (Bogers, 2011; Pouwels & Koster, 2017; Radziwon, Bogers, & Bilberg, 2017). Building upon literature that focuses upon entrepreneurs and intrapreneurs, we assume that effectuation (S. D. Sarasvathy, 2001, 2009) and the role of champions within innovation holds the potential for additional insights. This would add further understanding into why and how such personal enthusiasm and skills are translated into the way companies develop their CE vision and collaborative COI strategies. The challenge is whether such insights can result in formalised processes, or whether experience, characteristics and the traits of the actors are central and inseparable from the collaborative COI activities. Additionally, an understanding is needed on the differences between, on the one hand, the actors involved, and on the other, their motives to support collaborations and to maintain commitment (both personally and at the organisational level).

2.5.2. Drivers and Barriers for CE Vision and the COI Strategy

The current system context, combined with the circular principles, goals, and recovery strategies guides front-running companies to develop their CE vision. This is translated into COI strategies that shows how radical and open the company culture is, and reflects their goals and interpretation of the CE challenge. Our cases show that increasingly, within CE front-running companies, the CE vision is being translated into circular oriented corporate policies. These signals both the intrinsic and extrinsic motives to employees and potential collaborative partners for why CE is undertaken, and supports the proposed centrality of a CE vision for developing collaborative COI actions (N. Bocken et al., 2016; P. Brown et al., 2018). This also aligns with Dangelico and Purjari (2010), who found that translating the core vision into strategy and policy is needed for success, but that this effect goes deeper within collaborative COI activities. Cases (A/B/C/E/I/J) directly stated that aligning and sharing future visions with potential collaborative partners early, acts as a marker for partner selection. This tests the viability and credibility of the partners, beyond interdisciplinary competencies. The indication is that alignment is needed at the

level of values and norms, as well as 'hard' capabilities. However, some cases (B/D/I/G/K) also highlighted that collaborators' motives to engage with CE can also be driven by the fear of missing out or of losing existing or future competitiveness. It is unclear whether these differing motives affect the collaborative process for COI. However, it is clear that presenting a culture for innovation-oriented learning and critical reflective analysis of actions is a crucial condition. Cases (A/B/C/E/F/I/J) specifically mentioned that the company culture, CE maturity level, and their ability to consistently co-create a learning environment, whilst displaying flexibility and adaptability for decision making, were decisive factors, which supports De Mederios et al.'s (2014) findings. If such a CE vision and 'soft' cultural alignments are met, these can translate into a motive to collaborate. We propose that future research is needed within COI to explore whether these specific conditions interact to affect collaborations or the COI process.

2.5.2.1. Drivers and Barriers for COI the Increasing Focus upon Resources

The first tactical and operational determined motive to collaborate, as shown by all our cases, is the increasing focus upon resources within COI. This commonly leads to the first collaborative step, which implies THE collection of data for materials, products or supply chain operations. These activities identify potential hotspots, common risks, critical leverage points and technical barriers. The increased need for data triggers early collaboration within COI processes. This aligns with Adams et al. (2016), who signify that co-developing the problem and solution space is a crucial motive for developing collaborations. The drive for data created some new collaborative arrangements within our cases, although mostly these were conducted between existing suppliers, known experts or previous collaborators. While some cases (B/D/E/F/H) indicated an increase in exploring multi-sector collaborations driven by common challenges around materials, the requirements for new supply and demand side data, or societal challenges such as ocean plastics. The motive to collaboratively gather data is linked to the need to understand the system, such as global supply chains, differences across sectors, and the scale of regional/local collection and

processing to support CE recovery strategies. The data is also needed to assess the feasibility for reuse of materials, logistics and COI potential system impacts. Furthermore, collaboration was cited as being required earlier within the design process for new CE products and services. Cases stated a need to get the designer, manufacturer and material recovery experts together to maximise potential material recovery opportunities. Where new products were developed, they combined a focus on materials and alternative business models, with cases (A/B/E/I/K) for realising product improvements through such collaborative COI actions. The majority of these material-focused collaborations explored closed-loops or product-service-system combinations. Deviating from Adams et al. (2016) proposed 'system builder', the developed innovations are not yet radically different, but they rather represent incremental improvements via material selection or substitution ratios of recycled content. Yet, we identify that increasingly radical shifts in the way in which business is conducted, based upon motives for material criticality, reuse potential and supply chain impacts, are beginning, as represented by cases (D/E/G/I) who explored new knowledge in the form of material passporting and the exploration of current value opportunities within material reuse or reduction. Further research is required to assess whether this increased focus upon resources is a first step that results in radically new collaborative value constellations, as per Adams et al. (2016) proposed 'system builder'.

2.5.2.2. Drivers and Barriers for COI Finding a Suitable Context to Test, Experiment and Pilot at Scale

The second tactical and operational motive identified to collaborate is the need for finding a suitable context to experiment. This allows for the reduction of the complexity of the potential systems approach into manageable projects. The suitability of a context is determined by the physical space of the product or service that is identified to experiment upon, but it also incorporates engaging the 'right' mix of partners with the minimal levels of knowledge, capabilities, infrastructure, credibility, and trust that is required to conduct fast learning cycles. This is dependent upon the type and purpose of the experiment to be conducted. Recent work by Bocken et al. (2018) identifies that motives for

experimentation can be used to explore value propositions, delivery, creation, capture and field experiments, which companies can iterate between. Beyond the knowledge creation that experimentation brings, it also supports deeper engagement with other stakeholders to develop proofs of concept that can overcome internal resistance to the potential CE transition. Collaborative experimentation also ultimately allows partners to see whether they work well together, and whether their skills, culture, mindset and vision are truly aligned. A key challenge within finding suitable contexts to experiment is also the need to test at scale, to allow unintended or unexpected system impacts such as logistics, storage, or other operational challenges to emerge. Here, collaboration is crucial to reach such a scale, and also allows the risks and costs to be shared. This opens new research areas with regard to understanding the different ways by which to select suitable contexts, strategies and methods to separate systemic challenges into smaller, testable and lean experimentation processes.

2.5.2.3. Drivers and Barriers for COI to Operationalise the Circular Business Model

The third tactical and operational motive, and arguably within our cases, the least developed, are collaborative pursuits that operationalise the business model. This finding seems to confirm the statement of Adams et al. (Adams et al., 2016) that 'system builders' are not yet widespread. Here, our cases show a key split between technical innovation on the one hand, and market and business model innovation on the other. Case (B) described this split as being directed by the level of maturity of the various activities, with the business model being less mature and challenging. However, this represents potentially greater rewards if solutions are found. The lower level of collaboration is paradoxically observed where increased collaboration is required to develop all of the operations needed to operationalise CE recovery strategies that aid CE business models. However, this is also the area where competition increases, which reduces tendencies to be open and collaborative. This is remeniscent of the open innovation paradox identified by Bogers (2011), whereby firms share, but also simultaneously want to protect knowledge. Case (J) took this further by indicating that collaboration becomes increasingly challenging when it comes to

sharing economic rewards, which is often needed for circular business model innovation (Kraaijenhagen et al., 2016). This is due to the predominant mindset to maximise one's own returns, rather than assessing the potential increase for the whole operation. This directly reflects a 'soft' cultural barrier for advancing COI collaborations beyond the experimentation phase towards the competitive.

The 'soft' factors that represent the company culture and abilities to collaborate effectively can be described as a higher-order challenge. Without a suitable culture and mindset within and across the organisations involved, the shared CE vision and value propositon will not develop. Our finding aligns with Kirchherr et al. (2017), who indicate that changing corporate culture is the highest challenge for a company. This, we speculate, creates a causality issue and tension between maximising one's own profits and sharing rewards to increase the successful pursuit of collaborative COI activities to develop radically new products, business models and value constellations. The challenge is how to increase internal motivations to change the company culture without first achieving early wins and proof of CE concepts. Here, the actors driving collaborative COI activites need to be astute to the motives of collaborative actors (depicted in Figure *2*) to navigate potential barriers and to maintain enthusiasm. As noted by Kirchherr et al. (2017), our results show that such bursts of enthusiasm are accelerating experimentation. These experiments are needed to develop clear answers and examples of ways to capture and assess circular value, to create further motives for companies to advance their CE agenda. We argue this is required, as cases (B/D/F/J/H/G) indicated that collaborations have thus far been challenged by transitioning to the competitive. Cases (D/H/G) expand upon this by stating that the challenge is around what is valued, and how to overcome the current linear mindsets to support COI. This builds upon the challenge of collaborative finance and contracting that was previously raised by Fischer and Pascucci (2017) and Rizos et al. (2016), as we highlight the essential 'soft' barriers of the company culture and mindsets that need to be overcome. Building on this, future research into how organisations can collaboratively create value propositions and contracting structures will support such collaborations to move beyond the current experimentation phase

towards functioning systemic-level business models. Otherwise, the creation of novel new value configurations will be limited, challenging Adams et al.'s (2016) proposed 'system builder'.

The Dutch government aims to support the advancement of these tensions between 'hard' and 'soft' drivers and barriers for COI by motivating companies through policy and stimulating B2B demand through competitive circular oriented tenders (so-called Green Deals (IenM, 2016; Ministry of Infrastructure and the Environment, 2016)). The Green Deals reduce certain legal demands on government purchasing, and require collaborative experimentation within the initial phase of successful tenders (Case A/I). Such formalised structures are designed to initiate collaborations and is a further motive for why companies collaborate. Case (I) indicates that, "our current success rate has been 8 out of 10 for the circular tenders that have come out". Such tenders also challenge the organisation to solve operational challenges, such as issues of contracting or logistics. This shows that the capabilities to successfully develop collaborative CE innovation are starting to become a clear economic driver, aligning with findings from Rizos et al. (2016). This also aligns with proposals from Curley and Salmelin (Curley & Salmelin, 2018) that COI policies stimulated by government involvement via the triple (or quadruple) helix support, can stimulate new markets and create win–win situations that kick-start COI ecosystems. Cases (A/C/E/H/J) also indicate there is an increasing collaborative lobbying and consultation process happening with the Dutch and EU governments to explore 'soft' legislation and system barriers to further stimulate COI opportunities.

2.5.3. Proposed Conditions and Motives for Collaborative Circular Oriented Innovation

Inferring from the literature and case findings, we describe the initial conditions and motives (placed where they most commonly occur) that lead to collaborative COI, as shown in Figure 4. This starts with the identification of a current system failure or a shared problem, which inspires an entrepreneurial oriented CE champion. Due to the awareness of interdependencies, the CE champion

actively engages with other CE innovation-oriented learning by presenting an initial CE vision, and proposes collaborative COI strategies. Initially, this is to engage the minimum viable capabilities and resources that are suitable for experiment. Thus, pursuing the motive for new knowledge results in collaborative groups who aim to overcome the ‘hard’ and ‘soft’ barriers. The ultimate intention is to operationalise COI, although, based on our cases, this is still rare.

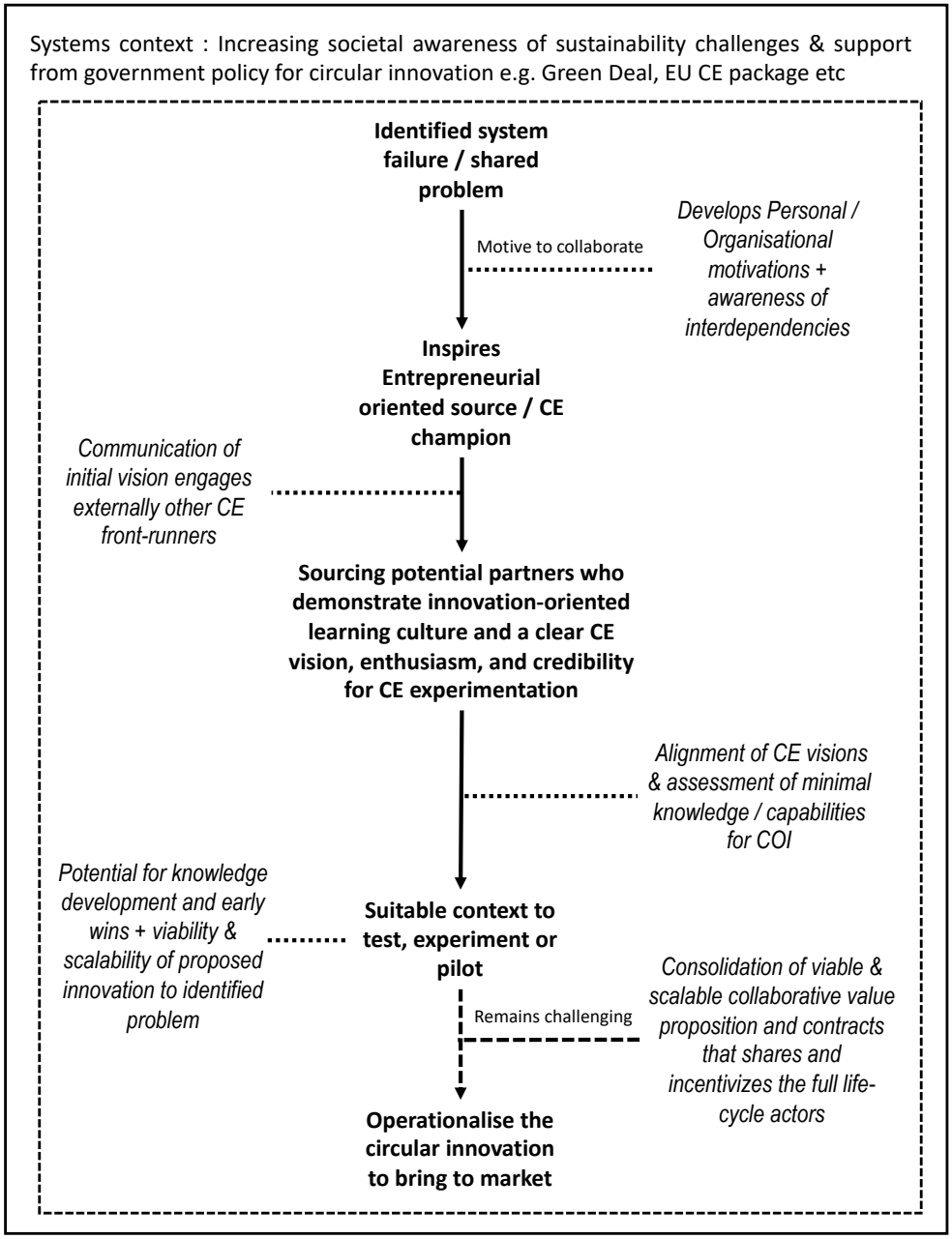


Figure 4. *Proposed conditions and motives for collaborative circular oriented innovation.*

2.6. Conclusions

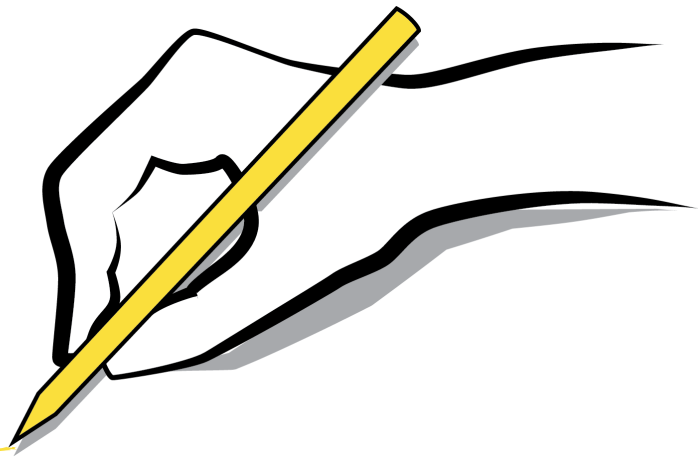
Our study has shown how circular oriented innovation is positioned upon an expanding, increasingly complex, and radically sustainable oriented innovation continuum. Circular oriented innovation takes place at the systemic level, to gain the biggest potential sustainability impact. We define COI as the coordinated activities that integrate CE goals, principles and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposefully maintain product integrity and value capture potential across the full life-cycle.

We have shown that collaboration is increasingly engaged earlier and deeper and built upon relational elements that incorporate normative and value-driven motives to collaborate. Within circular oriented innovation, these motives originate from both the individual and organisational levels, and represent intrinsic and extrinsic motivations. These motives are manifest through the CE vision, COI strategies and the technical and operational challenges that these create. Further research through longitudinal case studies is required to test if the motives, conditions and stages we identified are accurate, or whether potential iterations and feedback loops are exhibited. Furthermore, it is important to test the accuracy of our findings in relation to specific product categories, sectors or CE challenges.

Our study shows that excitement for CE and the ambition to become a CE front-runners is driving the co-creation of the problem and solution space to develop insights, best practices and guidance through fast-cycle collaborative experimentation and the validation of underlying assumptions. Collaborative partners are being sourced by entrepreneurially minded leadership, motivated by enthusiasm, and crucially, a credible approach to CE. Such collaborating groups actively aim to overcome the ‘hard’ and ‘soft’ barriers to COI, to create the right environment and culture to collaborate effectively. This has two added benefits: one, it raises the reputation and credibility of those involved, which is a key motivation, and two, it incentivises others to follow proofs of concepts. Such collaborative experimentations test the current pre-paradigmatic status of

CE. However, these collaborations are still largely challenged by moving to the competitive.

Based upon our cases and the literature studied, circular oriented innovation currently faces the challenge to move from the level of new market opportunities and closed-loop exploration to the generation of societal changes, through novel larger-scale collaborations. This requires increased attention towards ‘soft’ barriers, to change organisational mindsets to facilitate collaborative knowledge development and sharing, the creation of shared visions, and collaborative value propositions.



3 How

How do companies collaborate for circulair oriented innovation?

Chapter 3 - How

This chapter is based on the publication: Brown, P., Bocken, N. and Balkenende, R., 2020. How Do Companies Collaborate for Circular Oriented Innovation?. Sustainability, 12(4), p.1648.

This builds upon the 'why' to explore and understand the 'how'. This chapter engages strategic management literature to explore what is known about how collaborative innovation management can be conducted. This identifies the strategic decisions that can represent degrees of openness within collaborative innovation, the different knowledge management approaches and the potential tensions that can arise, and the different types of innovation. These are then used to understand the implications of how collaborative innovation can be managed. A resulting and crucial framing applied is whether the COI scope and activities represent incremental or systemic intentions. These literature foundations are then tested against multiple practice-based case-studies to assess similarities and differences. This analysis shows that different collaborative approaches and degrees of collaborative openness (internal and external) within COI projects result from the scope of innovation activities. This can dictate the need for competitors or increased numbers of collaborative partners. The challenges presented around the number or type of partners (chiefly whether competitors are present or not) within a project is shown to affect knowledge management approaches and how collaborative projects can be structured. For incremental innovation, we observe phases of collaboration, whereas, for more systemic innovation, we observe a more collaborative portfolio and layered approach. This advances our understanding of the different reasons that lead to different collaborative COI approaches.

3.1. Introduction

The circular economy (CE) concept promotes innovation strategies to adapt or create new systems to reduce material throughput, waste, and environmental impacts (Geissdoerfer et al., 2017; Ghisellini et al., 2016). Circular oriented innovation (COI) is increasingly researched to understand how to operationalise and support the transition towards a CE and a more sustainable society (Blomsma & Brennan, 2017; Lieder & Rashid, 2016). COI is distinguished by its combination of product design, business model, and value-network strategies intent on narrowing, slowing, and closing (material and energy) resource loops (N. Bocken et al., 2016; W. Stahel, 2014; W. R. Stahel, 2010). The strategic aim is to manage obsolescence, maintain product and material integrity, and keep value capture opportunities at their highest possible levels, throughout multiple life-cycles (M. Den Hollander, 2018; Ranta, Aarikka-Stenroos, & Mäkinen, 2018). To do this, recovery strategies are essential (reuse, refurbishment, remanufacturing, and recycling), but the resources, knowledge, capabilities, and infrastructure needed to integrate these are dispersed across actors (Blomsma, 2018; Den Hollander, 2018). So, new value-network configurations and relationships (created through collaboration) appear needed to connect actors' innovation activities to explore how to adapt or create new systems (Geissdoerfer, 2019; Ünal et al., 2019; Urbinati, Chiaroni, & Chiesa, 2017). Such innovations require a higher degree of complementary innovation activities, across different levels of interaction within a system, to generate or facilitate value creation, delivery, and capture opportunities by connecting actors business models (Evans, Fernando, & Yang, 2017; Takey & Carvalho, 2016). It is also not always clear what complementary innovations are required, how to create or test potential combinations, or even whether positive systemic changes are produced; this necessitates a more collaborative, iterative, and experimental approach towards innovation (Bogers, Chesbrough, & Strand, 2020).

Since COI aims to change how systems operate (by innovating for more circular material and energy flows), increasingly, collaborative, radical, and systemic

innovation activities should be pursued. Yet, collaborative innovation for sustainability requires specific internal and external competencies (Melander, 2017); and in COI, also, a range of 'hard' and 'soft' factors, such as linear system operations or cultural barriers, can inhibit efforts (P. Brown, Bocken, et al., 2019; Jesus & Mendonça, 2018; Kirchherr et al., 2018; Ranta, Aarikka-Stenroos, Ritala, & Mäkinen, 2018). This means actors from across the system and product life-cycle stages (who may not have traditionally worked together) need to align company motivations, expectations, and cultural differences to explore the tactical and operational requirements to implement COI (Blomsma, 2018; P. Brown, Bocken, et al., 2019). The challenge is to understand how collaborative COI can be organised, while successfully integrating CE goals, principles, and recovery strategies into technical and market-based innovations.

Research clearly indicates collaborative innovation is necessary within CE (e.g., (Geissdoerfer, Vladimirova, et al., 2018; Kirchherr et al., 2018; Lieder & Rashid, 2016; Linder & Williander, 2017; Sjors Witjes & Lozano, 2016)). Yet, Korhonen et al. (2018) highlight that difficult practical and strategic questions for 'how' to manage collaborative networks (e.g., organisational structures, knowledge sharing, sharing of returns, or risk management, etc.) is one of the key CE challenges. Answering such practical questions are needed since real-world examples of COI implementation are rare [23,26]. This represents a knowledge-implementation gap, which requires focus upon the processes and challenges involved in 'how' companies can implement COI (Bocken, Morgan, & Evans, 2013; Geissdoerfer, Vladimirova, et al., 2018). CE research predominantly focuses on product or business model innovation, which is important for understanding what to do. However, the investigation into how strategic decisions and knowledge management approaches are selected and conducted for collaborative innovation (needed to integrate and implement CE product and business model innovations within a system) is nascent. Moreover, there is a lack of empirical investigation, especially into the collaborative aspects of COI. Bogers et al. (2020) have recently initiated exploration into how open innovation can be used to engage with circular economy and sustainable grand challenges, to understand the collaborative structures and knowledge management

between multiple organisations. The focus of the present study is to bring this strategic management and open innovation lens into the COI context, by developing explorative cases to investigate whether this aids our understanding of how companies collaborate for COI. Understanding 'how' collaborations can be coordinated is crucial to advance the CE knowledge-implementation puzzle. We seek to address this gap by exploring the following research question: How do companies collaborate for circular oriented innovation?

We firstly present the literature background and key concepts used in this paper. The research design and empirical findings follow. Findings focus on how contextual elements can impact the structure and collaborative approach for COI. We then discuss these findings and present limitations, further research, and our conclusions.

3.2. Literature Background

Since COI is a nascent research field and largely lacks a collaborative innovation focus, we review adjacent research into collaborative innovation to gain insights into how it can be coordinated. We firstly present factors derived from strategic management and open innovation literature. We then highlight the different types of innovation that can be conducted within collaborative innovation. Throughout, connections are made to COI.

3.2.1. Strategic Management of Collaboration

Strategic management concerns the development of strategic visions, the setting of objectives and formulating, selecting, and implementing specific strategies to secure competitive advantages. One strategy can be to pursue collaborative advantage, which requires selecting specific approaches, performing deliberate actions, (Huxham, 2003) and represents a key strategic tool and source of competitive advantage (Gold et al., 2010). Within strategic management, key factors to consider for collaboration are broadly connected to the need for; (1) deliberate and emergent phases of planning, and (2) flexibility.

Firstly, many collaboration studies focus on the phases of collaboration that broadly incorporate assessing the context, partner selection, collaborative strategic planning, and implementation. Such phases require deliberate planning to assess the problem and context in relation to; the available resources, characteristics of potential collaborators, their number or level of heterogeneity, credibility, and possible power differentials (Barbara Gray & Wood, 1991; Lasker, Weiss, & Miller, 2001; Saxton, 1997). Imposed and emergent factors derived from the context can impact collaborative implementation (2003; 2000). Thus, collaborative strategy should incorporate both a deliberate planning phase and adapt to emergent factors throughout; which can arise from the collaboration itself or the individual collaborators involved (Clarke & Fuller, 2010). Clarke and Fuller (2010) further state phases need to be specific to the issue(s) pursued within the collaboration and tailored throughout towards the needs of partners (both the group as a whole and the individual partners involved). Secondly, the requirement to tailor collaborations throughout connects to the aspect that increased collaborative success is linked to increased flexibility. From a systematic analysis of 22 longitudinal cases, Majcherzak et al. (2015) conclude the most successful collaborations are those that overtime proactively adapt in response to emergent factors. Such adaptions can incorporate evolving collaborative goals, contracts, decision-making, or actor composition (Majchrzak et al., 2015). Thus, collaborators need to be responsive to emergent factors and actively initiate changes, rather than following prescribed innovation or collaborative management trajectories.

3.2.2. Open Innovation: Degrees of Openness, Challenges, and Tensions

Within the strategic management, open innovation research investigates the strategic decisions and knowledge management strategies required to acquire, assimilate, transform or exploit knowledge from across organisational boundaries through collaborative innovation (Bogers, Chesbrough, Heaton, & Teece, 2019). The intersection of circular economy and open innovation research is underexplored, but notable additions from Bogers, Chesbrough, and Strand (2020), and Curley and Salmelin (Curley & Salmelin, 2018), have started

to explore whether open innovation practices can provide a foundation for understanding 'how' collaborative innovation can be conducted to support sustainable pursuits.

Open innovation research broadly examines how companies accelerate internal innovation, competitiveness, and performance through increased inflows and outflows of knowledge across organisational boundaries (H. Chesbrough, 2003; West & Bogers, 2014). Of importance to collaborative COI are investigations into 'coupled' innovation, whereby companies jointly develop and commercialise innovations (Enkel, Gassmann, & Chesbrough, 2009; Rouyre & Fernandez, 2019). West and Bogers (2014) show these can represent either singular or multiple projects, and, can be structured around different collaborative relationships from buyer/supplier or bilateral co-creation to larger-scale innovation networks or ecosystems. Within these types of collaborative projects, knowledge sharing is crucial for success (Bogers, 2011; Ritala & Hurmelinna-Laukkanen, 2013; Rouyre & Fernandez, 2019). West and Bogers (2014) also show how collaborative innovation is increasingly networked, iterative, and moves away from the linear innovation funnel presented by Chesbrough (H. W. Chesbrough, 2003). Chesbrough (2017) has also later supported this view; stating future open innovation strategies will require increased collaborative systems, especially to implement new product-service combinations. However, West and Bogers (2014, 2017) show research into how these new business models are implemented represents a gap. More specifically, research that investigates how companies commercialise innovations collaboratively and measure value capture rather than just value creation is lacking. Bogers et al. (2019) identify two aspects that are crucial: (1) the business model around how technology is developed (i.e., the proportion of in-house vs. contract or external research, and (2) how intellectual protection is structured (open or closed). The challenge is that increasingly, value creation, delivery, and capture activities operate at the system-level (N. Bocken, Boons, & Baldassarre, 2019; Bogers et al., 2019; West & Bogers, 2017). Thus, the need to understand dependencies and complementarity between the multiple business models and collaborations

required to function across product life cycles are of specific importance for both open innovation and circular economy research.

Two elements stand out from open innovation research that companies should be clear upon when thinking of collaborating; (1) the structure of the project and the level of openness, and (2) the potential challenges and tensions.

Collaborative innovation can have different project structures with different levels of openness, which result from strategic decisions (Bogers et al., 2019; Rouyre & Fernandez, 2019). Pisano and Verganti (2008) explore the openness of collaborative innovation and identify that the company's strategy, capabilities, and organisational processes can dictate the 'right' conditions to select different collaborative structures. They propose external participation can be open or closed and governance hierarchical or flat. Lazzarotti and Manzini (2009) advocate open innovation represents 'degrees of openness' directed by partner variety (the number and type of partners) and the innovation openness (the number and type of phases open or closed to external collaboration). Yet, coupled innovation projects rely on multiple knowledge flows from complementary partners, but both the diversity of partners and the potential presence of competitors can affect knowledge sharing (Rouyre & Fernandez, 2019). Additionally, Bogers (2011) shows how pre-competitive and competitive collaboration can also impact the levels of knowledge sharing. A further strategic factor is whether the type of knowledge is explorative (new & radical) or exploitative (capitalising on existing knowledge & incremental) (Bengtsson et al., 2015; Mudamdi & Swift, 2014; Osiyevskyy & Dewald, 2015).

Starting collaborative innovation is challenging since all partners need to develop trust (Pemartín, Sánchez-Marín, & Munuera-Alemán, 2019), recognise collaborative advantages, and the innovation potential (Pouwels & Koster, 2017; Radziwon et al., 2017). This indicates collaborators require competencies to orchestrate knowledge, leverage existing, or generate new resources to create value for the collaboration. Yet, knowledge sharing represents a key tension within collaborative innovation. Bogers (2011) defines this as the 'open innovation paradox', whereby firms share, but simultaneously want to protect

and secure knowledge or advantages when collaborating. Bogers (2011) identifies two coping strategies employed to overcome this paradox. When the potential value of collaboration is extremely high, collaborators can use 'open exchange strategy' to share knowledge under secrecy agreements and agree to co-own resulting outputs, such as patents. Alternatively, a 'layered collaboration scheme', is used when vertical and horizontal (potential competitors) actors are present. Collaborators are layered into sub-collaborations (inner and outer members), whereby joint licensing agreements can share outputs. The defining selection criteria between these coping strategies are the number of partners involved, whether competitors are present, and whether the knowledge is specific (exploitative) or new (explorative). Rouyre and Fernandez (2019) similarly explore the effect of competitors on knowledge sharing within coupled innovation projects; finding different project structures that use different formal and informal mechanisms are important and shaped by the type of innovations pursued and the types of partners present within the project. Faems et al. (2005) also explore the distinction between the type of knowledge and types of partners, and advance another collaborative approach, to arrange multiple different but complementary collaborations within a portfolio; they find this is more likely to create new or improved commercially successful innovations. Thus, the availability and distribution of knowledge, and whether it requires competitors to be present for innovation activities contribute towards selecting different collaborative approaches (Bogers et al., 2017; Felin & Zenger, 2014). It is, however, unclear whether such criteria derived from open innovation literature are also valid within the COI context.

3.2.3. Types of Circular Oriented Innovation

COI is a comprehensive term that promotes a holistic view of innovation that goes beyond the boundaries of a single organisation to adapt or create new systems (Konietzko, Bocken, & Hultink, 2020). When companies explore how to adapt or create new systems, this needs increased focus, and integration of innovation activates across the levels of product, process, organisational, and market innovations. Pouwels and Koster (2017) find a positive and significant effect of collaborative innovation across these same types. Since our focus is

on collaborative innovation between companies, we focus on these types of innovation. Yet, we note that there are perspectives that take a wider focus on innovation that brings in, for example, policy or cultural aspects; such as the multi-level perspective in transitions research (Geels, 2002; Schot & Geels, 2008) or the research on technology innovation systems (Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007).

Product innovation, when focused on circularity, represents improvements to the use-phase or recoverability of products through new product developments (NPD), or re-design, and the addition of associated services, such as product-service combinations (M. Den Hollander, 2018). This entails integrating CE product design principles and strategies, such as: the reduction, substitution or the removal of harmful and non-recoverable materials (narrowing loops); designing long-life products or life-time extension through modular product structures to increase repair, refurbishment, or remanufacturing opportunities (slowing loops); and component recoverability, material recyclability, or integration of recovered materials (closing loops) (Bocken et al., 2016).

Process innovation is closely linked to product innovation, for it is the introduction of new technologies or methods of production (Klewitz & Hansen, 2014), which in COI means improving use of renewable inputs (such as energy or materials) or recoverability of outputs. COI recoverability entails redesigning operations across the value-network to minimise or eliminate, through design choices, non-product outputs, such as waste or hazardous by-products; or to recover, reuse, and reintroduce materials, components, or products (Lieder & Rashid, 2016).

Organisational innovation represents strategic decisions that change routines or structures to introduce new ways of arranging or thinking about things, such as resource scarcity, supply chain, or environmental management (Klewitz & Hansen, 2014; Pouwels & Koster, 2017). Within collaborative COI this can reflect how new collaborative processes are structured between companies. Klewitz and Hansen (2014) also establish that an organisational innovation can be redesigning the company's innovation process via integrating new innovation

principles, increased reflexivity, and interaction with external actors; which is especially relevant for COI. Pouwels and Koster (2017) emphasise that collaboration in the design and development phase is commonly around product and service innovations, while process and organisational innovations aim at how to produce such products or accompanying services. They also highlight that process and organisational innovations are necessary preconditions for developing new products and services.

Market innovation is closely linked to the concept presented by Schumpeter of opening up new markets, but expands upon this through the experimentation of variations (Pouwels & Koster, 2017). Kjellberg et al. (2015) proposes that market innovation requires successfully changing existing market structures or how business is done through innovating new business models, modes of exchange, and assessment methods. This encompasses integrating CE business model strategies, such as providing services over ownership to extend product value or to exploit residual value through recovery activities. Pouwels and Koster (2017) raise the point that to change market structures commonly requires a collaborative approach.

When COI is more focused on adapting how systems operate or creating new systems, it is anticipated that there will be an increased investigation across these different types of innovation to explore the degree of complementarity needed to implement the innovation and assess the environmental or societal impacts. However, this increases the complexity of innovation activities. Zucchella and Previtali (Zucchella & Previtali, 2019) propose an orchestrator who acts as a transformational leader is crucial to secure the tangible and intangible resources to promote radical innovations and navigate such complexity. Curley and Salmelin (Curley & Salmelin, 2018) propose such leaders act as catalysts, educators, and visionaries by developing real-world experimentation. Yet, it remains unclear how collaborative experimentations are conducted or coordinated across these types of innovation.

Finally, innovation activities can be incremental or radical. The key distinction is whether the innovation activity modifies accepted processes, products, services,

technologies, and ways of doing business, or aims to create entirely new ones that are disconnected from the current context (Dahlin & Behrens, 2005; Klewitz & Hansen, 2014; Szekely & Strebel, 2013). Both are important when pursuing sustainability. Yet, research by Brown et al. (2019) into collaborative COI, which builds on research into sustainable oriented innovation by Klewitz et al. (2014), Adams et al. (2016), and Ceschin et al. (2016), show how increasing sustainable impact requires more radical socio-technical and system-oriented approaches towards innovation. Szekely and Strebel (2013) advance that 'game-changing systemic innovations' require transformation of the relationships and interactions within and across a system. Takey and Carvalho (2016), state systemic innovations only generate value if accompanied by complementary innovations, and highlight how this is linked to open innovation concepts, whereby producing innovations requires increased collaboration across company boundaries (Chesbrough & Teece, 2002).

3.2.4. Research Gap

Circular economy focused research has grown quickly and is seen to hold promise to stimulate a sustainable transition. However, many contributions are conceptual and focus upon 'what' changes are required to product design (Bakker, Balkenende, & Poppelaars, 2018; Bocken et al., 2016), business models (Florian Lüdeke-Freund et al., 2019; Urbinati et al., 2017), and the required value-network (Geissdoerfer, Morioka, et al., 2018; Ghisellini et al., 2016). Studies that explore 'how' to operationalise and implement such changes, especially collaboratively, are needed but are lacking (Blomsma & Brennan, 2017; Zollo, Cennamo, & Neumann, 2013). Understanding how COI coevolves and is conducted to adapt or create new systems is needed (Korhonen, Honkasalo, et al., 2018; Schaltegger et al., 2016). We argue that understanding how collaboration is conducted is crucial to advance the knowledge-implementation gap (Bocken, Morgan, et al., 2013; Evans, Fernando, et al., 2017; Geissdoerfer, Vladimirova, et al., 2018). Additionally, COI has much to gain from integrating strategic management and open innovation literature to understand; (1) the potential structure of the collaborative projects (Rouyre & Fernandez, 2019), (2) how open to be when collaborating

within the COI context (Bengtsson et al., 2015; Lazzarotti & Manzini, 2009; Pisano & Verganti, 2008), (3) the challenges of the open innovation paradox (Bogers, 2011; Rouyre & Fernandez, 2019). These aspects require investigation if COI is to innovate to adapt or create systems and advance collaborative business models focused upon circular recovery strategies. Thus, the main objective of this exploratory research is to understand how a strategic management and open innovation focus could aid our understanding of how collaborative COI may be conducted.

3.3. Research Design

The research field of COI is underexplored. Hence, we conducted exploratory qualitative research, through semi-structured interviews with business practitioners to gain empirical insights. This study focused on the Netherlands. The Dutch government is actively supporting COI activities intending to become fully circular by 2050 (IenM), 2016), and many companies have started activities in this field. This means the Netherlands offers the opportunity to gain insights from the state-of-the-art into how companies collaborate for COI.

We chose semi-structured interviews to ask 'how' questions to practitioners (Bryman & Bell, 2011; Yin, 2009). This generated insights into the specific events, actions, rationale, and the context. Interview topics and questions were derived from literature and focused on how COI projects were structured, managed, and evolved to identify different approaches used (Appendix C shows interview questions). Our unit of analysis was the collaborative actions undertaken. We chose a diverse sample of companies across multiple contexts to provide a rich and broad-view of the COI phenomenon to conduct our explorative qualitative research. Cases were selected based on a stated CE vision and external communication of a collaborative COI project. We focused upon commercially oriented COI projects, although a few cases were precompetitive, or partially developed through or followed public funding. Accessibility of key managers who directly led the COI projects was another criterion for selection. This resulted in 25 semi-structured interviews (one to two hours) with a range of company roles of interviewees from 19 companies, which

produced insights into 23 collaborative cases, presented in Table 10. This range indicates that there are currently no specific positions who manage these types of projects, because of the relatively new nature of the COI phenomenon.

We coded the interview transcripts within NVivo software. The coding started by using broad explorative initial codes with subsequent refinement (Appendix D). This was used to deepen our understanding of the case material and their approaches towards collaboration. This supported our later use of process research methods; such as developing narratives of the events within the COI, based upon the experiences presented by our interviewees. We also used desk-based research from supporting communications about the collaboration (press releases, company communications, and websites) to cross-reference (Langley, 1999). We then combined visual mapping strategy to support data synthesis by ordering frequently occurring events across our cases. This identified initial patterns across the different contexts to sequence 'how' collaborations were conducted (Langley, 1999). Further, building upon the reviewed open innovation literature (section 3.2), we assessed the composition of the collaborators; their number, diversity, relationships, and especially whether competitors were involved. Then, we assessed the type of innovation conducted within cases, their scope, and anticipated implementation timeline. Since our objective of our case analysis is exploratory, we used this to support pattern-matching (comparison of patterns from theory sections with those empirically observed) across our multiple cases to highlight similarities and differences between our cases and theory to offer explanations for how collaborations were conducted (Yin, 2009).

Table 10. *Companies, interviewees, and scope of the circular oriented innovation cases.*

Comp-any	No. of Inter-views	Total Length	Interviewee(s)	Industry	Product Category/ Type	No. of Employees	Case	Aim and Scope of Collaborative Circular Oriented Innovation
1	1	85 Mins	Corporate Social Responsibility, CO_2 and Circularity Consultant	Energy	Infrastructure	>5500	A	B2B infrastructure CE tender (rules require minimum of two suppliers): single product re-design, material fairness & selection, upgradability and recoverability
2	2	130 Mins	Director of Sustainability + Senior Manager Sustainability 2 X CE Design and Business Model Researchers	Electronics	Consumer products	>70,000	B	Testing closed-loop recoverability & re-use of post-consumer material with challenging product specifications
							C	Pre-competitive exploration of CE business models, use phase & consumer acceptance focused on retail

3	1	75 Mins	Circular Economy Manager	FMCG	Food, Drink and Health Products	>100,000	D	Testing recoverability of material for single consumer product
							E	Alliance to explore options for CE material selection: focus on Bio-PET plastic for single FMCG product stream
4	1	60 Mins	Circular Economy Specialist and Strategic Consultant	Real Estate	Sustainable construction	>25	F	COI living lab space to conduct collaborative COI projects
5	1	60 Mins	Lead Global Centre Circular Economy	ICT	Hardware and services	>350,000	G	Buildings as material banks: material reuse and data passports (some partners previously engaged in separate H2020 Project)
							H	Buildings as material banks: focus materials, product, business models & data integration (built off previous H2020 project)
6	2	125 Mins	Program Manager Sustainable Entrepreneurship	Tourism Hospitality	Holiday accommo-dation	>3000	I	New product-service innovation: Role of buyer - Ran multiple collaborations with suppliers to explore product categories

7	2	136 Mins	Supply Chain Manager Research Engineer	Furniture	Beds and Mattresses	>200		Role of supplier– Understand new business model (B2B) from traditionally business to consumer, product redesign, logistics and circular recovery operations
8	1	70 Mins	Director EMEA regulations, environmental affairs and producer responsibility	ICT	Hardware and services	>100,000	J	Pre-competitive exploration: potential for cross-sector recovery & reuse of plastics
9	2	175 Mins	Head of Sustainable Development (EMEA) Concept Designer	Flooring	Carpet	>3000	K	Consortium producing a range of B2B and B2C products exploring material recovery & reuse of Ocean plastics: expansion of previous successful project by company 9 with additional partners
10	1	80 Mins	Co-founder, resource efficiency manager	Electronics	Smartphone	>75	L	Circular operations testing for spare parts to assess upscale and expansion of a B2C CE business model to maintain products

							M	Explore global material supply chain: focus on fairness of supply, reuse potential and operations (H2020 collaboration)
11	1	90 Mins	Circular Economy Manager	Furniture	Office Furniture	>150	N	Circular tender B2B product-service (role of supplier) expanded on CE design knowledge from public funding: testing circular recovery operations & data for refurbishment & reuse
							O	Material selection for CE product (re)design to improve material heath and recovery for B2B product
12	1	90 Mins	Director of sustainability	Flooring	Carpet	>350	P	Consortium to explore material selection: PVC materials for a mix of B2B and B2C products
13	1	90 Mins	Sustainability marketer	Chemicals	Health, Nutrition and Materials	>21,000	Q	Development & marketing of new product and adhesive process to improve end-of-use recoverability for circular products (Companies 7, 11

								& 17 in contact as potential users & initial discussions towards collaborations)
14	1	80 Mins	Project Manager Business Development	Waste Manage-ment	Material collection and recovery	>8000	R	Material recovery and reuse potential: primarily exploiting core knowledge
15	1	75 Mins	Co-Founder	Sports Equipment	Refurbished race bicycles	<5	S	Operations testing (sourcing, diagnostics, refurbishment) for B2C circular business model: including users to sell old products or parts.
16	1	75 Mins	Material Resource Manager	Waste Manage-ment	Material collection and recovery	>80,000	T	Material recovery and reuse potential: primarily exploiting core knowledge
17	2	140 Mins	Circular Economy Business Developer	Material Producer	Waste to biological composites	>60	U	Pilot new CE process to test & upscale operations: repeated collaborative projects focused on new customer development to exploit material recovery & reuse knowledge (company 4,7 & 13 discussing potential collaboration)

18	2	125 Mins	Project Manager Sustainability EMEA + Sourcing Manager Packaging and Waste	FMCG	Coffee Retailer	>250,000	V	Material selection, product & process for CE recovery potential: pilots across countries built upon a previous failed collaboration with new & expanded collaborators
19	1	90 Mins	Sourcing Manager + Corporate Sustainability + Commercial Market Manager	Energy	Energy infrastructure management	>150,000	W	Pilot for circular building: Separate build, use-phase, and reuse & recovery. Case focus: Use-phase operations testing for B2B product as service models for buildings and potential recovery

Note: If interviewees discussed multiple cases, these are linked to the same company (e.g., Cases B & C). If multiple companies interviewed discussed collaborating on the same case these are linked to the companies (e.g., case G). B2B is business-to-business; B2C is business-to-consumer.

3.4. Findings

This section presents the landscape of collaborations (Figure 5) and case examples to highlight the different approaches used (Cases presented in Table 10). The focus is on how the context can affect the collaborative approaches used and specifically, how the project and knowledge management are structured. Case analysis shows a distinction between incremental and more radical oriented COI that pursue system changes. This is assessed by analysis of two COI characteristics: (1) the types of innovation conducted to advance and implement the COI and (2), the composition of collaborators, their number, relationships, and whether competitors are present (when below four collaborators competitors were not present). These characteristics result in different collaborative project structures, phases of collaboration, or portfolios of collaborative projects (shown in Figure 5), and explained below with case examples.

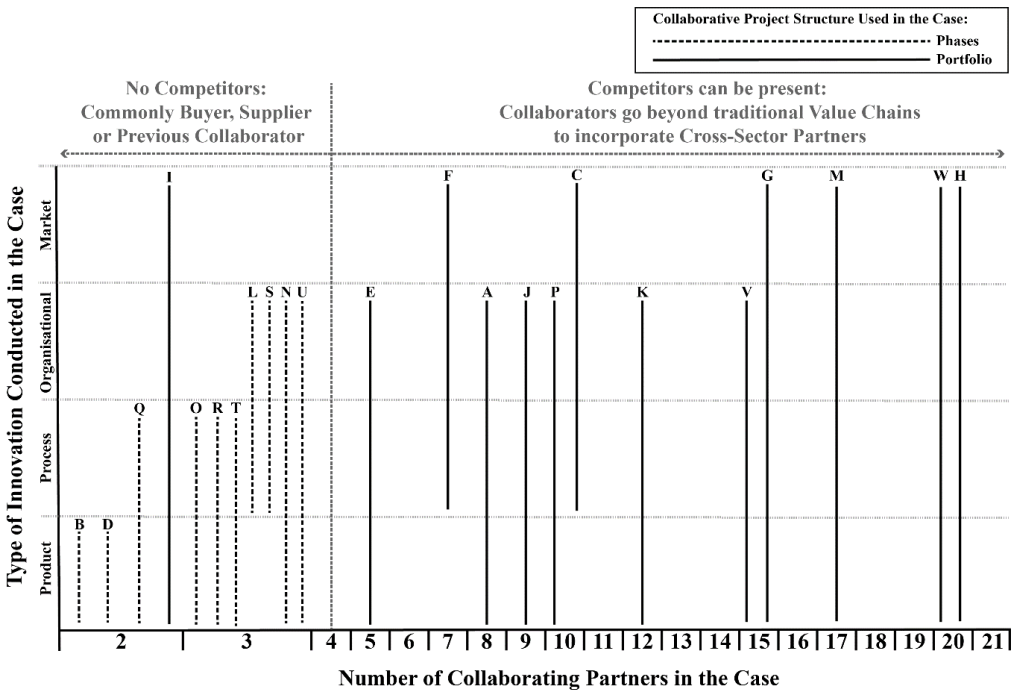


Figure 5. *Landscape of collaboration within circular oriented innovation from our cases.*

3.4.1. Incremental Circular Oriented Innovation: Phases of collaboration

Incremental COI is distinguished by the following:

Firstly, more incremental COI conducts fewer types of innovation, due to a lower degree of complementary innovations required to implement. The focus is commonly on the product or process with limited organisational innovation. For example, Case Q stated: *"they had the idea around [Product name], but their struggle was around the development of the [Process]. That is of course our strength"*.

Secondly, the CE strategy is predominantly focused on closed-loop material recovery and reuse. Knowledge is largely exploitative. Implementation can be more immediate, requiring reduced deliberate planning, and the reduced potential for emergent factors. Implementation is commonly achievable with the selected partners. This was demonstrated in Case B, who innovated with a known partner: *"The alternative material we were using had failed three times (…) So then we ended up with [name of collaborator]. Why, because we knew them, we had already done similar testing before with them."*

Thirdly, partner selection maintains traditional value-network arrangements engaging buyers, suppliers, previous collaborators, or known research institutes and competitors are not included. Case N for example worked with buyers to understand operational requirements needed for new CE business models:

"We have to prove we can make steps towards the development of a circular business model. [Buyer Name] helps as the first step is to organise how they buy the furniture, so we are collaborating with their reuse people to develop a kind of webshop, so we can arrange refurbishment."

Due to the partner selection process, trust can be higher. This allows reduced agreements to initiate the project; represented by Case B:

"One and half months later they had a material that we could test and it met the requirements. (…) Not having it completely tide up in MOUs [sic. memorandum of understanding] and contracts. But just go for a first try small-scale at first and then scale-up and just do it."

This also shows a common rationale, at least initially, is to construct the 'minimum viable collaboration' needed to develop proof of concepts.

The project structure observed for incremental COI are more traditional phases of collaboration. Between phases, the collaborative dynamics (roles, partners, responsibilities), the resources for further experimentation cycles, and implementation or the agreements and contracts can be assessed or (re)negotiated. Case R for example, showed that different partners might emerge to support experimentation:

"We started a diaper project with a technology partner and somebody we knew who can pre-process the diaper. In the first concept, in the first collaboration, we explored the diaper processing. Although, the technology partner is now out, since we worked out we only needed one process step, and we could do that (…) But, the whole project now is turned around, since we found somebody who is making diapers and needs the cycling as a marketing tool. But it's still ongoing, we will experiment further and pilot at the end of the year."

3.4.2. Systematic Circular Oriented Innovation: Collaborative Portfolios

Systemic COI is distinguished by the following:

Firstly, when the COI aims to adapt or create new systems, knowledge is more explorative and spans more innovation types and exploration of complementary innovations. This creates a longer implementation timeline, greater need for deliberate planning and increased potential for emergent factors. Case H stated:

"We are the business model advisors looking into the industry model, business model and technology proof of concepts needed (…) we started by building the first passports for 10 product categories within buildings. Then when I sit with a mechanical engineer, we can ask what is the relevant information you need to have as a professional buyer".

Yet, here Case W describes how aligning exploration can be challenging by the statement:

"the collaboration between the partners is really based on how can we strengthen each other. But, also that's the main challenge, finding the right synergy between the right partners within the whole partner community we have to explore the steps towards circular maintenance and services."

Secondly, the innovation focus is also more organisational (Cases A, E, J, K, P, V), how to produce new products or services, although material recovery through exploring closed-loop activities can still be a

predominant aim (Cases E, J, K, P, V). When the focus is on business model innovation (Cases C, F, G, H, W) exploration can be more on how slowing strategies might function. Here, understanding how to structure agreements between partners and share innovation outputs is a key feature. Case H stated:

"as any company we are used to contracts with party 'X'. So how do we build a contract to 4 to 5 to 'N' parties together, while we are all providing services to each other. So how do you do that? Now we are in the middle of this. We will find a solution to these problems. But these are all new problems."

The business model focus is also predominantly business-to-business (B2B) as Company 7 [Supplier] Supply chain manager discussed the benefits of Case I:

"It helps us now because [Company 6 - Buyer] brings volume and shape that makes it feasible for us to build a product that can become circular for a future consumer point of view. This is because consumers are still pretty linear."

Thirdly, in the case of more systemic COI, partner selection can go beyond traditional value-chains to include cross-sector partners and competitors. Company 9's head of sustainable development stated:

"We have so far been working within our supply-chains. But to drive the circular economy to a larger scale we have cross-sector collaborations slowly starting now, but it is not the easiest thing to do. Because everyone is working with different materials, mind-sets and KPI's, which makes it more complicated."

When scale is needed, cases displayed a pursuit for new partners, and to lead by example to prove the concept and attract others. For example, Case V stated: *"We know unless everyone is in, it's not going to work. (…) But we said let's not wait for everyone. Let's do it, set an example and lead, and hope we can inspire others to join".*

Similarly, Case H stated: *"So the thing is around this platform new business models start to emerge. We have the municipality who are interested, [and other organisations discussed interested in collaborating] as you also see new roles for these people. Once we have a winning ecosystem, others will start to look at it and then it will expand. I am hoping*

that the projects that we are starting now will truly be proof of a concept at the ecosystem level."

The project structure observed for systemic COI is more complex, whereby we observe a portfolio approach for collaborations is used to separate and manage the complexity of conducting the collaborative innovation and knowledge management. Once separated, the resulting projects are then commonly conducted using the more traditional phases of collaboration (observed in incremental COI). This also offers the potential to subsequently layer collaborators, creating inner and outer members, to reduce challenges around knowledge sharing. Our case analysis highlights four separation drivers.

Firstly, separation is used to purposefully manage participation, displayed in Case I by Company 7's Supply chain manager statement:

"[Company 11] are very interested to join, although at this stage it is too early for us to bring on board additional people. But when [Company 6] see some proofs of concept working [Company 11] would be a very nice partner to include into the project and deal with."

Here, Company 6 stated the involvement of other suppliers when discussing Case I:

"No, it's different suppliers [within other collaborations] and that's also I think really nice, as it keeps it simple. So it's two other suppliers, which we work with already for like a decade, for different product categories. I think when the time is right to move there will be more integrating of these, but not now."

Secondly, separating competitors within a project to conduct innovation activities is illustrated by Case A:

"We tried to get the two suppliers to collaborate with each other to exchange knowledge. But this is a highly vulnerable thing as they are both innovating and want to be the first. So, we now actually have two different pilots with the two different suppliers. One focuses on data collection of the system to map and visualise, so we know what the best options are (…) Then the other pilot with [Collaborator Name] was much more on the prototypes, so really redesigning the [product]."

Thirdly, separating to move from open sessions of knowledge sharing and ideation to more closed sessions of knowledge development is used in Cases C, G, J, M, V, W.

Case C for example mentioned on knowledge sharing *"But now we have gathered all the data. It is the retailers by themselves that are going to use that data to create different pilots. So, it is kinda open, closed, diverging to converging regards information sharing".*

Here, Case J described how collaborators separated to perform investigations by stating:

"So it is much more about generic issues or solutions that we have come across when open. The real results are not derived from a fully open network. Rather out of the network 2 or 3 partners need to then go off and do something".

Fourthly, separating complementary innovation exploration within a systemic idea is found in Cases F, G, H, K, M, W. Here, Case F firstly shows purposeful separation of competitors, but also layered innovation activities to explore the systemic idea:

"We make sure we do not have 2 or 3 companies that work in the same niche all at the same table. (…) But you should do it in 3 to 4 different places to find out if there is a business case underlying something that superficially does not represent something that would or could stand as a business case, but still needs to be done in order for the other 3 things to be effective. Then bringing it back together, that is the really hard part."

3.5. Discussion

We set out to understand how companies collaborate for COI by assessing whether open innovation aids our understanding of collaborative COI or whether specific characteristics are displayed. Our contributions are fourfold: firstly, we found that open innovation criteria can aid our understanding and analysis of collaborative COI. Secondly, we show how the incremental or radical scope of COI can result in different collaborative project and knowledge management structures. Thirdly, we empirically show how much of the collaborative activity is currently incrementally exploring COI and is primarily focused on B2B relationships. Fourthly, we show that a crucial challenge remains for how to develop and assess collaborative and system-oriented business

models. We discuss these contributions below and present the limitations, future research, and our conclusions.

3.5.1. How the Context and Scope Structure Directs the Collaborative Circular Oriented Innovation Approach

Criteria derived from open innovation, such as the number of collaborators, phases of collaboration to be open or closed (Bogers et al., 2019; Lazzarotti & Manzini, 2009), and the type of innovation and associated challenges for knowledge sharing (Bengtsson et al., 2015; Bogers, 2011; Rouyre & Fernandez, 2019) support investigations into how collaboration can be conducted within COI. A critical consideration within COI is the associated degree of complementary innovations needed for adapting or creating new systems. This can signify the COI implementation timeline, and whether competitors are required to complement innovation activities or participate to reach scale, and therefore increase potential risks and costs. The focus on systems, recovery across multiple life cycles, and the increased importance of non-financial assessment impacts how collaborations and knowledge management can be structured. These characteristics create a distinction between more incremental or more systemic focused COI.

The more incremental the COI is, the lower the degree of complementarity and the less engagement there is with competitors. This means the collaborative structure is similar to hierarchical and closed participation of ‘elite circles’ (Pisano & Verganti, 2008) and ‘integrated collaborators’ (Lazzarotti & Manzini, 2009). Partner selection, at least initially, constructs a ‘minimum viable collaboration’ needed to reach the innovation goal and commonly selects previous relationships. Collaborators are engaged to bring specific and exploitable knowledge; project teams remain separate with clear task divisions, and knowledge sharing is limited to the minimum levels needed to achieve the innovation aim. The finding that contracting and agreements at least initially can be reduced to speed up collaborative activities indicates managers are able to use informal mechanisms, while more formal agreements become more important when the innovation advances towards marketisation. These elements link to insights from Rouyre and Fernandez (2019) that the incremental nature indicates both a reduced cost in terms of project structure and risks within knowledge management. In addition, since the innovation pursuit is more defined, planning is easier and expected implementation more immediate, whereby more traditional phases of collaboration are conducted. Phases allow collaborators to iterate the innovation pursuit (resources required, implementation, upscale potential, or decisions to halt or persevere the

innovation focus) and renegotiate the collaborative dynamics (changing roles or responsibilities, actors involved, agreements, and contracts). This increases flexibility to adapt to emerging factors from the collaborative process and increases the potential for successful collaborations (Clarke & Fuller, 2010; Dietrich et al., 2010; Majchrzak et al., 2015). The implication is that exploring incremental innovation offers a way to start small, learn, and build competencies for COI. Yet, managers and companies who really want to engage with grand sustainability challenges, will, at some stage, need to be prepared to undertake more radical COI; and thereby engage more complex and costly collaborations to adapt or create new systems.

The more the COI activities focus on adapting or creating new systems the higher the degree of complementary innovations and the need to engage competitors. This creates complexity, risks, and costs in terms of project structure and knowledge sharing. In response, managers separate collaborators or complementary innovation activities into smaller, more manageable projects to reduce complexity, confirming the work by Rouyre and Fernandez (2019), but the alignment of partners (still) needs to be addressed. Yet, we found multiple motivations for separation into smaller projects; these resulted in a more collaborative portfolio approach, whereby companies arrange different but complementary collaborations to increase potential success (Faems et al., 2005). However, the separation at the project-level draws similarities to the 'layered collaboration scheme' of inner and outer members to control knowledge flows (Bogers, 2011). We did not find central project structures that used an external and independent third party, identified by Rouyre and Fernandez (2019), yet it could be that currently there are no suitable third parties to run such COI projects. We only found the use of third parties as 'knowledge brokers' to facilitate pre-competitive or initial knowledge exploration activities. Here, the use of third parties offered the ability to withhold specific technical or sensitive details such as costs to avoid competitive constraints on knowledge management by adopting a hybrid strategy of open and closed knowledge sharing. This suggests an additional strategy to the 'open exchange strategy' presented by Bogers' (2011) by separating actors.

At the project management level, we rather found companies who instigated the COI project needed to decide upon the structure and how connected or separate projects are to be. This could also be presented to the collaborative group as a means to gain legitimacy, accountability, and to build trust within how the project and knowledge management is

structured. When directed by the instigating company hierarchical control is maintained, but this might challenge alignment, trust, and knowledge management. When made by the collaborative group, this signifies a flatter governance structure, which focuses upon consortium, network and co-development (Lazzarotti & Manzini, 2009; Pisano & Verganti, 2008), but can be harder to maintain. In either case, the structure, governance, and knowledge management might be required to become externally more open in time, due to the need or desire to scale participation (to secure competencies, knowledge, or creativity) or explore systemic value opportunities and share risks to reduce the implementation timeline. Thus, the structure, roles, and agreements can (and might have to) evolve more requiring closer participation and advanced managerial competencies (compared to more incremental COI) to maintain flexibility, adaptability, and crucially accountability (Clarke & Fuller, 2010; Dietrich et al., 2010; Majchrzak et al., 2015). An implication for managers and companies who want to engage with more radical COI is that they need to be clear on these costs, timelines, and the required ability to balance both formal and informal knowledge sharing mechanisms; since the complexity and number of competitors means one cannot rely on trust or individual capabilities or relationships (Rouyre & Fernandez, 2019). This could ultimately mean this is prohibitive for some types of companies (especially start-ups or low resource companies) due to the lack of resources, capabilities needed, or the associated risks and costs.

3.5.2. Collaborative Circular Oriented Innovation Challenges

Our study highlights challenges remain within collaborative COI. Innovation activities show that at present, many collaborative COI projects are incremental in scope. The primary focus is on exploitative knowledge for material recovery (closed-loop, material reuse, or removal from the environment) to integrate into products. Additionally, the more radical COI projects can also represent incremental innovation steps that exploit existing knowledge from specialised collaborators. Explorative knowledge into circular design and business model combinations to slow loops is limited to B2B arrangements, yet these are still mostly in research or pilot phases. Consumer products maintain a transaction of ownership, without specifying slowing or recovery mechanisms. Exceptions are start-up cases founded to pursue circularity (Case L, Case S) that engaged collaborations to explore how slowing models for consumers could work, though product ownership is still transferred. This indicates that the pressures to maintain existing business models and predictable revenue seems to limit extant firms' ability to explore radical COI, especially when

engaging consumers. This empirical finding supports desk-based research by Stewart and Niero (2018) into fast-moving consumer goods. The literature argues that pursuing more explorative knowledge is a matter of timing linked to perceived levels of risk versus disruption to current operations and experience of successful explorations (Faems et al., 2005; Mudamdi & Swift, 2014; Osiyevskyy & Dewald, 2015). Within COI currently, B2B arrangements offer less risk or disruption to current operations for incumbents compared to consumer arrangements. Though, incremental COI is shown to aid increased buy-in through proof of concepts and early wins that can incentivise more radical and systemic-focused COI, which Bogers et al. (2020) suggest is key to advancing companies engagement with grand sustainable challenges.

Finally, even when the COI scope was more radical, requiring increased complementary innovations to explore market-based collaborative activities, understanding how to create and test agreements or contracts for collaborative innovation and business models was a key innovation goal. This indicates companies are still figuring out the business model for collaborative COI and associated intellectual property (IP) strategies, which represents a key open innovation challenge (Bogers et al., 2019). This adds to recent guidance provided by Bocken et al. (2019) that practice should critically assess system boundaries, value created versus captured, and fairness between partners over-time, while business models still evolve. The fact that collaborative agreements also evolve throughout innovation processes advances this guidance. Furthermore, our case analysis shows practice is still trying to answer how to measure and understand system-level dependencies between multiple business models for COI to perform economically and sustainably. This wider empirical analysis substantiates findings from Bogers et al. (2019) that the longer-term perspective and purpose driven nature of COI requires companies to increasingly incorporate non-pecuniary mechanisms to understand systemic impacts needed to move beyond a solid 'business-case', but that also scaling COI activities requires aligning business models across partners. However, a common theme discussed that limits collaborative agreements and business models is the traditional mindset to maximise individual advantages, over exploring the potential value from a whole-system perspective. Thus more radical, collaborative, and systemic COI activities centred on how to solve grand sustainability challenges will be frustrated, and are still underexplored in practice (N. Bocken, Boons, et al., 2019; Evans, Fernando, et al., 2017). We argue this challenges the effectiveness of the current modes of collaboration and

represents a bottleneck that confronts companies' ability to implement COI that can adapt or create new systems. If this is not overcome, it could potentially halt a transition towards a circular economy.

3.5.3. Limitations and Future Research

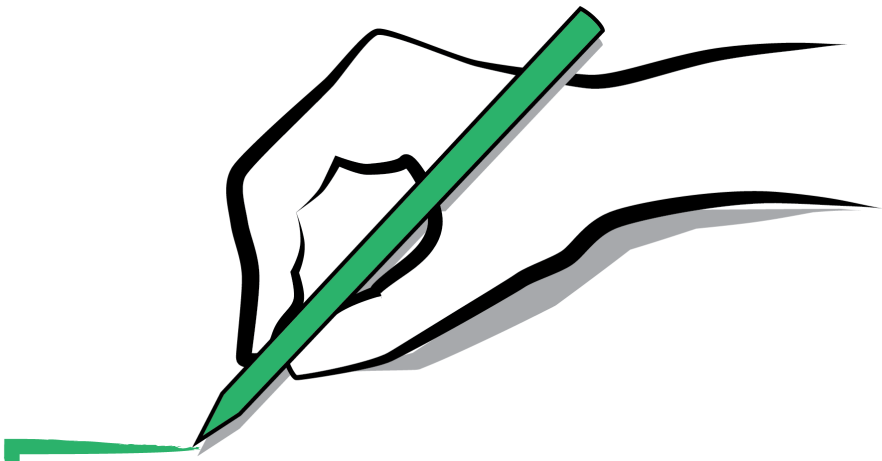
Our findings present a first empirical investigation across multiple collaborative COI projects. Firstly, we acknowledge that other literature streams within and beyond strategic management and open innovation that have not been considered for this study, could contain useful additional information on collaborative COI. Future research should expand on and integrate these into COI, since our analysis has shown CE research can learn valuable insights from integrating strategic management perspectives. Secondly, limitations stem from our explorative research approach and data collection, which represent three elements: (1) the country context, (2) the retrospective nature, and 3) the availability of data. Firstly, case selection focuses on the Netherlands, which reduces our ability to generalise findings to other country contexts. Secondly, collecting retrospective data meant details provided may suffer memory bias that could impact accuracy, interviewees also rarely mentioned failures or whether collaborative actions were part of wider strategic plans. Thirdly, even though the Netherlands represents a 'hotspot' for circular activity and we engaged leading circular companies, we found few cases had to date fully advanced or implemented radical and systemic collaborative innovations. This highlights the CE knowledge-implementation challenge (Bocken, Ritala, et al., 2017; Geissdoerfer, Vladimirova, et al., 2018) and the longer implementation timelines and timespan of circular business models (Linder & Williander, 2017).

To address these limitations, future research should expand our analysis by firstly collecting data from different country contexts and larger data sets (where available). Secondly, we propose in-depth longitudinal action-research that investigates from initiation to implementation to specify how companies collaborate throughout the entire process. This can offer insights into the effectiveness of current collaborative processes and agreements with the aim to propose normative changes to stimulate increased radical COI activities. This could develop practical guidance on how open information sharing needs to be or what are minimum requirements; especially around costs to adequately assess collaborative business models and value across multiple life cycles ,within a proposed COI. Furthermore, this could also inform partner engagement and

collaborative negotiations by linking these to the required levels of openness (internal and external) to facilitate radical collaborative COI.

3.6. Conclusions

Our explorative study set out to understand how companies collaborate to advance COI. Our empirical insights from practice lead to four main contributions. Firstly, criteria established in strategic management and open innovation literature supports empirical investigation and analysis of collaborative COI. Secondly, within COI, a key managerial implication is the need to understand the degree of complementarity. More precisely, the increased complementary innovations required to implement circular recovery systems and associated business models can dictate whether competitors or increased participation are needed. This results in different collaborative projects and knowledge management structures. We observe a phased collaboration approach when innovation activities are more incremental, immediately implementable, and commonly engage a 'minimum viable collaboration' without competitors. We observe a more collaborative portfolio approach when innovations are more radical, have uncertain implementation timelines, require competitors, or scale is needed. This portfolio approach can separate complementary innovation activities or competitors to facilitate collaborative management and reduce complexity. Thirdly, we show how more radical exploration of circular recovery expands collaborative innovation beyond market delivery, which means collaborators need to assess how systems of business models can operate to narrow, slow, and close resource flows across multiple lifecycles. This remains a challenge for companies, especially to move beyond business-to-business arrangements. Fourthly, we show how a wider, longer-term, and more collaborative view on value creation and capture is needed to understand potential system impacts and move beyond the need for a solid business case when pursuing more radical COI. Yet, it still needs to be established to what extent the current collaborative arrangements described here will result in systemic innovations and the collaborative business models needed to stimulate a circular transition.



4 What

A process model for collaboration in circular oriented innovation

Chapter 4 - What

This chapter is based on a paper under publication with the journal of cleaner production: Brown, P., Von Daniels, C.,Bocken, N.M.P.[1,3], Balkenende, A.R (In Publication). A process model for collaboration in circular oriented innovation

This builds on the 'why' and the 'how' to explore the 'what'; specifically to understand what design and implementation processes are undertaken within COI. This chapter engages strategic management research to synthesis what is known about collaborative processes to identify and propose process 'building blocks'. These literature foundations are then used to investigate COI cases building on three research cycles; to 'explore', 'validate', and 'deep-dive' into the collaborative design and implementation process. This study produces a collaborative COI process model. This advances our understanding of the key processes undertaken when designing and implementing collaborative COI. This analysis is used to derive a future research agenda, support the identification of current challenges and identifies possible areas whereby tools could offer solutions to support and advance the collaborative COI process. One of the primary challenges within the process (which can impact the latter process steps and overall collaborative success) is how to identify and select the 'right' partners for a collaborative COI project. This is needed to support the creation of a working collaborative architecture to advance the exploration of the circular idea.

4.1. Introduction

The circular economy (CE) promotes systemic strategies to transition our linear "take, make, use, and dispose" economy towards circular systems; this holds many innovation challenges, but also opportunities for companies (Ghisellini et al., 2016). Circular oriented innovation (COI) explores combinations of product design, business model, and value network configurations to investigate how to operationalise CE strategies (Blomsma et al., 2019; Blomsma & Brennan, 2017; Brown et al., 2019). CE strategies focus on narrowing, slowing, and closing resource loops to eliminate waste, increase efficiency, and maintain (product and material) integrity across multiple life-cycles (Den Hollander, 2018). Recovery strategies (reuse, repair, refurbishment, remanufacturing, and recycling) are needed to realise value capture opportunities within a circular proposition (Blomsma, 2018; Bocken et al., 2016; Stahel, 1982, 2014). Yet, most companies are (still) inexperienced in the CE field and do not have the capabilities nor capacity to operate all the aspects that comprise a viable circular proposition (Blomsma et al., 2019b; Bocken, Ritala, et al., 2017; Boons & Bocken, 2018; Florian Lüdeke-Freund et al., 2019). Instead, COI requires connecting expertise from upstream and downstream actors and creating the necessary exchanges to operate circular propositions and recovery strategies (Geissdoerfer et al., 2018; Ghisellini et al., 2016; Urbinati et al., 2017).

CE scholars agree collaboration is critical to the success of COI (Blomsma, 2018; Blomsma et al., 2019b; Geissdoerfer, Morioka, et al., 2018). Leising et al. (2017) use predefined elements of "visions, actor learning, network dynamics, and business model innovation" linked to collaborative cases (p. 977), but do not investigate the underlying collaborative processes. Similarly, Fischer & Pascucci (2017) identify that coordination procedures, contracting, and financial mechanisms between actors demand attention within CE but do not empirically investigate the collaborative processes for doing so. Kraaijenhagen et al. (2016), centre collaboration within their work on circular business models to provide process guidance, but do not directly engage empirical evidence. Brown et al. (2019) explore the initial conditions for why collaboration can be initiated and go onto explore how collaborations can be managed (2020). Yet, empirical investigation into the overall collaborative innovation processes remain underexplored within COI; we therefore within this paper aim to contribute to circular research by bringing in a process perspective.

Process research asks how and why things (people, organisations, strategies, environments) change over time (Langley, 1999; Langley, Smallman, Tsoukas, & Van De Ven, 2013). Process studies can have a 'weak' (change in phases) or 'strong' focus (change as continuous) (Langley, 2007; Langley et al., 2013; Sandberg, Loacker, & Alvesson, 2015) and can trace backwards using retrospective analysis or forwards using longitudinal analysis to understand how change unfolds (Langley, 2007). Furthermore, scientific contributions into collaborative innovation processes come from diverse disciplines, which can incorporate different levels of analysis and position boundaries in relation to the focus of the study; these range across micro (within organisations e.g. the individuals or teams), meso (the organisations and value networks involved), and macro levels (societal, political and institutional impacts to assess the whole system) (Austin & Seitanidi, 2012b; Valkokari & Rana, 2017).

How collaborative processes develop and function overtime between organisations represent a highly researched topic within strategic management (Provan et al., 2007; 2008). Focus is predominantly on the meso level that explores the collaborative process and phases between companies to formulate, select, and implement specific strategies and actions to secure competitive and collaborative advantages[1]. Yet, Bryson et al. (Bryson, Crosby, & Stone, 2015) state collaborative process knowledge is fragmented, exhibits low-levels of consensus and presents a large portfolio of processes and practices. This is aligned with the notion of high context-dependence identified by Wood & Gray (1991). Several key themes, regarding strategic, cultural and organisational capabilities (Davis & Eisenhardt, 2011; Ritter & Gemünden, 2003; Swink, 2006) as well as process 'building blocks' have emerged, which share some degree of consensus, for how to conduct collaboration (Bryson et al., 2015; Clarke & Fuller, 2010; Emerson, Nabatchi, & Balogh, 2011; Gray & Stites, 2013).

[1] Other approaches that take a broader macro view beyond strategic management used within this paper could offer valuable insights for understanding collaborative COI E.g. Innovation literature such as sociological approaches; Social Construction of Technology (SCOT) or Actor-Network Theory (ANT), or Technology transitions research such as; multi-level perspective (MLP) or Technology Innovation Systems (TIS).

There is also a growing exploration into how strategic management research can be used to engage with CE and sustainable grand challenges, yet there is currently limited empirical investigation into the circular context (Bogers et al., 2020; George, Howard-Grenville, Joshi, & Tihanyi, 2016). Additionally, existing strategic management insights, derive from a linear system. It is therefore required to empirically test their explanatory power; 1) for the design and implementation of collaborative COI, and 2) to highlight similarities and differences. The limited explicit engagement with existing collaborative process knowledge and the lack of empirical investigation into collaborative COI design and implementation processes creates a knowledge gap. We argue this contributes towards the design-implementation gap proposed by Geissdoerfer et al. (2018). This is substantiated by the lack of real-world examples and operationalisation of CE (Blomsma et al., 2018; Blomsma & Brennan, 2017; Bocken et al., 2017).

To investigate the knowledge gap for collaborative processes within COI, we take a 'weak' process focus to identify phases of collaboration by integrating disparate strategic management research. We generate practice-based insights via engaging retrospective analysis of the experiences of actors who directly managed the collaborative activities and were inside the collaborative COI projects. Our objective is exploratory in nature; firstly, the purpose is to identify and present a process model that provides an overview of how to design and implement collaborative COI. The second intended purpose is to propose future research to further demystify the role of collaboration within COI. We investigate the following research question: '*What processes do companies undertake when designing and implementing collaborative circular oriented innovation?'.*

The structure of the paper is as follows; Section 4.2 outlines collaborative processes from strategic management literature, to derive a set of process 'building blocks' relevant to the design and implementation of collaboration. Section 4.3 presents the research cycles, case-study data, and analysis. Then section 4.4 presents our empirical findings and a structured process model. Section 5.5 discusses the model, proposes future collaborative COI research, and presents the limitations of this study. Finally, section 4.6 presents our conclusions.

4.2. Literature Background: understanding the process to design and implement collaborations

Section 4.2.1 presents key definitions for collaborative innovation and section 4.2.2 distinguishes collaborative process phases from literature. Section 4.2.3 presents dynamic aspects of collaboration, which are not a specific phase in themselves, but factor into the overall collaborative process. Lastly, section 4.2.4 consolidates these insights into our conceptual framework to aid our study and understanding of collaborative COI.

4.2.1. Defining collaborative innovation

Collaboration is difficult to define (Barbara Gray, 1985), many definitions within strategic management emphasize different attributes of collaboration and create substantial ambiguity (Donahue, 2010). Yet, the majority of definitions, also followed here, highlight that collaboration is the intentional and voluntary interactions (linking or sharing of information, resources, activities, and capabilities) between two or more organisations (and those individuals involved) directed towards the achievement of a common goal or purpose that could not be achieved individually (Bryson et al., 2015; Cao, Vonderembse, Zhang, & Ragu-Nathan, 2010; Wood & Gray, 1991). Collaborative innovation involves actions of collective learning to enhance the joint creation of novel ideas, products, services, processes or business models by combining expertise, capabilities and resources of the participating organisations and individuals. The collaborative process represents the purposeful decisions and actions within and between organisations and the collaborative network are those organisations who are engaged within this process.

4.2.2. Towards a conceptual framework: collaborative process phases

Here, we review strategic management, sustainable oriented innovation, and early COI literature. We build upon key collaborative process contributions (e.g. Bryson & Crosby, 2015; Clarke & Fuller, 2010; Emerson et al., 2011; Gray & Stites, 2013; Kraaijenhagen et al., 2016). Each subsection represents a phase that the literature distinguishes as collaborative ‘building blocks’ for the design and implementation process.

4.2.2.1. Identify the need and articulate the intent to collaborate

Identifying the need to collaborate represents the first phase. Bryson et al (2006, p. 45) point out, “organisations will only collaborate when they

cannot get what they want without collaborating". Thus, realising that the desired innovation cannot be achieved in isolation is crucial. The system context and macro-level changes across institutional environments, market developments, industry trends, or competitive intensity act as sources of innovation necessity that create collaborative opportunities (Alexiev, Volberda, & Van den Bosch, 2016; Bryson et al., 2015; Emerson et al., 2011). Collaborative innovation increases when focused on emergent technologies, methods of operation, or is highly competitive (Eisenhardt & Schoonhoven, 1996), and requires complex system-wide knowledge (Powell et al., 1996). It is the access to complementary assets, transfers of tacit and codified knowledge that produce collaborative innovation benefits (Faems et al., 2005). The necessity and decision to collaborate is thus influenced by the competitive significance, inherent complexity and the distribution of the required knowledge (Felin & Zenger, 2014).

In sustainable oriented innovation, which investigates the implications across the business model and value network, the challenges to overcome are usually characterised by their systemic nature that requires a wider view of value and increased engagement with value network actors (N. Bocken, Short, Rana, & Evans, 2013; Breuer, Fichter, Lüdeke Freund, & Tiemann, 2018; Evans, Vladimirova, et al., 2017a; Schaltegger et al., 2016; W. Stubbs & Cocklin, 2008). Similarly, the COI context shows how collaboration is driven by intrinsic and extrinsic motivations at both individual and organisational levels (Brown et al., 2019). Bocken et al. (2016; 2018) indicate that a clear vision and goals are required before ideating and selecting CE strategies. Here, Rohrbeck et al (2013, p. 4), Wiener et al. (2018a), Kraaijenhagen et al. (2016, p. 67), and Leising et al. (2017, p. 984) recommend using strategic foresight and design tools to "map" the system and ideate upon CE strategies that form the core circular proposition. This process should connect goals, motivations and interrelationships between the market, potential technologies, and required resources to identify those processes that may require external partners to realise the COI.

4.2.2.2. Identify and Select Partners

The second phase is to identify and select suitable partners. Partners can be sought vertically (suppliers or customers) or horizontally (across competitors or cross-sectors) (Barratt, 2004). The aim is to source complementary capabilities and resources to strengthen collaborations (J. P. Davis & Eisenhardt, 2011; Dyer & Singh, 1998; Romero & Molina, 2011). This requires 'collaborative know-how' and has a crucial influence.

Firstly, by selecting the available resources and capabilities to innovate solutions and create value for partners. Secondly, by directing how the collaboration can evolve due to how partners may respond (Holmberg & Cummings, 2009; Simonin, 1997). Cummings & Holmberg (2012) propose partner selection criteria should balance the objectives, tasks, and intended learning outcomes with a fit between relational harmony needed and risks between partners. Whereas, Emden et al. (2006) prioritise technical alignment with subsequent strategic and relational alignment as selection criteria for new product development. Management research commonly recommends capturing the relational capital of existing relationships to minimise transaction costs (Nieto & Santamaría, 2007; Powell et al., 1996; Provan et al., 2007; Thorgren, Wincent, & Örtqvist, 2009). Partner selection should also balance the desired governance (hierarchical or flat), and degrees of openness both internally (information sharing) and externally (openness to new partners) (Bengtsson et al., 2015; Bogers et al., 2020; Lazzarotti & Manzini, 2009; Pisano & Verganti, 2008).

In sustainable oriented innovation, a partners' culture and their concept of and tolerance towards risk need to match the scope of the project (Barbara Gray & Stites, 2013). A key managerial consideration is whether the innovation scope is incremental or systemic; the latter requires a more networked approach to explore complementary innovations and business models, greater tolerance for risk and expands the scope of collaboration beyond existing relationships to explore increasing sustainable impacts (Adams et al., 2016; P. Brown, Bocken, et al., 2019, 2020). This can impact the ability to identify and select partners, which is why 'system mapping' to identify complementary material flows or shared problems is needed (Kraaijenhagen et al., 2016). Creating a shared understanding of the problem or opportunity, and fit between partners' interests is also needed, but difficult to judge within pre-collaboration communication (Kraaijenhagen et al., 2016).

4.2.2.3. Align partners on a shared purpose

Once selected one needs to align partners on a shared purpose, build a shared understanding of key concepts, a shared vision and joint goals. This is crucial to create internal agreement between partners, ensure support and avoid functional myopia (Barratt, 2004). This requires revealing interests and ideas as well as exchanging knowledge to align the understanding of key terms (Emerson et al., 2011). Bryson et al. (Bryson et al., 2015) refer to these as the internal collaborative processes that bridge differences, establish trust and legitimacy, and form the basis

of future communication. Bryson et al. (2016) state to maximise the collaborative advantage, partners need to create a 'joint goal system' that incorporates; core, shared, negative (potential collaborative risks), and 'not-my-goals' (others' goals partners are not prepared to be held accountable for).

Sustainable oriented innovation emphasises the exploration of differences across actors, their priorities and motives. Prioritising interpretations of the problem, potential approaches, and desired solutions are thus critical to creating a shared vision (Barbara Gray & Stites, 2013; Rohrbeck et al., 2013). In COI, Kraaijenhagen et al. (2016) highlight this can motivate and inspire partners to find solutions and manage tensions, but also show if the collaboration might be required to go beyond the reach of rules, norms, and formal agreements to explore more radical COI. This is because to test and pilot complementary innovations, inherent within systemic COI and circular business opportunities, require scale and radical approaches (Blomsma et al., 2019; Brown et al., 2019). Common practices are collaborative foresight sessions (Gattringer et al., 2017; Wiener et al., 2018a). Such practices should highlight the participant's background, perspectives, and interests and are intended to explicate the desired innovation value.

4.2.2.4. Develop structural and procedural governance

Designing effective collaborations requires agreement on procedural as well as structural mechanisms to govern relationships (Bryson et al., 2015). These can range from unspoken or emergent norms and values to formalised rules defined in documents, agreements, or contracts. Topics usually covered by these governance mechanisms are network management tasks, such as the coordination of interactions, common rules for communication and transparency (Bryson & Crosby, 2015; Emerson et al., 2011; Ritter & Gemünden, 2003), and the development of joint decision-making processes (Cao et al., 2010). Crucial decisions are the levels of integration between organisations and assignment of responsibilities for administrative tasks (Ritter & Gemünden, 2003). Governance can be by the lead organisation, shared, or by a network administrative organisation (NAO) that engages or creates a separate organisation for network management tasks (Provan et al., 2007; Valkokari & Rana, 2017).

In sustainability contexts potential for conflict and differences of opinion is high, due to the increased number and type of partners and their different economic, ecological, and social motives. Gray and Stites (2013)

conclude that defining mechanisms for how to deal with such differences of opinion are needed to facilitate collaborative discourse. Within COI, Kraaijenhagen et al. (2016) propose that collaboration is best structured around inter-organisational project teams, consisting of one delegate from each organisation. Brown et al. (2020), show COI can also be structured using phased or portfolio strategies that have different levels of openness and required agreements between partners. Beyond this CE research does not currently account further for the complexity arising from potential high diversity and number of partners involved.

4.2.2.5. Define a collaborative value capture model

Defining how to capture value is concerned with the distribution of risks and rewards. It involves formulating agreements, contracts and setting accountabilities to evaluate collaborative performance (Barbara Gray & Stites, 2013; Provan et al., 2007). It might also require a definition and allocation of intellectual property rights (Bogers, 2011; Bogers et al., 2017; Romero & Molina, 2011). Yet, understanding how new business models are collaboratively implemented is nascent (West & Bogers, 2014, 2017). A challenge for value network actors is that value creation, delivery, and crucially capture activities increasingly operate at the system-level, so are harder to assess (N. Bocken, Boons, et al., 2019; West & Bogers, 2017). This challenge is increased when the focus is on sustainable value capture, due to the wider scope of value and actors needed (N. Bocken, Short, et al., 2013; Evans, Fernando, et al., 2017; Evans, Vladimirova, et al., 2017a; Yang, Evans, Vladimirova, & Rana, 2017)

In COI, Leising et al. (2017) propose contractual agreements for circular value capture should integrate CE principles and be non-traditional. They state focus should be on collective gains (rather than over-specifying individual responsibilities) and the fulfilment of the shared circular ambition but do not state how. Kraaijenhagen et al. (2016) advise to simplify CE contracts, avoid micro-managing relational aspects, and advocate for both multilateral agreements (that affirm commitment towards the formulated vision) and bilateral agreements (that govern transactions or operational overlap between two organisations). The valuation method of end-of-life (EOL) products or materials should be agreed upon from the start to reduce potential conflicts (Kraaijenhagen et al., 2016). Finally, Kraaijenhagen et al. (2016) suggest entering any discussion on revenue models or coverage of risk within COI needs a collaborative whole-system mind-set. Their argument acknowledges how tendencies towards self-maximising behaviours, over-specifying risks, and allocating responsibilities, are counterproductive to collective

outcomes and contradict the idea of sharing responsibility for both positive and negative externalities of COI.

4.2.3. Employ dynamic aspects of collaboration within design and implementation

Several relational factors influence the overall collaborative design and implementation process. Gray & Stites (2013) coin the term 'process issues', which are aspects that unite partners, strengthen relationships, and create 'zones of agreement' to pursue mutually beneficial and shared goals. Many 'process issues' connect to phases of vision, structural and procedural alignment. Others stand-out and warrant further description.

Firstly, leadership plays a vital role in all collaborative phases (Bryson et al., 2015; Emerson et al., 2011). Leadership is critical for championing a circular vision, to attract resources, unite stakeholders (internal and external), and guide COI activities, whilst maintaining focus upon CE objectives (Brown et al., 2019; Curley & Salmelin, 2018; Goodman et al., 2017; Kraaijenhagen et al., 2016; Leising et al., 2017; Zucchella & Previtali, 2018).

Secondly, effective communication drives collaborative performance and is characterised as civil, reasoned, open, inclusive, and active (Emerson et al., 2011; Kähkönen, Lintukangas, Ritala, & Hallikas, 2017). Collaboration requires communication to espouse and integrate values, norms, and discuss behaviours (Koschmann, Kuhn, & Pfarrer, 2012). Closely linked are trust and transparency, especially of individual interests, which is needed to avoid misunderstandings or mismatches between collaborators (Gold et al., 2010; Kraaijenhagen et al., 2016). Withholding critical information impedes collaboration, as operations are interdependent, and risks cannot be shifted to partners without incurring collective costs.

Thirdly, the ability to resolve conflicts, resulting from differences of opinion or innovation decisions (J. P. Davis & Eisenhardt, 2011) or tensions arising from collaborators characteristics (Bryson et al., 2015; Barbara Gray & Stites, 2013; Lichtenthaler & Lichtenthaler, 2009; Weare, Lichterman, & Esparza, 2014), is crucial to successful collaborative relationships.

4.2.4. Conceptual framework derived from the literature

COI has much to gain from strategic management research into how to design and implement collaborative processes. Here, we present

Table **11**, structured along six 'building blocks' for setting up collaborations and the overarching relational dynamics of collaboration from contributing authors. The applicability within the circular innovation context remains to be empirically tested. Consequently, distinctions that could improve innovative performance in a COI domain are likely still to be discovered. Table 11 forms the conceptual framework we use to empirically investigate our collaborative COI cases.

***Table 11**. Collaborative processes and key aspects for collaborative innovation design and implementation*

Process Phase and Category	Key Aspect (What is needed)	Sub aspect (How to achieve or understand what is needed)	Contributing authors
Identification of need and articulation of intent to collaborate	Need identification from: system context or external antecedent conditions	Institutional environment	(Bryson et al., 2015; Emerson et al., 2011; Lober, 1997)
		Market developments	(Alexiev et al., 2016; Bryson et al., 2015)
		Industry trends	(Alexiev et al., 2016)
	Need identified based on innovation characteristics	Competitive Significance, Complexity, Codifiability	(Austin & Seitanidi, 2012b; Eisenhardt & Schoonhoven, 1996; Powell et al., 1996; Tidd, 1995; Tidd, Bessant, & Pavitt, 2005)
	Need identified based on organizational characteristics	Lack of existing competencies, a strong corporate culture, low management comfort	(Faems et al., 2005; Felin & Zenger, 2014; Tidd, 1995; Tidd et al., 2005)

	Articulate intent	System sketch of processes	(Kraaijenhagen et al., 2016; Leising et al., 2017)
		Road mapping and Business modelling	(Rohrbeck et al., 2013; Wiener et al., 2018a)
Identifying and selecting partners	Partner identification in the system	Vertical collaboration with suppliers or customers	(Barratt, 2004)
		Horizontal collaboration with competitors or other markets and industries	
		Collaborative Know-How and experience	(Austin & Seitanidi, 2012a; Cummings & Holmberg, 2012; Holmberg & Cummings, 2009; Simonin, 1997)
		Shared or complementary material flows	(Kraaijenhagen et al., 2016)
		Existing partners	(Austin & Seitanidi, 2012a; Bryson et al., 2015; Provan et al., 2007; Seitanidi & Crane, 2009)
		Control over partners	(Lazzarotti & Manzini, 2009; Pisano & Verganti, 2008)
		Openness of collaboration	(Bengtsson et al., 2015; Lazzarotti & Manzini, 2009; Pisano & Verganti, 2008)

	Partner selection based on complementarity and fit	Complementary capabilities and resources	(Austin & Seitanidi, 2012a; J. P. Davis & Eisenhardt, 2011; Dyer & Singh, 1998; Kraaijenhagen et al., 2016; Romero & Molina, 2011; Seitanidi & Crane, 2009)
		Shared understanding	(Kraaijenhagen et al., 2016; Leising et al., 2017; Seitanidi & Crane, 2009)
		Shared interests	
		Risk tolerance	(Barbara Gray & Stites, 2013)
Aligning partners on a shared purpose	Formulating a shared purpose	Preparation of partner background (interests)	(Barbara Gray & Stites, 2013; Kraaijenhagen et al., 2016; Leising et al., 2017)
		Invite competitors	(Kraaijenhagen et al., 2016)
		Goal Alignment for collaborative advantage	(Bryson et al., 2016)
	Principled engagement	Discovery, Definition, Deliberation and Determination of key ideas, interests and ambitions	(Emerson et al., 2011)
		Linked interests & value	(Austin & Seitanidi, 2012a; Seitanidi & Crane, 2009)

	Capacity for joint action	Prioritising and Creating a shared understanding and internal legitimacy	(Bryson et al., 2015; Rohrbeck et al., 2013)
Defining structural and procedural governance mechanisms	Emergent governance	informal norms and values	(Bryson et al., 2015; Clarke & Fuller, 2010)
	Defined governance	formalised rules in authoritative document	
	Network management tasks	Coordination and depth of interaction	(Bryson et al., 2015; Emerson et al., 2011; Ritter & Gemünden, 2003)
		Rules of conduct	
		Development of joint decision-making processes	(Cao & Zhang, 2010)
	Network governance mechanisms	Shared governance	(Provan & Kenis, 2008; Valkokari & Rana, 2017)
		Lead organization Governance	
		Network Administrative Organization governance	(Kraaijenhagen et al., 2016; Provan & Kenis, 2008; Valkokari & Rana, 2017)
	Conflict management	Defined mechanisms to resolve difference of opinion	(Barbara Gray & Stites, 2013)

Defining a value capture model	Managing risks, responsibilities and rewards	Definition of accountability criteria	(Barbara Gray & Stites, 2013)
		Intellectual property rights	(Bogers, 2011; Provan & Kenis, 2008; Romero & Molina, 2011; West & Bogers, 2014)
		Introduction of shared vision and circular principles into contract	(Kraaijenhagen et al., 2016; Leising et al., 2017)
		Simplistic contracts	
		Combination of multilateral and bilateral agreements	(Kraaijenhagen et al., 2016)
		Defined valuation methods for EOL products	
		Collaborative mind-set	(Barbara Gray & Stites, 2013; Kraaijenhagen et al., 2016)
		Share risks	
Employ Dynamic Aspects of Collaboration Within Design and Implementation	Leadership roles	Vision Championing	(Dietrich et al., 2010; Goodman et al., 2017; Kraaijenhagen et al., 2016; Leising et al., 2017; Zucchella & Previtali, 2018)
		Attracting Sponsorship	
		Evoke commitment	
		Provide Guidance	
	Leadership characteristics	Self-awareness	(Dietrich et al., 2010; Kraaijenhagen et al., 2016; Pitsis, Kornberger, & Clegg, 2004)

	Internalised moral perspective	(Kraaijenhagen et al., 2016)
	Balanced processing of information	(Kraaijenhagen et al., 2016)
	Relational transparency	(Kraaijenhagen et al., 2016)
	Emotional intelligence	(Dietrich et al., 2010; Pitsis et al., 2004)
Communic-ation	Civil and reasoned	(Emerson et al., 2011)
	Open and inclusive	(Emerson et al., 2011)
	Active and frequent	(Kähkönen et al., 2017)
Transparency	About interests and capabilities	(Kraaijenhagen et al., 2016)
Trust	formal commitment	(Barbara Gray & Stites, 2013; Tidd et al., 2005)
	institutional security	
	legitimized self-interests	
	Length and frequency of positive experience	
Conflict resolution	Reconciliation through recombination	Davis & Eisenhardt, 2011)
	Balancing and resolving tensions	(Bryson et al., 2015; Barbara Gray & Stites, 2013; Lichtenthaler & Lichtenthaler, 2009)

4.3. Research Design

COI research is nascent, especially the aspect of collaboration is underexplored. Thus, we chose an exploratory case study approach to gather first-hand insights into the collaborative processes underlying COI (Yin, 2009). Across three research cycles; 'Explore' (section 4.3.1), 'Validate' (section 4.3.2), and 'Deep-Dive' (section 4.3.3), (shown in Figure 6), we conducted semi-structured interviews and desk-based case study research. This supported triangulation of insights across these cycles. Each followed a retrospective approach, an outcome of interest (a collaboratively developed COI project) was identified and explored to understand how the process unfolded over time (Boons, Spekkink, & Jiao, 2014; Langley, 2007). In research cycles 'Explore' and 'Validate' interviews were conducted with project leaders, but engagement with collaborative partners was serendipitous, which limited the assessment of differing perspectives. The deep-dive case was designed around interviews with multiple organisations and actors to capture different perspectives on the same collaborative process. The unit of analysis across our research cycles focused on the collaborative decisions and actions between companies. Our case selection focused on the Netherlands. The Dutch government aims to become fully circular by 2050 and is actively supporting COI and exploring possible circular subsidies (IenM, 2016; Pieters, 2019). Thus, the Netherlands is seen as a hotspot of circular activity, which offers valuable case insights into collaborative COI processes.

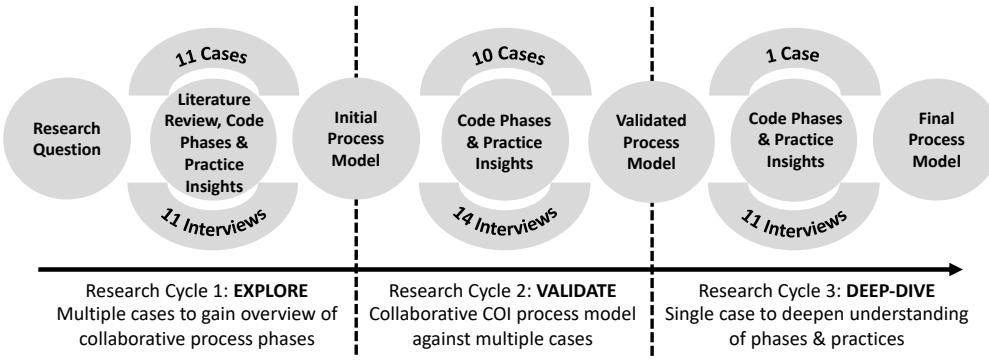


Figure 6. *Research cycles and methodology used to develop a collaborative circular oriented innovation process model*

4.3.1. Research cycle 1: Explore

We reviewed collaborative process literature[2] to identify an initial set of 'building blocks' (Table 11). An overview of interviewees is given in Table 12 and interview questions are provided in Appendix E. These explorative interviews were coded, using NVivo software[3] and the collaborative process 'building blocks' to form our first understanding and identification of the collaborative process across multiple contexts. We used cross-case analysis (assessing typologies of essential actions and processes across our cases) and pattern matching (comparison across our cases of patterns from theory identified in section 2 with those empirically observed) to assess similarities, differences, and order the frequently occurring elements (Yin, 2009). The output from this research cycle was the development of our initial collaborative COI process model.

Table 12. *Research Cycle 1 Explore – Overview of the Interviewees*

Comp-any	Interviewee(s)		Length (Mins)	Industry	Product Category / Type	No. of Employees
	Code	Position				
1	E-A	CSR, CO_2 and Circularity Consultant	85	Energy	Infrastruct-ure	>5500
2	E-B	Director of Sustainability + Senior Manager Sustainability	60	Electronics	Consumer Products	>70,000

[2] Search Criteria (Title/Abstract): "strategic management", "cross-sector", "sustainability" or "circular economy" AND "Collaborative", "Collaboration" AND "process model" or "process framework". 1st review = abstract and conclusions to assess relevance to research question & whether a process model is presented in the paper. 2nd review = assess the relevance of the process model, extensiveness, and scope. 3rd review = assess unique elements, characteristics, and attributes of the collaboration process model

[3] Coding software was used across our research cycles to provide an efficient, structured and iterative coding approach and to manage the quantity of interview content and transcripts

3	E-C	Circular Economy Manager	75	FMCG	Food, Drink and Health Products	>100,000
4	E-D	Circular Economy Specialist and Strategic Consultant	60	Real Estate	Sustainable construction	>25
5	E-E	Lead Global Centre Circular Economy	60	ICT	Hardware and Services	>350,000
6	E-F	Supply Chain Manager	63	Furniture	Beds and Mattresses	>200
7	E-G	Director EMEA Regulations, Environmental Affairs and Producer Responsibility	70	ICT	Hardware and Services	>100,000
8	E-H	Co-founder	80	Electronics	Smartphone	>75
9	E-I	Circular Economy Manager	90	Furniture	Office Furniture	>150
10	E-J	Director of Sustainability	90	Flooring	Carpet	>350
11	E-K	Sustainability Marketer	90	Chemicals	Health, Nutrition and Materials	>21,000

4.3.2. Research cycle 2: Validate

An overview of interviewees is given in Table 13 and interview questions are provided in Appendix F. Towards the end of the interview, our initial COI process model was presented and discussed. Interviews were coded, using software (NVivo), to validate and improve our model. Again, pattern matching was used to assess challenges, ways to improve and support the collaborative process and add detail on the practices displayed across our cases. The output from this research cycle was the validation and expansion of our initial collaborative COI process model.

Table 13. *Research Cycle 2 Validate - Overview of the Interviewees*

Company	Interviewee(s)		Total Length	Industry	Product Category / Type	No. of Employees
	Code	Position	(Mins)			
2	**V-A**	2 X CE Design and Business Model Researchers	70	Electronics	Consumer products	>70,000
6	**V-B**	Research Engineer	73	Furniture	Beds and Mattresses	>200
12	**V-C**	Program Manager Sustainable Entrepreneurship	125	Tourism Hospitality	Holiday accommo-dation	>3000
13	**V-D**	Head of Sustainable Development (EMEA) + Concept Designer	175	Flooring	Carpet	>3,000
14	**V-E**	Project Manager Business Development	80	Waste Manage-ment	Material collection & recovery	>8000

15	**V-F**	Co-Founder	75	Sports Equipment	Refurbished race bicycles	<5
16	**V-G**	Material Resource Manager	75	Waste Manage-ment	Material collection & recovery	>80,000
17	**V-H**	Circular Economy Business Developer	140	Material Producer	Waste to biological composites	>60
18	**V-I**	Project Manager Sustainability EMEA + Sourcing Manager Packaging and Waste	125	FMCG	Coffee Retailer	>250,000
19	**V-J**	Sourcing Manager + Corporate Sustainability + Commercial Market Manager	90	Energy	Energy infrastructure management	>150,000

4.3.3. Research cycle 3: Deep-Dive

The last research cycle features a deep-dive into a single case-study to further understand the collaborative process phases and practices within a COI context. We selected a case in the construction sector, which is one of five priority sectors identified in the European Union CE action-plan (Bourguignon, 2016; European Commission, 2015). In the Netherlands, construction is also a key target for Dutch 2050 circular ambitions (IenM 2016). The rich data generated supported further refinement of our process model and advanced our understanding of potential challenges or ways to improve the collaborative process.

4.3.3.1. Case Description

The case is a recent circular construction project in Amsterdam. Its design and construction involved a large variety of organisations making it highly relevant to research. Additionally, supporting data collection, all participating organisations are encouraged to share experiences and insights by employing a "right to copy" policy (Kubbinga et al., 2017).

The innovation process exhibited two phases. First, the initial 'linear' design; but due to internal and external drivers, the aim adapted to integrate circular design and recovery. Creating a second phase, case data is on this circular design, shown in Figure 7. The transition from phase 1 to 2 was marked by the project owner placing a hold on construction until the CE redesign gained approval from top management, before further refinement and physical construction.

Integration of circular design, use-phase, and recovery features required new collaborators to provide expertise, capabilities, or services to develop: 1) high energy efficiency and self-sufficiency, 2) use of secondary materials, 3) reuse of components (e.g. windows and frames), 4) use of biological materials (e.g. a wooden structure designed to be reused), 5) Grey-water circulation, and 6) pay-per-use services (e.g. elevators and facilitates management). Additionally, the focus and scope of collaborations changed from traditional collaborations needed to design and construct a building to a more explorative focus; specifically, to explore the potential for circular strategies within the built environment to develop a leading circular showcase.

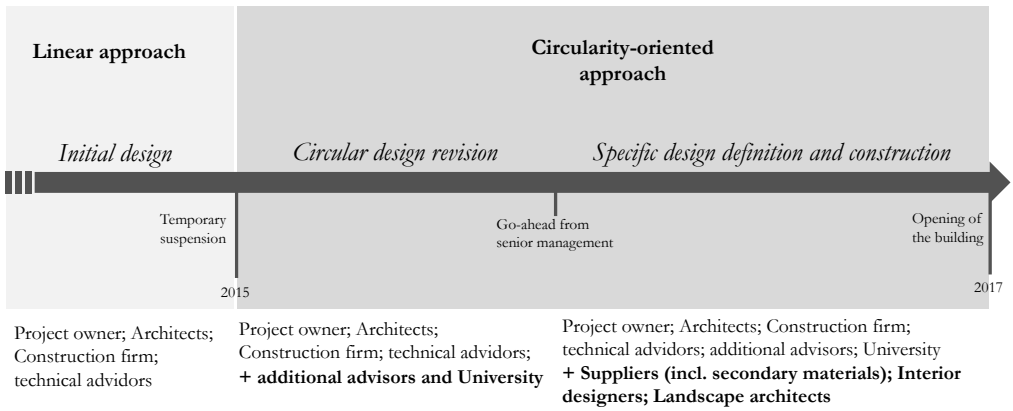


Figure 7. *Timeline of the innovation process of the Case*

4.3.3.2. Case Data

Multiple primary and secondary data sources were collected to aid a more complete representation of historical, contextual, and behavioural information (Yin, 2003). Primary data includes; 1) semi-structured interviews, and 2) direct observations of interviewees and case representatives' interactions from different organisations within the project, made during (four) visits to the site. Secondary data includes desk-based research; 3) public reports and videos on the development of the project, and 4) internal documentation on the process of partner selection (made available by one of the interviewees). This allowed triangulation, ensured richness of details, and provided a variety of subjective perspectives. A summary of data sources is given in Table 14 and semi-structured interviewees in Table 15. Interview questions are provided in Appendix G.

Table 14. *Research Cycle 3 Deep-Dive - Overview of Case Data*

Type of Data	Authoring Organisation	Content	Length (A4 Pages) / Duration (Minutes)	Publicly / Privately available
Video	Construction company	Vision, market studies and project proposal	3 minutes	Public
Internal project documentation	Project Owner: Banking Group	Procurement and partner selection procedure by request for information and circular economy weighting	34 pages	Private
Public report #1	Circle Economy	Case study on future proof-built environment	28	Public
Public report #2	Project Owner: Banking Group	Development process of the building from idea to final construction	web page format ca. 20 pages	Public

***Table 15**. Research Cycle 3 Deep-Dive - Overview of the Interviewees*

Interviewee	Organisation	Role & Position of Interviewee	Length (Mins)
D-A	Banking Group (Project Owner)	Sector Banker Built Environment	49
D-B		Project Manager Real Estate	83
D-C		Project Manager	79
D-D		Project Developer Zero Waste	51
D-E	Technical University	Project advisor / CE researcher	63
D-F	Technical Advisory Company	Director: Building Physics and Sustainable construction	48
D-G		Project Manager	44
D-H	Technical & Sustainability Advisory Company	Project Manager	67
D-I	Architectural Office (Project Architect)	Advisor / Project Architect	56
D-J	Secondary material provider	CEO / Supplier	50
D-K	Construction company	Project Manager	54

4.3.3.3. Data Analysis

Interviews were coded using software (Atlas.ti 8) and the collaborative process 'building blocks' (Table 11). Deductive analysis allowed themes to emerge from the case data (Corbin & Strauss, 1990, p.61). Inductive coding then defined new aspects or sub-aspects that expand upon existing codes. These were clustered and subsequently summarised under aggregate dimensions. Evaluative codes were also used when data revealed suggestions for improvement, criticism, or highlighted successes. Differences and similarities between the theory and empirical evidence were registered. Divergence on the COI context was used to improve the process model.

4.4. Results

Firstly, we present a summary of results and key insights from research cycles 'Explore' (section 4.4.1) and 'Validate' (section 4.4.2). Results on the aggregated collaborative process dimensions (section 4.3), collaborative dynamic capabilities and attributes (section 4.4.4) and process insights (section 4.4.5) from our deep-dive case are then presented. We finally present our updated process model (section 4.4.6).

4.4.1. Research Cycle 1 Explore: summary of results

Cross-case pattern matching supported ordering and added detail to the 'building blocks' to develop our initial collaborative COI process model (Figure 8). Case insights showed that once a decision to pursue CE is made the initial challenge is to internally understand the business rationale and develop a circular proposition. Most cases undertook some form of system mapping to support this step to highlight the need to collaborate to secure capabilities. Some also engaged externally to support this process. When identifying partners cases commonly used CE criteria and assessed an actor's credibility or previous CE activities, engaging partners they described as 'forward thinkers' or 'CE front-runners'. The collaborative architecture phases raised most challenges on how to align actors, govern the collaboration, and develop the agreements and contracts to capture value. Cross-case pattern matching did not present a common ordering or methods used for these phases, rather a preference for learning-by-doing, iterative experimentation, and use of co-creation workshops were highlighted.

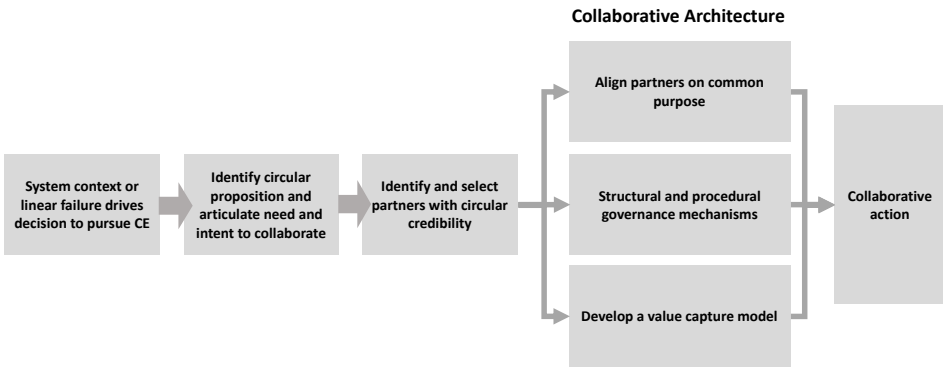


Figure 8. *Initial Collaborative Circular Oriented Innovation Process model*

4.4.2. Research Cycle 2 Validate: summary of results

When (at the end of the interview) we presented our initial process model, all interviewees recognised and validated the collaborative phases displayed. Interview V-B stated; "*If you would apply this on the circular collaboration we have with [Name of collaborator] this is the process one on one.".* Interview V-G added: *"even if you have a very complex circular project with more partners, the model is more or less the same, these are the steps you have to follow".* Interviewees also discussed how collaborative activities often created feedback loops, whereby new partners can be sought prior to or once collaborative action has been conducted, here interviewee V-C stated; "*I think this [process model] is very clear, but for us we will always be looping back with existing or new partners, but that's really depending on the relationships you have and need".*

Beyond validating our model this research cycle adds detail to the importance of partner selection and the collaborative architecture.

Interviewees discussed how both formal and informal partner selection are crucial in COI projects. Formal could use CE criteria and both focused upon a partner's motivations. Interview V-J stated motivation was a crucial difference between a failed and successful collaborative COI process; *"I think that's where we somehow got stuck in the previous project. Some people in that process were not motivated. You have to have the right mindset.".* Interview V-E expands upon the mindset and motivation needed: *"If the other partners don't have that same mindset, or at least 80% of it, you're dead. I always try to find out why people want to step in. And if they say: 'I want to make money', you're out. Because the first thing you need is to want to do it. The other important thing is that you have a*

vision and can align around this to share the motivation and the willingness to actually get there.". Interview V-G adds to the discussion on motivation and mindset for partner selection is the element of competitors, stating; "*I think the other main tip is no competitors on the table. Because they don't tell you the right information.".* Although here interview V-D indicated an initial preference to explore existing partners, but if needed they could explore competitors; *"From a partner selection perspective, whether you have partners within your existing supply chain or whether you need to explore other sectors, or even competitors depends on the project.".*

Elements within the 'collaborative architecture' happen simultaneously. Interview V-B stated that; "This [alignment, governance, and value capture] happens simultaneously. You share motivations, do circular mapping and business rationale together, and you turn it into planning phases and decide how to organise it.". Interviewees discussed how developing the value capture model is particularly important to advance collaborative action (commonly experimentation). Interview V-A highlights how experimentation is a key difference of COI projects; "you need even more proof and experimentation to convince people than for a normal project and you need more collaboration across the full life-cycle, especially on logistics and financing, to understand if it will work". Interview V-E adds; "So each experimentation and evaluation cycle was financed separately. But we always start with everybody takes an equity, as a principle of cooperation.". While, interview V-H adds credibility is crucial; "credibility is key to develop internal buy-in from the rest of their organisations to make this investment (…) since essentially, you're wanting to make a collaborative business model, but we're not sure how that's going to look financially". Yet, interview V-D highlights how agreeing upon the 'collaborative architecture' does not always require strict contracts "For two years we didn't have a contract (…) We cooperated, because we wanted to solve the problem and we saw an opportunity to do so by working together.".

4.4.3. Research Cycle 3 Deep-Dive: Results on aggregated collaborative process dimensions

Each subsection provides case data on the associated process phase.

4.4.3.1. Identification of the need to collaborate differently for COI

Identifying a need and articulating the decision to pursue circularity and collaborate differently was the most frequently encountered analytical

code. The system context triggered the project owner's decision to temporarily suspend construction, and threaten discontinuation of existing relationships. This forced actors to question their approach and ask for external input. Interview D-A stated; *"We didn't get what we wanted from the first designs and from the design philosophy of the architects. So, this created tension, and required bringing in new partners, for help."*. Interview D-E highlighted the lack of specific circular knowledge drove this; *"they [the project owner] wanted to move into circular economy, but they simply didn't have an idea of what that would look like".* This knowledge was crucial in the circular design revision (Figure 7), and prior to engaging new partners or suppliers, to define an initial vision and circular proposition. Interview D-B stated; *"I think we learned a very expensive lesson with throwing away a complete design of a building (…) not taking the time at the starting point really introduced a chance for error.".* A key learning is defining a clear vision in advance helps identify the need for external input and which partners to involve.

4.4.3.2. Identification and selection of partners

The case exhibited different approaches to identify and select partners. The dominance attributed to vision congruence, CE knowledge, and mutual pursuit of COI aligns with insights from previous cycles. Interview D-F stated; *"So the architect asked me, do you have ideas of how we can implement the ambitions of the bank into this project, otherwise we will be kicked out"*. The case similarly to previous cycles shows both formal selection (based on criteria) and informal selection (based on existing or serendipitous relationships) were used and perceived as strong guarantees for vision congruence. Interview D-H describes how CE weighting in formal partner selection narrowed their partner selection process; "*Well, we made a long list (…) we asked these parties to answer some circular economy questions, so we could find out if these parties matched their vision to our vision. And in that way, we turned the long list into a shortlist.".* On informal serendipitous partner selection Interview D-J stated; *"So they learned in my presentation of the possibility of reusing material from the built environment in new buildings and on the spot decided that they wanted to implement that as well."*.

4.4.3.3. Partner Alignment on shared purpose

A collaboratively agreed circular vision was emphasised as an important source of guidance and motivation. For the circular redesign three process steps were shown to be crucial; 1) creating agreement upon CE principles, 2) developing a shared knowledge-base of technical realities

backed by experts, and 3) a mutual understanding of respective interests. A pressure-cooker setting and continuous refinement over-time was used. Interviewee D-E, who designed and orchestrated the pressure-cooker, describes this process; *"Beforehand, I wanted each and every company to tell me 'what do you plan to bring to the table and what do you plan to take home' and really have that communicated to everyone"*; (…) *"one entire day where we had the leads of their respective companies. Everyone had to present what are we thinking about and really focus on 'ok what can we achieve within this minimal time-set'."; (…) "once we were able to get on the same page for a single goal and really interpret our goal to different languages, that's when we started working properly.".*

4.4.3.4. Developing collaborative structural and procedural governance mechanisms

Apart from content-related alignment, case-data revealed efforts were devoted to developing structural and procedural guidelines to govern collaborative interactions. The rules and norms of interaction were formally defined within collaborative round-tables, which interview D-H describes how they produced *"a document that describes the intention of all the parties to work together and collaborate and make sure that the risks do not occur".* The rules and norms were also developed informally as interview D-H adds; *"I don't think it was only the document that helped, but it was the mindset and interaction that helped".* Furthermore, the case showed rules and norms were dynamic throughout, such as; 1) different organisations were charged with network management tasks, 2) co-creation sessions were designed according to the collaborative process and innovation phase, and 3) decision-making was balanced between collaboratively agreed decision criteria[4] and final decision-making power of the focal firm (Project owner).

4.4.3.5. Developing a value capture model

The case similar to previous research cycles showed challenges around how to define and share collaborative value created and how to arrange contracts and risk management for the; 1) building and its components, 2) knowledge generated and exchanged between collaborators, and 3)

[4] 1) Circularity = highest weighting, 2) Aesthetics, 3) Lifecycle costs, 4) Normal costs, and 5) Existing experience

reputational benefits and publicity that the visionary approach attracted. Interview D-J stated that "*traditional contracts adopted formats that entail an incentivisation for shifting 'the risk to the next contractor in the chain', rather than to address what is most effective"*, signalling traditional contracting and risk management processes were sub-optimal. Here, Interview D-K stated; "*if you calculate all the risks it sums up to such a huge number, which nobody wants so you have to share.".* This led the collaboration to explore non-traditional, bilateral and multilateral agreements and contracts. For instance, Interview D-B highlighted; "*the risk premium of 2% that is common in traditional construction projects was eliminated from the contract"* and Interview D-J highlighted how; "*contracts were generally kept simple and short and that adopting a collaborative mindset offered additional trust".* Yet, still how to define value remained a challenge, Interview D-J stated surprise that *"a financially oriented client like [Project owner] with a circular ambition of making a circular building was not able to find the financial circular structure".* This impacted upon the ability to define circular recovery strategies or how to account for these within the project.

4.4.4. Collaborative dynamic capabilities and attributes

Desired personal characteristics were a collaborative mindset, adaptability, and vulnerability. Interview D-H highlighted how the project owner focused on the collaborative mindset; *"they pushed that the right people with good character came to the table. So, they made sure that everybody participating was aware of principles of circularity, the goals of it and the necessary mentality, being positive about cooperation.".* Interview D-C advanced this by emphasising the importance of showing *"Vulnerability - And the ability to accept that. That's the important thing."*. Interview D-A also discussed how "*you need some brave hearts, some ambassadors, some 'marchers'.".* Such people are needed as Interview D-F highlights *"if you have to invent a new way of building and even new techniques, you need a little bit of mess, a little bit of chaos to get it done".*

At the process level, interviewees discussed the need to share data, build trust and transparency, and create a shared sense of responsibility. A key insight was the role of a knowledgeable facilitator to act as a 'circular conscience'. Interviewee D-C highlighted how Interviewee D-E "*was a very good person in that, because he was also doing research in the field and I think he was really like a little bit of the 'verbinder', the connector (…) He was just like this kind of teacher guiding every step and looking at OK is this circular."*. Interview D-E stated when facilitating "*you have to keep facilitating those links, so you have to see those links before they*

are needed and its highly difficult. I think this is a valuable role within the circular economy.".

4.5. Deep-dive case: Process insights

This section provides process insights from our deep-dive case presented in Table 16.

Table 16. *Deep-Dive: Consolidation of Process Insights*

Aggregated collaborative dimension	Key Aspects	Process insight(s) from case
Identification of the need to collaborate differently for Circular Oriented Innovation	System context	External market pressures and legislation caused strategic re-orientation towards circular innovation
	Existing Relationships	Circular (re)design challenged design team's approach and mentality
	Innovation characteristics favouring collaboration	The competitive significance of circular innovation drove collaboration (e.g. construction has high relevance) The complexity and ambiguity of envisioned circular innovation increased collaboration Interdependencies of circular innovation meant conventional supplier relationships not sufficient, led to 'designing by supply'
	Organisational characteristics favouring collaboration	Lack of CE knowledge inhibited articulation of desired CE output Need for early defined vision and circular proposition prior to entering collaborations with partners
Identification and selection of partners	Identification and selection criteria	Knowledge and pioneer role in circular construction
		Technical expertise and competencies to guarantee feasibility of the circular design

	Willingness to join a movement	Creation of a movement to educate and inspire people towards circular economy
	Formal Partner selection	Partner evaluation: four dimensions, one on technical expertise -circularity weighted the highest (40%)
	Informal Partner selection	Credibility, reputation, prior relationship experience, and coincidence produced informal formation of collaborations
Partner Alignment on shared purpose	Formulating a collaborative CE vision and shared purpose	Co-design workshops (pressure-cooker format) enabled alignment of interests and knowledge in a short time-span (3 one day workshops over 3 months) Dynamic vision refinement over-time through external engagement Engage operational staff to support the circular vision
	Mutual understanding of individual interests	Create a common language and open exchange on perspectives to balance individual interests One-on-one interaction with each individual party by facilitator prior to workshops supports mediation, facilitation and effectiveness
	Shared Knowledge base	Supporting a shared vision avoided unnecessary discussion and ensured optimal use of organisations respective knowledge
Developing collaborative structural and procedural governance mechanisms	Emergent vs. planned and defined governance mechanisms	Formal multi-lateral agreements for collaboration created within round-tables Informal norms, rules, and passion emerge over time through interaction to increase a 'collaborative mindset' and governance

	Network management tasks	Distribution of coordinating responsibilities Aim for equality and mixed representation amongst parties
	Joint decision-making process	Collaboratively defined weighting criteria[4]. Final decision-making power remained with the bank as the client.
Developing a value capture model	Contractual aspects	Bilateral (buyer/supplier) contracts and multilateral collaborative contracts developed by round-tables Explored flexible contracting (goods and services) and non-defined budget
	Risk management	Traditional risk management and incentivisation leads actors to shift risks
	Capitalise collaborative value created	Traditional approach to depreciation to zero is sub-optimal
Collaborative dynamics capabilities and attributes	Personal characteristics	Get the 'right' mix of people with a collaborative mindset Find circular champions and inspirational sources Partners need to be able to manage change, uncertainty, and complexity by accepting flexibility, evolving roles, and vulnerability
	Process related aspects and capabilities	Importance of facilitator assistance who can act as a 'circular conscience' Create shared data and information models Build a team spirit and sense of belonging and ownership of the collective result Need to develop trust and transparency

4.6. Updated Collaborative Circular Oriented Innovation process model

By combining the reviewed literature and our case insights we present our updated process model (Figure 9). It represents a holistic overview of the collaborative 'building-blocks', with distinctions drawn for the design and implementation of COI (discussed in detail in section 4.7). This represents a path-dependent process, which starts with the decision to pursue a COI outcome. The need for collaboration arises from contextual changes, identified system failures, or failures within existing collaborations to produce circular innovations. The first steps present a chronological order leading to the identification and selection of partners. The 'collaborative architecture' represents interdependent processes that iterate between; the vision and purpose, designing a collaborative value capture model, and the governance structures, before collaborative action. Case insights highlight how new partners can be sought before or after collaborative action, which can represent dynamic adaption of the collaboration over-time. In either case, this process requires re-establishing the 'collaborative architecture'. The identified individual and process characteristics support this process.

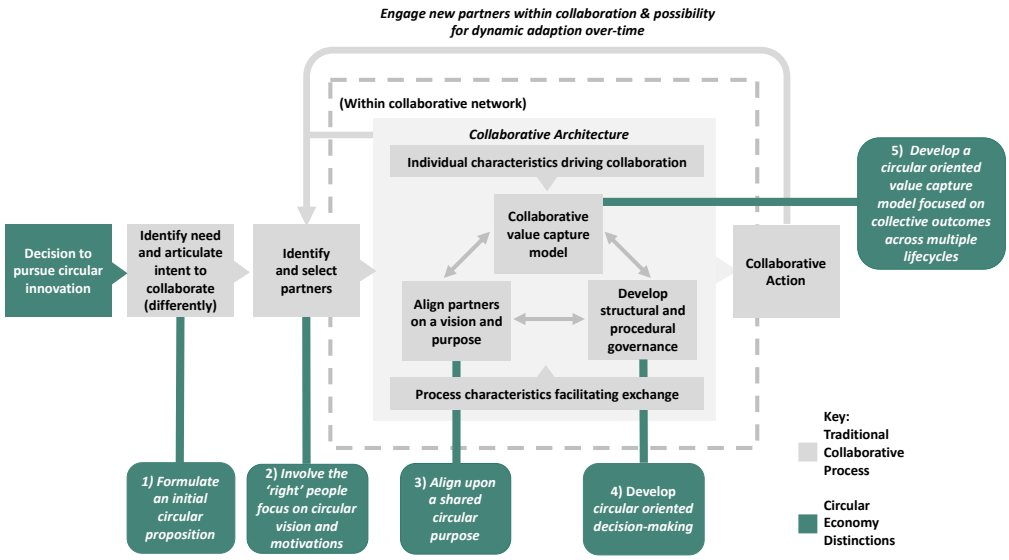


Figure 9. *Final Collaborative Circular Oriented Innovation Process model*

4.7. Discussion

We sought to understand and identify the process that companies undertake when designing and implementing collaborative COI. In Figure 9 we present COI distinctions; each is discussed below and we propose promising future research questions. Limitations and our conclusions are subsequently given.

4.7.1. Formulate an initial 'circular proposition'

Given the path dependence of any collaborative approach, establishing a clear circular proposition early on is crucial to guide the following phases. It outlines the core circular ambition, desired outcomes, and COI design requirements that warrant collaboration by assessing existing capabilities (both internally and externally). Such a design approach is consistent with the highly contextual nature of collaboration (Bryson et al., 2015; Barbara Gray & Wood, 1991). Cases showed the use of strategic foresight and design-led tools, which substantiates with empirical evidence the initial mapping proposed by Kraaijenhagen et al. (2016), Leising et al. (2017), Wiener et al. (2018a), and Bocken et al (2016; 2018). Involving external parties to facilitate and bring in scientific knowledge can generate significant strategic value within this initial COI ideation phase. Such engagement with a scientific knowledge base helps understand how to combine different circular strategies, safeguard the circular, systemic and long-term sustainability perspective, and maintain accountability to the collective outcome.

Promising future research questions are:

- To what extent do companies consider the systemic impacts of CE strategies upon their existing business model and relationships when deciding upon their circular proposition and COI process?
- To what extent does a companies' interpretation of circular economy and mindset help or hinder the formulation of a circular proposition?
- What role do product, sector, position within the value-network or geographical differences play within a company's ability to combine CE strategies most effectively within a circular proposition?
- How can tools and methods enable the formulation of a viable circular proposition and provide an outline of key stakeholders?

4.7.2. Involve the 'right' people

Identifying and involving the 'right' partners and people is critical for COI. In the literature on cross-sector partnerships, getting the 'right' partners and people means being inclusive and looking for diversity (Ansell & Gash, 2008; Emerson et al., 2011). For sustainable oriented innovation, it refers to resources, cultural fit, reputation, characteristics, and the time-frame for expected results (Barbara Gray & Stites, 2013). These elements are relevant in COI. But, our findings show that in the circular context, getting the 'right' people is also driven by the aim to achieve a congruent vision and motivation. Focus is therefore as much on 'soft' cultural elements as on purely 'hard' technical capabilities (P. Brown, Bocken, et al., 2019). This is in line with Cummings et al. (2012; 2009) who state that the aim should be to balance relational harmony with technical expertise.

Identifying and involving the 'right' partners for COI warrants a delicate balance between informal and formal selection. Informal selection is serendipitous or engages prior relationships, which is recommended by Bryson et al., (Bryson et al., 2015) and uses effectual practices (whom do you know?) (S. D. Sarasvathy, 2009). This means that partner selection could rest upon the available network an organisation or individual has. Thus, formal processes (which can run concurrently or used when no or limited relationships exist) can go beyond existing networks, supporting repeatability and standardisation. We find formal selection uses criteria weighted towards circularity to assess organisational culture and openness to explore change and COI.

On an individual level, identifying and involving the 'right' people for COI requires characteristics such as leadership and entrepreneurial drive (Blomsma, 2018; P. Brown, Bocken, et al., 2019; Kraaijenhagen et al., 2016; Lewandowski, 2016). We extend this by showing individuals' capabilities to accept and balance uncertainty, vulnerability, and other's motivations, whilst emphasising entrepreneurship to capitalise upon innovative opportunities, are also crucial. This indicates a preference for people who can be effectual (skilled at navigating complexity and comfortable with uncertainty) (S. D. Sarasvathy, 2009). Correspondingly, companies should empower or train effectual individuals to manage COI collaborations.

An implication for the COI process is that partner selection, informed by the initial circular proposition, represents a key leverage point for later phases within the collaborative architecture. Furthermore, without the 'right' balance between formal, informal, and individual characteristics

within partner selection processes this could produce exclusivity, reduced flexibility or challenges to achieve the COI ambitions (Keskin, 2015; York, O'Neil, & Sarasvathy, 2016). A negative result could be collaborative cliques unable or unwilling to work together or with those actors who do not share the CE motivation or desirable characteristics; but who have crucial resources or capabilities needed to operationalise a circular proposition.

Promising future research questions are:

- To what extent does selecting partners based on vision and motivation congruence help or hinder the pursuit of COI?
- What processes and techniques exist to assess and evaluate vision congruence in a pre-collaborative setting?
- How can companies most effectively balance between formal and informal partner selection processes?
- How can companies assess who are the 'right' people to maximise collaborative COI potential and effectiveness?
- How can companies assess whether a company or actor has the right mindset to engage with the desired COI?
- How can companies scope the range of potential partners for COI projects across sectors and value-networks?

4.7.3. Align upon a shared circular purpose

Co-creating and aligning upon a shared purpose and vision is crucial within COI. This is advanced by exploring partners' (and individual's) stance towards circularity and their interests (Brown et al., 2019; Kraaijenhagen et al., 2016) and might require adjustments to existing collaborations or adaptions to the COI ambition. An intended output is to also build a shared knowledge-base for circular principles and technical possibilities.

The practice of conducting collaborative workshops enables a condensed exchange of ideas and brainstorming. This advances and adds empirical insights to the visioning sessions proposed by Kraaijenhagen et al. (2016), as these require repeating with partners. Additionally, the one-on-one preparation with partners to support alignment confirms Ansell & Gash (2008), who propose that face-to-face dialogues are crucial to pursuing collaborative value. Our study extends the knowledge on organising such alignment sessions by emphasising the role of scientific CE knowledge to act as a 'circular conscience' and facilitate such alignment. This advances findings by Brown et al. (2020) who show that

external facilitation can aid analysis, but here includes a requisite level of knowledge and credibility to ensure circular ambitions are maintained when aligning partners.

Promising future research questions are:

- How does the collaborative context affect the minimum requirements for alignment across partners (e.g. about vision, purpose) to facilitate collaborative COI?
- How can potential tensions within a collaborative COI process be best overcome? And whose role is it to relieve such tensions?
- How can different motivations and interpretations of CE help or hinder alignment efforts and exploration of COI?
- To what extent can different collaborative workshop designs help or hinder alignment efforts?
- To what extent does external facilitation aid alignment processes and what level of CE knowledge and credibility is required?

4.7.4. Develop circular oriented governance and decision-making

Collaborative governance within COI happens both formally (through multilateral agreements) and informally (norms and rules emerge) through partner interactions. This confirms Clarke and Fuller (2010), but the assertion that traditional commercial and individualist attitudes need to be tempered by a collaborative mindset driven by the pursuit of the shared CE vision differentiates COI. This collaborative mindset is needed to decide how to share risks and overcome uncertainty, ambiguity in planning (due to COI complexity), and vulnerability for data or cost transparency (to facilitate CE strategies and recovery). Research cycles 'Explore' and 'Validate' show that both flat and hierarchical governance structures can be used, depending upon the context. The 'Deep-dive' case-study pursued a hybrid governance structure that operated as a consortium, but reserved final decision rights with the project owner (Pisano & Verganti, 2008). Interviewees discussed how this reflected the increased risks the focal firm undertook within the project. An implication for COI is that governance decisions seem to be linked to the levels of risk that are shared. Common practices to aid co-creation of governance are the creation of shared data-management platforms and pursuing equal representation between partners, especially when decisions are made or formulating decision criteria.

Promising future research questions are:

- How do contextual elements of a proposed COI affect the selection and effectiveness between flat, hierarchical, or hybrid governance structures? And how can these evolve?
- What types of decision frameworks are most valuable for advancing COI?
- What kind of collaborative mindset do actors within a COI process need to effectively facilitate governance? And is there a minimum threshold?
- How can companies assess, train, or maintain a collaborative mindset?

4.7.5. Develop a circular oriented value capture model

Strongly connected to governance is developing a circular oriented value capture model focused on collective outcomes. This represents a critical challenge. It needs to effectively distribute risks and rewards beyond single product life-cycles to incentivise recovery. Three aspects stand-out.

Firstly, traditional contracting approaches can fail, due to limited incentivisation of actions towards collective outcomes. Our empirical evidence supports proposed circular contracting outlined by Kraaijenhagen et al. (2016) by showing the use of bilateral and multilateral agreements that are simplistic, short, and are oriented towards the collective goal. Multilateral agreements to pool resources or govern overlapping activities, proposed by Fischer & Pascucci (2017), were not found since commonly selected actors did not exhibit high-levels of overlap. In 'Explore' and 'Validate' research cycles some cases chose not to create contracts initially but rather focused on rolling agreements between actors. This confirms a need for additional knowledge on when and how to design contracts. Emphasis needs to be on how to reward individual actions, responsibilities, and accountability, whilst achieving collaborative incentivisation.

Secondly, suitable valuation and accounting methods that can determine the value of products, components, or materials across product life-cycles are needed to support circular propositions and recovery combinations. No evidence of agreeing on circular oriented end-of-life (EOL) valuation methods were found to support proposals by Kraaijenhagen et al. (2016); rather cases commonly displayed use of traditional accounting mechanisms designed to fit a linear context (such as depreciating to zero) which can impede the business case of COI projects. All research cycles

indicate a need to create circular accounting, revenue, and return on investment mechanisms to realise CE intentions and cycle products and materials at their highest value.

Thirdly, and connected to the aim of creating collective outcomes, is the current high-risk nature of COI. Traditional approaches toward distributing risks and rewards can incentivise ineffective risk management. Fischer & Pascucci (2017) suggest risk and reward distribution should advance collective outcomes. Kraaijenhagen et al. (2016, p. 147) suggest leaving "breathing space", by not allocating all risks within contracts, to account for potential unknown externalities. The challenge in avoiding ineffective risk and cost management when going from a linear to a circular approach is that this seems to rely on individuals' collaborative mindset. Collaborative mindsets develop over-time and are contingent on trust, informal interaction between partners, internal motivations, and characteristics; so cannot be taken for granted. Ultimately, circular risk distribution should pool risks and incentivise those partners best equipped to address and thus minimise risks for the benefit of the network. Yet, this requires balancing a sense of responsibility towards the risks versus pursuing collaborative value. To date, no answer on how to do this effectively has been presented.

Promising future research questions are:

- How can companies balance trust and simplicity within written agreements and contracts when collaborating in the context of COI?
- When is it most effective to construct circular contracts vs. rolling agreements among partners to advance collaborative COI and value capture?
- What types of data, metrics, and mechanisms are needed to facilitate collaborative contracting and accounting for collective outcomes across multiple life-cycles?
- What are the minimum levels of transparency (e.g. on materials, operation costs and profit margins) required to effectively account for circular oriented value capture models across multiple life-cycles?
- To what extent do companies need to assess and balance financial and non-financial value creation, delivery and capture activities to support collective outcomes across multiple life-cycles?

- How important is the role of a collaborative mindset when designing COI contracts and accounting for risks and uncertainty across multiple life-cycles?

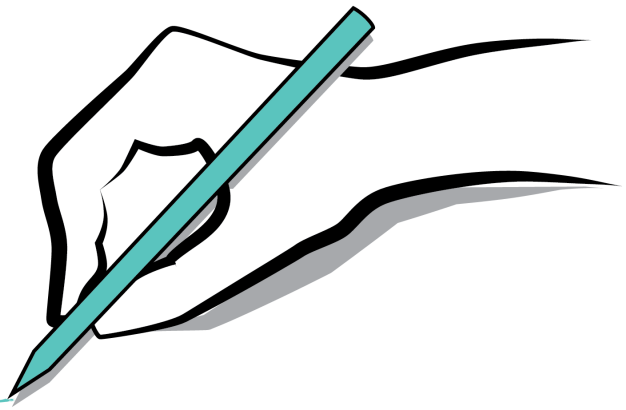
4.8. Limitations and future research agenda

Our study is subject to limitations. Firstly, other literature streams outside strategic management that have not been considered for this study could contain useful additional information on collaborative design and implementation processes. Future research may build upon and complement the proposed process model by integrating wider perspectives. Secondly, limitations stem from the case-study approach. A challenge held within all research cycles is the backwards approach used collects retrospective data, which can potentially create subjective biases (Boons et al., 2014; Langley, 2007). Yet, investigating such cases was a valuable approach for our exploratory research purpose to identify, understand and order the collaborative building blocks to present how collaborative processes unfold for COI design and implementation. Future research should validate and refine these through real-time action research.

Our approach has allowed us to present a first structured process model to provide a holistic 'helicopter-view' of collaborative processes in the COI context. We do not present this model as definitive, rather we see it as a call to action for future empirical and action-oriented research. A recommendation is to situate future research within collaborative groups to dive into and record the specific collaborative processes, practices, and dynamics as they happen, taking a forward view (Langley, 2007). Additionally, future research should test the process model to assess; 1) whether the proposed order and practices require reorganisation, additional, or complementary elements, and 2) if the model is relevant beyond business-to-business relationships, such as within triple or quadruple-helix innovation networks. Furthermore, such future research should keep one eye upon the challenges displayed within the collaborative process with the aim to develop tools and methods that can facilitate and advance to collaborative actions to help operationalise the CE concept.

4.9. Conclusion

Our study set out to understand and empirically investigate the collaborative COI process using a strategic management perspective. These empirical insights lead to four main contributions. Firstly, the outlined process model, is to our knowledge, the first to holistically focus upon and capture the key elements of collaboration within the COI context. This answers our research question and constitutes a valuable addition to circular economy researchers and practitioners since the investigation into collaboration has so far been a neglected field. Secondly, we contribute to circular research through our research design that assesses knowledge from strategic management literature upon collaborative innovation to then analyse COI cases to integrate this knowledge into the CE context. Thirdly, the scientific value of this study is held within our empirical investigation and results, which provide backing for several steps put forth by CE researchers; but we extend these by the additional focus on the dynamics of the 'collaborative architecture' and the identification of current practical 'know-how', challenges, and gaps within knowledge for how to build COI. Furthermore, the process model offers applicable findings and insights for managers into key practices to design and conduct collaborative COI. The intention is that by presenting the collaborative COI process this can stimulate others to start. Our final contribution is the proposed future research agenda that aims to challenge researchers and practitioners to further demystify collaborative processes to stimulate and accelerate the transition towards a circular economy.



5 Tool

A collaborative partner ideation tool for circular value proposition design

Chapter 5 - Tool

This chapter expands upon the accepted publication to the European Roundtable for Sustainable Consumption and Production (ERSCP) titled: 'Developing and testing a collaborative partner ideation tool for circular proposition design : Evidence from a circular innovation festival' (Brown, Baldassarre, Konietzko, Bocken, Balkenende, 2019)

The expanded paper is under publication with the special issue associated with the ERSCP conference 2019 for publication in the journal of cleaner production: Brown, Baldassarre, Konietzko, Bocken, Balkenende. A collaborative partner ideation tool for circular value proposition design.

This chapter presents the tool development process that uses a design science research approach to iteratively design, demonstrate and evaluate the ease-of-use and usefulness. This builds upon the insights from part one, whereby an initial challenge is how to think of and select partners when designing a circular proposition. This chapter engages the literature on sustainable and circular tool development processes to identify and present design criteria. The tool builds upon this literature foundation and integrates effectual decision-making principles to propose trigger questions within a canvas to map and visualise the challenge, resources, customers and potential collaborative partners. The aim is to stimulate ideation on the design of a desirable, feasible, and viable circular proposition. The tool design and development cycles, tested through participatory workshops with academic researchers and practitioners, are conducted across multiple industrial and geographical contexts. The evaluation cycles form the basis for iterations of the proposed tool to support early and quick ideation, identification and selection of potential collaborators to craft and design the circular proposition. The chapter presents the main learnings and benefits the participants experienced through using the tool.

The tool aids; 1) an increased focus on mapping and visualisation that supports moving from abstract and creative ideation towards assumption testing and concrete action planning, 2) the creation of an initial shared vision, and 3) deep-diving into a circular proposition or highlighting the need to pivot or adapt it. The tool supports the ability to quickly think of the desirability, feasibility, and viability of their idea from bringing in a focus on collaborative partners. Further it highlights any assumptions, challenges or potential testing that might be required to improve it. This chapter advances upon the main research question by proposing a possible solution to support companies when pursuing collaborative COI.

Sadly due to the Corona Virus pandemic, a further design, demonstration and evaluation round had to be cancelled. The tool presented within this chapter was to be used at the Sustainable Alpine Tourism Initiative (SATI) 2020, which had been planned to be held in Austria on March 27th. An expected 200 professionals were to use the tool presented here to explore how circular strategies could help develop innovations and increased sustainability within Alpine tourism. This demonstration would have been used to improve the tool and strengthen the practical contribution.

5.1. Introduction

Circular oriented innovation (COI) is a problem-centric and action-oriented iterative process. Its aim is creating business opportunities held within the transition toward a circular economy (CE) and to address sustainability challenges, such as resource scarcity, pollution, and climate change (Bocken et al., 2018; Ghisellini et al., 2016). COI explores the (re)design of industrial products, processes, business models, and value networks (Blomsma et al., 2019b; Geissdoerfer et al., 2017), by narrowing (using less), slowing (using products longer), and closing resource loops (using materials again) (Bocken et al., 2016; Lüdeke-freund et al., 2018). Such cycling of products, components, and materials maintain their integrity across multiple life-cycles till end-of-life recovery to maximise value capture and reduce environmental impacts (M. Den Hollander, 2018; Lüdeke-freund et al., 2018). COI relies on recovery strategies such as reuse, reparability, refurbishment, remanufacturing, and recycling (Lüdeke-freund et al., 2018). These competencies go beyond traditional relationships to connect upstream and downstream actors (Urbinati et al., 2017). Complementary innovations and business models are needed for recovery strategies to function across multiple life-cycles and at scale (Bocken, et al., 2019; Boons & Bocken, 2018). Such CE strategies have generated excitement, but need to be operationalised through validation to implement and realise proposed sustainability benefits (Blomsma & Brennan, 2017).

COI is nascent, however, research into how to operationalise it is growing. Researchers are integrating theory into tools, methods, and concrete practices within iterative innovation processes to support COI. COI needs collaboration to implement recovery strategies, and assess whether a circular proposition (the combination of circular product, business model and value network arrangements) can function at scale and achieve intended sustainability goals (Blomsma et al., 2019a; Manninen et al., 2018; Zucchella & Previtali, 2018). However, implementing such circular propositions in practice is very challenging due to the complexity, risks and uncertainties that come with collaboration (Baldassarre et al., 2020; Tukker, 2015). This results in a design-implementation gap that requires support mechanisms, such as tools (Baldassarre et al., 2020; Bocken et al., 2017; Geissdoerfer et al., 2018). Systematic reviews on sustainability and COI tools highlight that for them to be well-designed they should be specific to the intended purpose and require empirical evaluation (Bocken et al., 2019; Pieroni et al., 2019). Although tools have been developed, few focus on collaboration. Specifically, none have been found that

support companies to overcome difficulties occurring at the early stages of ideation to collaboratively identify partners and perceived values that are required to progress COI.

This study represents a first exploration into this gap. The goal is to develop a tool that helps companies ideate to identify partners and integrate perceived values into circular proposition design. In such uncertain conditions, an effectual attitude is recommended (H. Chesbrough, 2010, p. 362), since it is a more iterative and emergent approach as opposed to a more structured linear innovation funnel or stage-gate approach (Keskin et al., 2020; Sarasvathy, 2009; York et al., 2016). Moreover, an effectual process focuses on available means and collaborative learning cycles over extensive analysis before innovating. Using design science research (Hevner, 2007; Romme & Reymen, 2018), we develop a tool that integrates effectual decision-making logic within a design thinking approach to explore whether it can support COI. We, therefore, ask: *How can a tool support companies to ideate to identify partners and collaborative value for circular proposition design?*

To answer this question, first, the emergence of collaborative circular propositions, the development of tools and their approaches, are reviewed. Second, the design science research approach is explained and the tool demonstrated is provided. Third, data from the demonstrations and evaluation of the tool are analysed and the improved tool is presented. The discussion, limitations, future research directions, and conclusions follow.

5.2. Literature Background

Section 5.2 briefly reviews the emergence of collaborative circular proposition design. Then, section 5.3 investigates contributions from tool review papers that explore related sustainability research that is connected to the development of COI. Section 5.4 presents key elements from the literature for collaborative ideation tool and process development. Lastly, section 5.5 presents the research gap and identifies the objectives to be brought into our tool development process.

5.2.1. Emergence of collaborative circular value proposition design

COI builds on sustainable oriented innovation concepts by integrating CE principles and recovery strategies (Brown, et al., 2019). Central to both is the development of a core sustainable purpose (why one innovates).

Adams et al. (2016) and Ceschin et al. (2016) show how sustainable oriented innovation has evolved through product level eco-design approaches towards product-service systems (integrating business models and supply chains) towards an increasing focus on the exploration of socio-technical system changes (proposed by ideas such as CE) to increase sustainable impacts. Seuring (2013) states this needs to move beyond a sense of trade-offs between stakeholders to satisfy multiple and conflicting objectives to explore win/win and synergistic opportunities. Stubbs and Cocklin (2008) advance to do this requires integrating and connecting a view on how business models create value beyond the focal company for stakeholders such as customers, society, and the environment. Additionally, within COI processes this requires companies to also go further upstream and downstream within existing supply networks (Ünal et al., 2019; Urbinati et al., 2017) to explore and create complementary innovation activities (Takey & Carvalho, 2016); so value flows (Webster, 2015).

Understanding value and how it is created and flows is central to the business model concept, which aims to describe how business is done by characterising a company's value proposition, creation, capture, and delivery activities (Richardson, 2008). Here, Bocken et al. (2013) and Short et al. (2013) explore how combining a sustainable purpose with concepts of value missed, destroyed, wasted, and uncaptured (the latter expanded by Yang et al., (2017)) for stakeholders can identify opportunities to innovate business models to increase sustainable impacts. When integrating stakeholders into innovation activities Tyl et al. (2015) put forward three ways of ideating upon stakeholders; firstly their identification, secondly analysis of their values, and thirdly designing potential stakeholder interactions. Such processes aim to identify the interdependent activities and components that can stimulate ideas for what could be changed, in collaboration with stakeholders, to increase the efficiency of value flows and innovate solutions (Zott & Amit, 2010). Moreover, understanding how to increase and share value capture across stakeholders can aid new collaborative value propositions that incentivise COI (Kraaijenhagen et al., 2016; Rohrbeck et al., 2013). Within COI, understanding collaborative value potential is crucial when developing a circular proposition. Since the focus is on how to coordinate and combine circular strategies across multiple life-cycles; each stage needs to have value capture opportunities available to incentivise partner activities; such as initially recovering products to refurbish for reuse or as a last resort recovering the material value. These activities require resources (energy,

logistics, labour etc). So the actor who performs the activity also needs to capture value directly or indirectly. Yet, this needs to be considered within the initial ideation and design phase.

5.3. Tool reviews from eco-design, supply chain, product service systems, and business model innovation to understand circular oriented innovation tools

An early review into sustainability tools by Baumann et al. (2002) highlights that the conceptual stage is the most influential to change a product's environmental performance and needs to include a systemic focus on the business strategy and the full product life-cycle. Yet, they state tools were lacking and those that existed tended to be difficult to use. This difficulty of use is later corroborated by Rossi et al. (Rossi, Germani, & Zamagni, 2016), although they find that the use of tools are still the primary means for companies to engage with sustainability and eco-design concepts. Their review shows tools include life-cycle assessment and diagrams, checklists or guidelines that present intelligent questions to designers to anticipate and solve problems within the early phases of a product development process. Further, they suggest to use them effectively requires collaboration amongst people with different skills sets and taking an increased focus upon the supply chain. Alves and Nunes (2013), find similar tools within service design and also identify a gap upon integrating the supply chain focus. Yet, Taticchi et al. (2015), who review supply chain decision-making tools find few adequately support connections between supply chain decisions and product design, performance or business strategy across stakeholders. They state decision-makers need tools that aid a holistic approach towards overcoming disadvantages of traditional trade-off approaches, whilst bringing a focus on stakeholders, understanding relationships, and crucially value flows and customer needs.

Vezzoli et al. (2015) investigate the development of sustainable product service systems (PSS), whereby they find that a key challenge is the design of novel stakeholder interactions and creating cyclical testing using tools to co-create value. Here, Fernandes et al. (2020) review into approaches for CE oriented PSS advance the increased importance on integrating different stakeholders views (commonly through visualisation tools) to overcome increased complexity and uncertainty held within a circular approach to aid decision-making. Further, they highlight that tools intent on the development of collaborative systems of stakeholders needed to design shared value systems that go beyond customer value.

They, however, indicate these are limited and such a collaborative approach within tools is in its infancy.

Systematic reviews by Pieroni et al. (2019) and Bocken et al. (2019) that investigate sustainable and circular business model innovation tools show many explore value using the 'building blocks' proposed within Osterwalder's (2010) business model canvas. Here, Pieroni et al. (2019), notes that tools designed for sustainable and circular business model (re)design are increasingly built using the activity systems perspective proposed by Zott & Amit (2010). Focus is drawn to what interdependent activities and capabilities, from across company boundaries, should be performed, how they are linked, who performs them, and how they can be (re)configured to create new value (Zott & Amit, 2010). This promotes a collaborative view needed for sustainability by considering multiple stakeholders throughout the innovation process. Yet, Tyl et al (2015) highlight within their review that the process to identify stakeholders is not always explicit and commonly lacks guidance on how to integrate potential stakeholder value into the early ideation and design stages. They state few tools assess stakeholder value, other than the value mapping tool (Bocken et al., 2013) and social stakeholder business canvas within the triple layered business model canvas developed by Joyce et al (2016).

To manage the complexity and uncertainty within COI processes many researchers have proposed specific frameworks, tools, or methods. These include aspects on rethinking complexity in CE (Velte et al., 2016), circular design competencies (Moreno, De los Rios, Rowe, & Charnley, 2016; Sumter, de Koning, Bakker, & Balkenende, 2020), behaviour change (Wastling, Charnley, & Moreno, 2018) or consumer engagement (Sinclair, Sheldrick, Moreno, & Dewberry, 2018). Other researchers explore the combination of design and business model strategies (Bocken et al., 2016) and the development of circular PSS (Blomsma et al., 2019; Pigosso & McAloone, 2016). Similarly, many researchers have deep-dived into circular business model innovation and experimentation processes (Bocken et al., 2018; Geissdoerfer et al., 2018; Guldmann et al., 2019; Nußholz, 2018; Weissbrod & Bocken, 2017). Here, the need for increased collaboration is clearly identified. Collaboration is focused on by Witjes & Lozano (2016) who explore collaboration within procurement and Leising et al., (2017) who investigate collaborative supply chains. Yet, their approaches do not provide practical guidance on how to identify partners or integrate different perceived values of potential collaborators to model collaborative value in early COI. Work on collaborative circular business models by Kraaijenhagen et al. (2016) states the need to identify

partners and offers a range of questions and proposes plotting answers in a matrix (p.70-71) to start thinking about potential interests before engaging them. Yet, this approach does not explore the benefits of collaborative ideation. Further, Bocken et al. (2019), argue still many specific circular tools are not used, due to increased complexity, required resources, or being too context-specific.

5.3.1. Collaborative ideation tools, methods and process development

Tools designed to support sustainable or circular innovation processes can incorporate knowledge from more generic tools, innovation approaches, and different disciplines. Notably, researchers have started to draw together Design Thinking, Lean Experimentation, and Effectuation to offer support to collaborative ideation within highly uncertain innovation processes, such as COI (e.g. Baldassarre et al., 2017; Bocken et al., 2017; Bocken & Antikainen, 2018; Geissdoerfer et al., 2016; Guldmann et al., 2019). These different approaches are presented below.

Design thinking is seen as a way to ideate (the process of forming new ideas, concepts or images) within contexts of high uncertainty or even wicked problems (Micheli, Wilner, Bhatti, Mura, & Beverland, 2019; Von Thienen, Meinel, & Nicolai, 2014). It integrates different perspectives and matches users' needs to what is feasible and viable by combining analytical and intuitive thinking to generate novel ideas that create market opportunities (Brown, 2008). This is done through creatively reframing the challenge and empathic thinking. The aim is to overcome existing practices, challenge assumptions and explore uncertainty through co-creating experiments (Elsbach & Stigliani, 2018; Tschimmel, 2012). Collaboration with stakeholders is central to gaining wider perspectives on a problem or assessing potential needs (Elsbach & Stigliani, 2018; Micheli et al., 2019; Tschimmel, 2012). Needs can be brought into the thinking process either directly by engaging stakeholders or indirectly by empathetic sensemaking activities (Beverland, Micheli, & Farrelly, 2016). Chasanidou et al. (2015) indicate it is the identification and mapping of key stakeholders, their relationships, and needs that are essential to identify new insights or future actions. Design thinking tools and methods such as brainstorming, mind-mapping and visualisation create 'conversations' and support synthesis of insights by mapping a situation, problems or ideas to then explore new combinations (Micheli et al 2019 & Tschimmel 2012). Elsbach and Stigliani (2018) find that such hands-on creation of physical artefacts (filling in of a canvas, drawings, sketches,

concept prototypes) and the emotional experience (surprise, delight, increased empathy) of conducting design thinking reveals to users specific values, norms, and assumptions that support creativity and in-turn can aid organisational change to increase the value of experimentation and active learning.

Experimentation is a trail-and-error problem solving process that generates insights when information is non-existent or unavailable (Thomke, Hippel, & Franke, 1998) by using approaches such as 'probe and learn' (Lynn et al., 1996). More recently Lean Start-up's 'build, test, measure, learn' process is used to quickly test new ideas within practice (Ries, 2011, 2017). A lean experimentation approach has been popularised and increasingly used within a business context (Bocken & Snihur, 2020; Felin et al., 2019). The logic is to ideate, test variations, validate learning through experimentation and pivot if needed. These approaches have been integrated within design thinking through participatory workshops (Geissdoerfer et al., 2016b), and iterative user-testing (Baldassarre et al., 2017). The aim is to assess the desirability of value propositions (for different stakeholders), the viability and feasibility (Brown, 2008; Calabretta et al., 2016). Such an iterative process can refine abstract sustainability ambitions, ideas, values, and visions into concrete actions and can be used to model potential collaborative value (Baldassarre et al., 2017; Geissdoerfer et al., 2016b; Pieroni et al., 2019). This is important to understand whether the idea is scalable and would still meet the intended sustainability challenge (Brown et al., 2019; Manninen et al., 2018). Each step in such a process can and should be supported by specific practices with stakeholders to develop concrete actions that advance ideas and learning (Bocken et al., 2019; Geissdoerfer et al., 2016). Key tools and methods from lean experimentation can be the use of experiment cards, A/B testing or simple website mock-ups. These can be combined within a design thinking process and categorised as tools that support; 1) need-finding, 2) idea generation and 3) idea testing (Bland & Osterwalder, 2019; Elsbach & Stigliani, 2018). A review of collaborative ideation tools by Peters et al. (2020) identifies that analogue (non-digital) tools dominate the early idea generation stages, due to their ability to support quick, flexible, and low-cost ideation to understand and align on a context or future scenario. They show that card-decks and toolkits (e.g. worksheets, canvases, or templates) that incorporate prompts (e.g. trigger questions) or concepts (e.g. short descriptions of theory) are the most common collaborative ideation tools. These act as physical artefacts, combining visualisation

and mapping within a design thinking process to develop lean experiments (Bland & Osterwalder, 2019; Bocken et al., 2018; Geissdoerfer et al., 2016). Within such activities, the intensive use of post-its supports emergent idea generation by allowing participants to think more flexibly (post-its can be moved or removed) and radically (ideas can be added and combined quickly); but the workshop design should include periods of self and group reflection to allow participants space to diverge and converge (Micheli et al 2019 & Tschimmel 2012).

Effectuation proposes a 'resource-based' view that assesses what is available to create collaborative action (Sarasvathy, 2001). Effectual logic is counter to traditional innovation pursuits that extensively evaluates opportunities before actions to innovate products or services (Fisher, 2012; Sarasvathy, 2009). The focus is upon a decision-making logic towards assumption testing via experimentation using available means and immediate actions, so if ventures fail they do so early and at a lower cost (Fisher, 2012; Sarasvathy, 2009). Chesbrough (2010) advises using an effectual approach to conduct business experimentation in high uncertainty, due to the emphasis on action over analysis. Effectual logic starts from available means and is led by affordable loss principles instead of expected returns; it leverages relationships over competition and intends to uncover possible opportunities held within uncertainty, whereby goals are emergent and shaped over-time through interaction (Sarasvathy, 2009). Effectuation promotes five core principles (Sarasvathy, 2009) these are: 1) the bird-in-the-hand (use available means) focusing action on what can I do with what I have, 2) affordable loss (what can I accept to lose), 3) crazy-quilt (stakeholder commitments expand means and shape the enterprise), 4) Lemonade (leverage uncertainty and exploit unexpected opportunities), and 5) the pilot-in-the-plane (actor agency shapes the future). Sarasvathy et al 2013 indicate that an effectual process is a dynamic and double-loop process. Firstly, expanding available means by engaging new actors to commit resources. Secondly, self-selected actors incorporate their knowledge, ideas and desired pursuits that require converging on goals. This effectual process is represented in Figure 10.

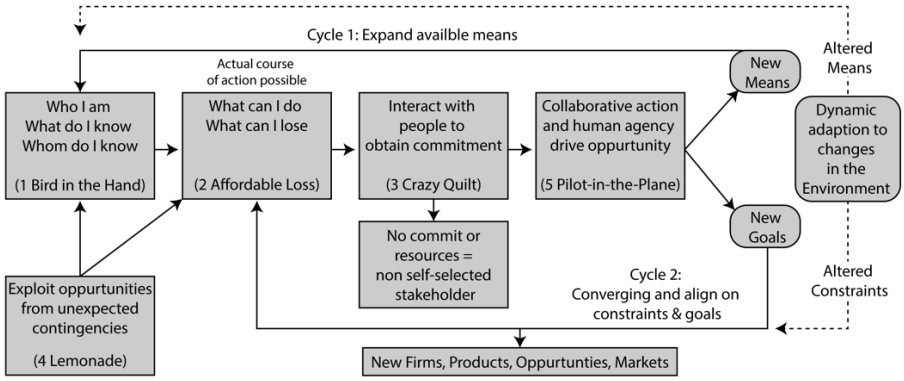


Figure 10. *Effectual Process. Authors visual based on Sarasvathy (2013; 2009)*

York et al. (2016), explore the use of the effectual process and logic by sustainable entrepreneurs. They find an entrepreneur's identity and focus upon commercial and sustainability logics can result in differing priorities that affect how they approach stakeholders. A more commercially oriented entrepreneur can be more open to stakeholders, but the focus is on economic incentives, profitability and viability; sustainability is the ancillary bonus. A more sustainability-oriented entrepreneur can be more exclusive, less open, and fear 'selling out' to corporates. Those that have a balanced orientation tend to be more synergistic, create more flexibility and appeal to all stakeholders (commercial or sustainably focused) to increase self-selection opportunities through stakeholders seeing co-creation options and value. Keskin et al. (2020) investigate how sustainable entrepreneurs use different logics to advance different tasks within sustainable ventures. If focused on a long-term and pre-defined value proposition (e.g. to sustainably adapt a specific market or customer experience) it is common to use an adaptive approach (more linked to causation). This uses longer-term and high-fidelity experiments (e.g. working prototypes) to test the technical performance, feasibility, and viability of the pre-defined value proposition; but rarely explore changing it. If focused on the search for different value propositions entrepreneurs use short-term and low-fidelity design experiments (paper prototypes or models), that engage different product concepts, customer segments, and stakeholder engagement. Here, the self-selection process aims to co-develop the value proposition through an exaptive approach (more linked to effectuation).

Souza et al. (2019) and Mansoori and Lackeus (2020), through their reviews into innovation and entrepreneurial approaches, build on this idea of combining or varying approaches. The latter explored different academic and practice-based approaches via assessing their logic, models, and tactics to indicate alignment and differences. Both argue practice-based approaches (such as designing thinking and lean experimentation) are more widely used in practice since they provide practical tactics and guidance to advance ideas. Whereas, academic approaches (such as Effectuation) offer fewer tactics and so can be difficult for practitioners to understand. Further, they indicate that an interesting area to advance the integration of academic approaches into practice can be through combing them with practice-based approaches. They propose effectuation can instigate innovation activities. Then design thinking and lean processes can guide practitioners to make their ideas more tangible and provide actionable steps. Whereby, the different approaches could be complementary over-time as the level of investment increases as an idea or start-up progresses. Such an integrated approach has been explored by Bocken et al (2017), but not within the development of a specific tool. Souza et al. (2019) and Mansoori and Lackeus (2020) also identify that while stakeholder interactions are crucial to effectuation, design thinking and lean, especially in the early stages to identify real problems, needs and potential solutions; yet, how to identify, integrate, and initiate stakeholders engagement within such a process are under-researched.

5.4. Research gap

Conducting COI means to integrate collaborative processes and value flows to ideate upon and design a circular proposition. Our review of sustainable and circular tool development literature indicates that COI is difficult because it is uncertain and complex, requiring collaborations to overcome this. Yet, there is a knowledge gap on how such collaborations can be supported. Specific gaps relate to the lack of relevant tools to support it and the need to integrate concepts like effectuation, design thinking and experimentation.

Firstly, Pieroni et al. (2019) state within tool development there is a lack of focus upon collaborative ideation to model and co-create value beyond customers to incorporate upstream, downstream and wider stakeholders such as the environment or society. Sustainable tool design principles and process-related criteria presented by Breuer et al. (2018) highlight this should be a minimum requirement; to include context-sensitive

externalities (traditionally outside the business model) and case-specific stakeholders. They argue this is essential to conduct collaborative modelling of value. Fernandes et al. (2020) advance this gap stating circular tools need to identify, integrate, and prioritise the needs, problems and perceived value for stakeholders; and to identify ways to collaborate to co-experiment with different value configurations. They argue the design of the circular proposition and the system design (developed through collaboration) are still largely being considered independently. They propose to integrate these through combining process models and visualisation approaches to aid the modelling of perceived value within a system. Yet, in COI due to the complexity of complementary connections within a circular proposition (the product design, business models, and value networks arrangements to facilitate recovery) this increases uncertainty.

Secondly, this increased uncertainty lends itself to combining effectual, design thinking and lean experimentation concepts into the development of an analogue tool for collaborative ideation to integrate and maximise their advantages. Developing such a collaborative ideation tool could decrease the uncertainty, orientate and inspire, but also resolve conflicts, align interests and produce tangible action planning and experimentation. Aligning interests is an act of finding balance, hence ideas need to be crafted to find or enhance synergies or overlaps between stakeholders (Keskin et al., 2020; York et al., 2016). This may require reframing or shifting sustainability goals or engaging different partners to improve market and/or sustainability performance (York et al., 2016). Thus a tool should be flexible and adaptable to support entrepreneurs (Breuer et al., 2018; Keskin, 2015). Moreover, to overcome the theory-practice gap for tool use Breuer et al. (2018), Pieroni et al. (2019), Bocken et al. (2019) and Mansoori & Lackéus (2020) propose the integration of approaches to advance systemic thinking, the ability to ideate and craft collaborative value and align the stage of the ideation to the approach used. Lastly, our review into tools shows none are specifically designed and tested to support ideation to identify partners and integrate perceived values into the early crafting processes for circular proposition design.

5.5. Research Design

This section briefly introduces design science research, the workshop format, demonstration contexts, and the data collection and analysis.

5.5.1. Design Science Research

Design science research (DSR) bridges theory and practice by designing and validating artefacts (that can include conceptual frameworks, models, and tools) using a pragmatic problem-solving and iterative approach to explore solutions to unsolved business problems (Hevner, 2007; Hevner & Chatterjee, 2004; Peffers et al., 2007; Romme & Reymen, 2018). DSR has been applied to entrepreneurship challenges engaging innovation phenomena and has proven valuable to structure scientific research, codify practice knowledge, and integrate theory into useable artefacts (Romme & Reymen, 2018; Van Aken & Romme, 2009); notably within Osterwalder's (2004) academic research, which led to the business model canvas (Osterwalder & Pigneur, 2010).

We chose DSR methodology, due to its structured and rigorous approach towards tool development. The use of DSR to develop our tool is visualised in Figure 11. The DSR design and validation process incorporates iterative evaluation and redesign of an artefact to increase usability, quality, and efficacy (Hevner, 2007; Romme & Reymen, 2018). Peffers et al. (2007) promote an iterative process (incorporating six steps see Figure 11) with the need to demonstrate the artefact within a suitable context (with users) to evaluate how the artefact is used and whether it is successful. In the first step Van Aken and Romme (2009) add a literature review and synthesis of available artifacts to identify gaps, aid ideas, and highlight possible solutions to be integrated into the new artefact. To support evaluation (step 5), Peffers et al. (2012) identify a range of suitable quantitative and qualitative evaluation methods. We use ethnographic observations of use, feedback forms and interviews or discussions at the end of the workshop with users to evaluate the perceived usefulness and ease-of-use of the tool (Davis, 1989; Venkatesh, Morris, Davis, 2003). Additionally, the researchers who facilitated the workshop also reflect and brainstorm upon design and facilitation improvements between each session; based on their observations, experiences, and field-notes. Each design-demonstration-evaluation cycle aims to improve the tool's design or facilitation. This approach is consistent with the circular business model innovation tool development checklist proposed by Bocken et al (2019), whereby tools should be purposively and rigorously developed (integrating literature,

practices, and knowledge from different disciplines) and evaluated with users.

The literature review and tool synthesis identifies an unsolved problem: COI tools do not explicitly focus upon partner identification or collaborative value when designing a circular proposition, although this is crucial. Our objective is to develop a tool that supports COI partner ideation and identification and to map and visualise collaborative value to aid the design of circular propositions and promote tangible and actionable next steps. This study communicates data on the 3rd design iteration of the tool, which is demonstrated through six workshop sessions with practitioners and CE researchers (see dotted line in Figure 11).

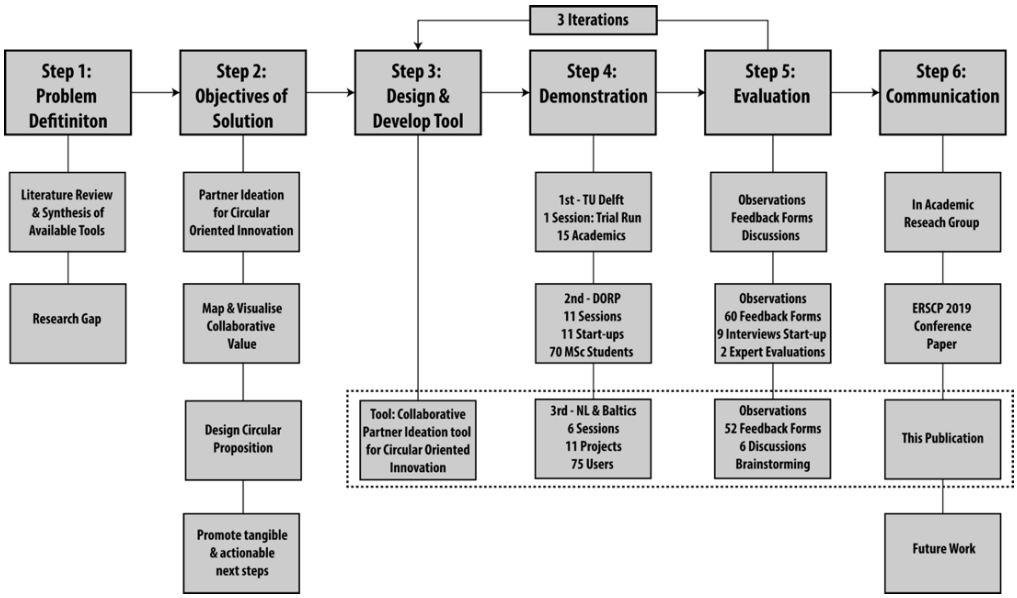


Figure 11. *Tool Development Process undertaken based on Design Science Research iterative design approach (Hevner, 2007; Peffers et al., 2007; Van Aken & Romme, 2009).*

This publication communicates the 3rd cycle of design, demonstration and evaluation (represented by the dotted line within figure) – See Appendix H for an overview of the DORP innovation festival & Appendix I for an overview of tool design iterations.

5.5.2. Workshop Structure & demonstration contexts

The demonstration workshops follow the same overall structure. Before the workshop demonstrations begin, participants have filled in an in-take form (Appendix J) to understand specific user challenges or CE ideas. Each team forms to then work on a live project brought forth by challenge owners who are active participants within the workshop. Challenges were identified from the in-take form (Question 4), whereby participants self-selected into groups based on their own interest or desires to work on the project. The locations, participants, and project focus are displayed in Table 17. The identified CE challenge is used in teams of 5-7 participants within a 2-hour workshop (before using the collaboration tool) that uses a card-deck to educate and help understand circular innovation strategy combinations (Konietzko et al., 2020). The output from the card-deck are initial ideas for circular propositions, presented within 'Circular Pitch' templates (Appendix K).

The proposed timeline is presented in Figure 12 (see Figure 13 collaboration canvas in section 5.6 to understand sections of the tool). Each team selects an idea to advance using the canvas. How to use the canvas is explained and then teams use it, while being facilitated. Once the sections have been completed the researchers, who are facilitating, re-issue the 'Circular Pitch' and provide the 'Action Template' (Appendix L). These are to aid users to distil insights from the canvas, craft their circular proposition, and plan initial actions. At the end of the workshop feedback forms (Appendix M) are issued and subsequently a discussion is conducted on the experience of using the tool (see Appendix G workshop protocol). We were not able to collect all feedback forms from all participants, since some users needed to leave the workshop demonstration early.

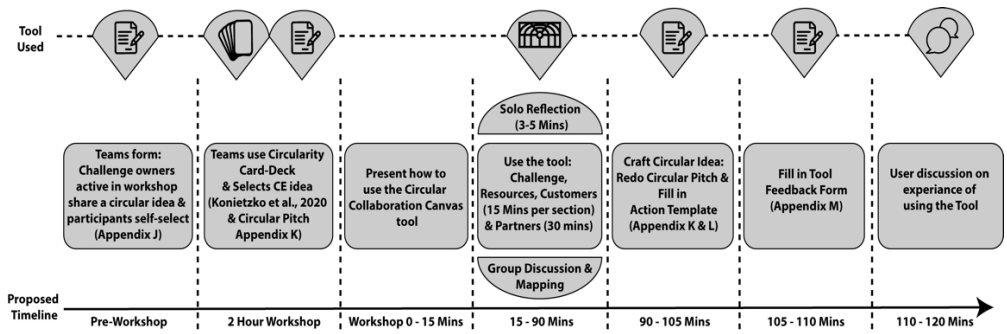


Figure 12. *Proposed Timeline of Workshop Activities*

Table 17. *Overview of Demonstration Workshops, Participants and Project Focus*

Work-shop	Location	Participants Background	Number of Participants & Groups	Teams Focus in Workshop Demonstration
1	Netherlands: Amsterdam company location	Mixed professionals (design, procurement, and business strategy) from large Dutch Multi-national	10 & 2	Both groups explored new circular business models for high-end consumer beauty products
2	Germany: Hamburg Impact Hub	Start-ups, Entrepreneurs and PhD researchers	15 & 3	Built Environment - Modular partition wall system Zero waste biological plastic packaging Circular Textiles and Fashion
3	Latvia: Riga Conference	Start-ups, Entrepreneurs and Innovation Managers	14 & 3	Toxic materials in sealant for insulation windows Reuse of materials from built environment Creating modular and repairable multi-season clothing

4	Finland: Aalto University	Professors, PhD and MSc researchers working on a Large Finnish CE Textile Project	12 & 3	All Groups explored challenges linked to the Finnish textile project, but separated to explore different aspects
5	Finland: Aalto University	Innovation Managers, Sustainable and CE Consultants, PhD and MSc researchers	12 & 2	Built Environment focus upon a circular building Explored Finnish textile project
6	Finland: Lappeenranta University of Technology (LUT)	Lappeenranta Regional Innovation Director, Directors of International Welding Company and Professors, Post-Doc and PhD researchers focusing on circular	12 & 2	Focused on the region of Lappeenranta built environment challenge to maximize use of existing building stock New product and service models for the welding company

5.5.3. Data collection

Data is collected during the workshop by researchers making field-notes and observations on the use of the tool and required facilitation. The researchers also collected insights from the filled-out tools, the circular pitch and action templates (Appendices D & E). Tool assessment forms are filled in (Appendix F). Forms included a Likert score of 1 (do not agree at all) to 7 (fully agree) assessing perceived usefulness and ease-of-use (F. D. Davis, 1989; Venkatesh et al., 2003). Space was provided to discuss the users design recommendations, learning and insights, and explain whether their idea had changed through using the tool. The

researchers also facilitated a group discussion at the end of the workshop session to further discuss the use of the tool (Appendix N).

After the workshop the primary researcher reviewed the feedback forms. Then the two researchers (Author 1 & 3), who facilitated workshops consolidated their observations, field-notes, and insights to brainstorm potential design or facilitation improvements (Appendix N). The focus was drawn to: 1) the order and actions users undertook, 2) discussion points raised around perceived usefulness or ease-of-use, and 3) direct questions, comments, or reflections from participants that raised challenges or improvements. These notes formed key insights into the perceived usability and ease-of-use that prompted recommendations and iterations between workshop sessions to improve the tool.

5.6. Tool development process

Tool development is an iterative process, which in this study represents six design-demonstration-evaluation sessions, previously shown in Figure 11.

5.6.1. Initial Tool Tested

The purpose of the tool is to identify and ideate upon value for stakeholders and partners. The tool incorporates an underlying logic of visualisation and integration of stakeholder perspectives beyond the company within ideation (Bocken et al., 2013; Short et al., 2013). The tool presents a canvas that uses trigger questions presented within key topics; Challenge, Resources, Customers, and Collaborative Partners. The logic and trigger questions are derived from; effectuation (Sarasvathy, 2009), customer pains (Bland & Osterwalder, 2019; Osterwalder, Pigneur, Bernarda, & Smith, 2014), and collaborative partnerships for sustainability (Gray & Purdy, 2018; Gray & Stites, 2013). These are used to generate ideas using design thinking practices (Brown, 2008; Elsbach & Stigliani, 2018; Geissdoerfer et al., 2016) to identify and balance partner synergies (Keskin et al., 2020; York et al., 2016) and explore perceived value (Breuer et al., 2018; Fernandes et al., 2020). Effectual trigger questions can include: 1) personal knowledge (who am I?, what do I know?), 2) skills (what can I do?), and 3) social networks (whom do I know?) (Sarasvathy, 2009), these are adapted and integrated into the tool, see Figure 13 (see Appendix B for previous tool design iterations).

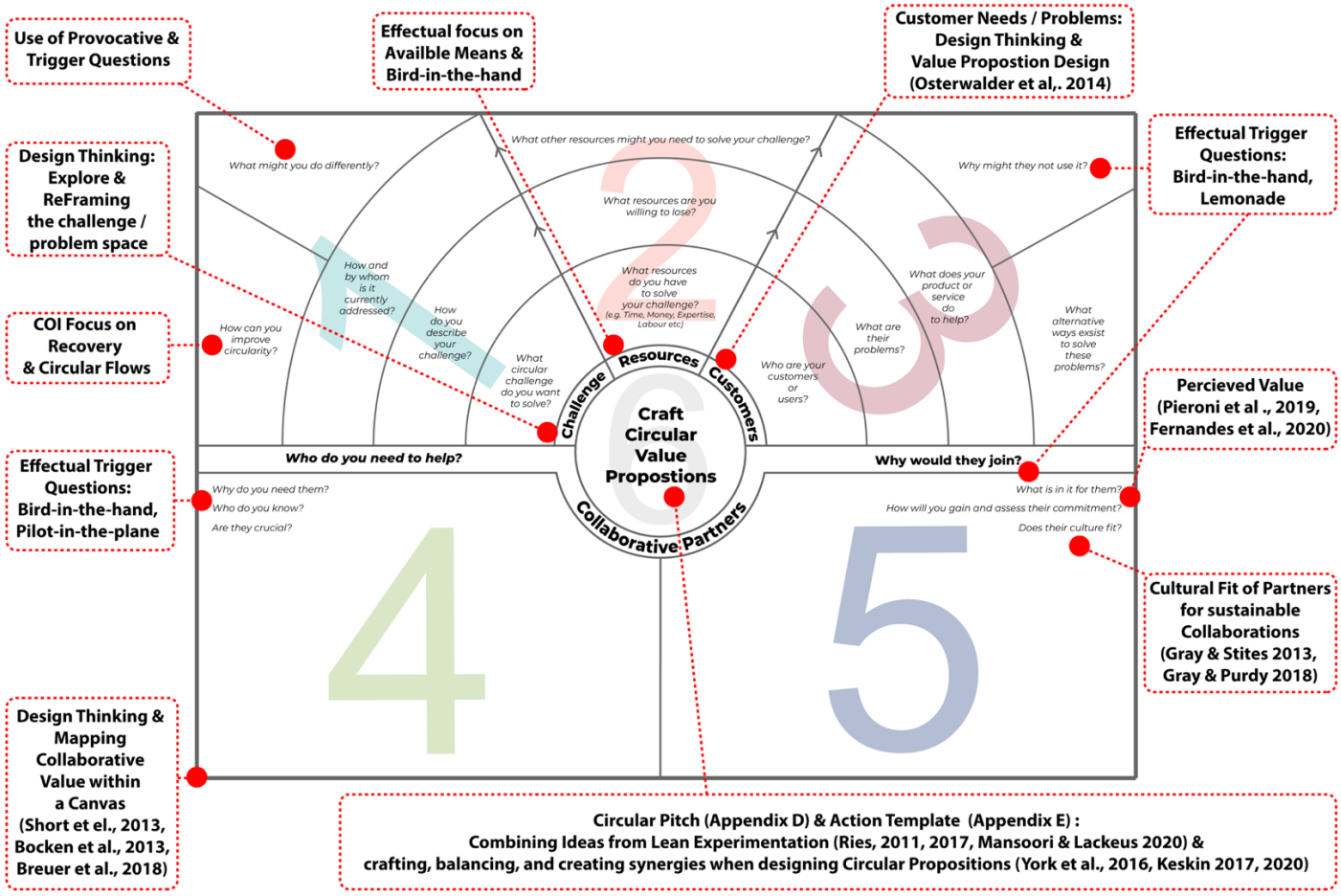


Figure 13. *Tool Demonstrated in Netherlands and Baltic: Plus descriptions of tool design & logic*

5.6.2. Demonstration and Evaluation of Tool

This section presents the results from the workshops. Figure 14 shows examples of workshop sessions, each represents a design-demonstration-evaluation cycle. Firstly, user ratings and insights from the feedback forms are presented. Subsequently, the tool is evaluated based on observations, facilitators field-notes and user discussions. Finally, an example of the use of the tool is provided presenting the outputs produced by the LUT Lappeenranta city team.

Figure 14. *Examples of the tool being used within demonstration contexts*

5.6.3. Feedback Form Results

Feedback form results are presented in Figure 15 and Figure 16. User scores across the 6 workshop sessions (total of 52 evaluations) indicate that the tool is useful (average score: 6/7; standard deviation: 0.71), but the ease-of-use is rated less highly (average score: 5.6/7; standard deviation: 0.88). User scores show an improvement as the workshop sessions progress. This indicates that the design-demonstration-evaluation cycles and tool edits and facilitation adaptions between the workshop sessions have improved the user experience, usefulness and ease-of-use of the tool. Example comments from feedback forms are provided in Appendix O

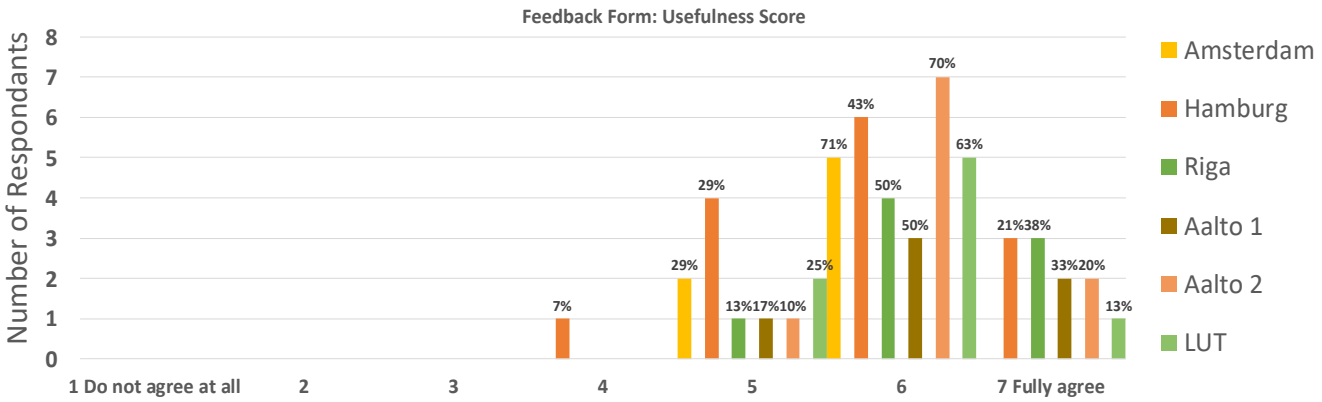


Figure 15. *Usefulness rating for the Tool*

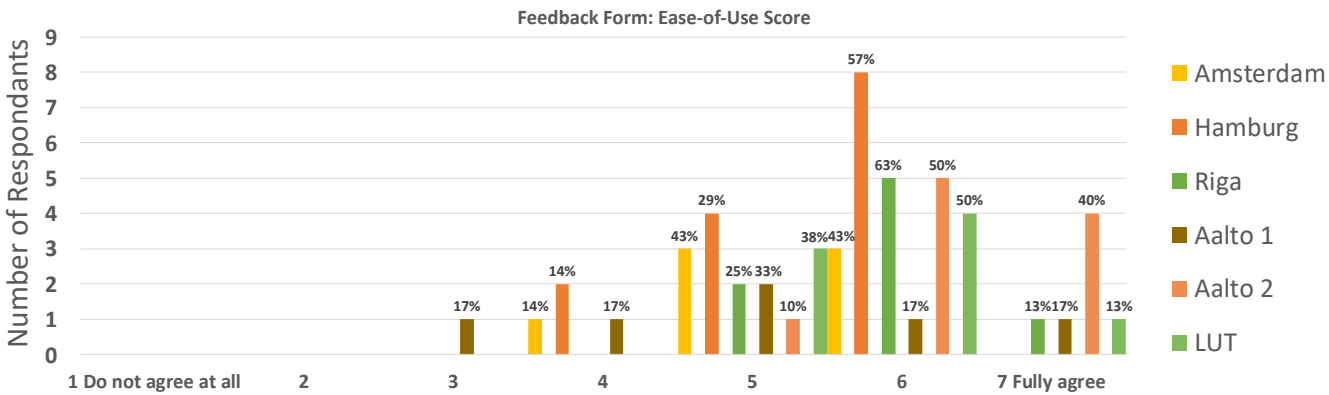


Figure 16. *Ease-of-use rating for the Tool*

5.6.4. Insights from observations, field-notes and discussions

Observations and user discussions highlighted the value of the tool. A common question across the workshops was whether the users could receive the canvas to use for other projects. One Hamburg user asked *"Can we use it with our partners or are you going to protect it and commercialise it? This is a really good first step to making your idea more relevant and workable".* Another user at Aalto stated *"I should really get my colleagues to use this as it is very useful and we need this type of thinking".* This indicates that users already assess that the tool offers professional level insights. Our further evaluation of the tool highlights four key insights into the use and design of the tool, which are corroborated through observations and user discussions. These relate to: 1) the workflow and topics, 2) Use of trigger questions, 3) Use of mapping and visualisation, and 4) the complexity to craft circular propositions.

1) Workflow of the tool

Groups across the workshop demonstration sessions were observed initially following the proposed workflow of the tool. The customer section required most time and needed investigation before the partner section. Another element presented for how to use the tool was to initially use self-reflection on the questions and then group discussion. Groups however approached this differently. Groups in Amsterdam, Hamburg, Riga and Lappeenranta followed this approach, but commonly assigned one member to read the questions and act as scribes within group discussions. Yet, Aalto 1 and 2 created subgroups to explore different sections separately, then groups would switch sections. Subsequently, they held group discussions to brainstorm content, consolidate inputs and ideate together. In this way, they could build upon each other's input to advance ideas. Finally, in one group in Lappeenranta, with a mix of professors and company representatives, the academics used the order of the questions to engage the company within a more consultancy style approach. This signifies who is present within the group can change group dynamics. It was noted that the professors challenged the company to keep the focus on the circular recovery elements throughout to support more radical ideas. This was also raised as a common challenge by others when using the tool. These different approaches were shown to work and within group discussions users stated a preference for balancing between the structured and more open approaches towards using the tool.

2) Use of Trigger questions

Observations throughout the workshops highlighted how the trigger questions were received well and generated quick answers and stimulated discussions. These aided rethinking or advancing the idea to become more realistic. Trigger questions were adapted throughout the workshops to improve them (see examples in Table 19). One such recommendation from Hamburg was to change 'what are you willing to lose' to 'what are you willing to invest' to better position and frame it, especially for start-ups who do not normally have a lot of resources. Later workshop observations and discussions highlighted fewer challenges were related the trigger questions. One Amsterdam user stated *"I like the use of the questions, it forces you to make really tangible outputs"* and one Riga user in the discussion stated *"the questions make you think much deeper on your idea, but can also create lots of unknowns or things that are not clearly defined yet, which is good as these are things you need to work on".* Other users agreed and referenced the need to adapt some questions to capture these elements. User discussions within the Hamburg and Aalto workshops advanced this stating the need for new questions to aid thinking about reasons or stakeholders who might oppose the idea and to create questions that engage potential challenges that arise while going through the tool. Users also discussed circular oriented questions were needed throughout to maintain the CE focus.

3) Use of canvas, visualisation, mapping, and design thinking workshop

Observations showed the users found the canvas valuable. They enjoyed the mapping, visualisation and group work approaches, which aided their ability to learn about and from each other. Many users referenced similarities to the business model canvas, but felt this tool provided more detail and forced you to produce more concrete ideas, due to the need to think deeper via trigger questions. Additionally, many groups used the canvas as a pitching tool. Most notably the groups in Amsterdam used the canvas to pitch their ideas to external supervisors directly after the session. Hamburg, Riga, and Aalto workshops all highlighted how the visualisation and design thinking workshop really worked for quickly bringing the group together and exploring the innovation challenges. Additionally, the use of the 'Circular Pitch' and 'Action templates' were discussed as a good way to bring the visualised content and discussions generated into tangible next steps. One user within Hamburg stated *"I want to use more tools like this, it is a great way to create better ideas"*.

Whereas a Riga user stated the visualisation and mapping was *"good for deepening our understanding and answering in groups helps to gain other types of thinking that help you make the ideas better"*. One user in Lappeenranta advanced this by stating how *"the canvas really helps you have a discussion as it acts as a physical object with the trigger questions that start conversations and discussions. This is especially important here in Finland where people are less conversational"*. This highlights how such an approach has properties that allow for and can cope with cultural sensitivity. Finally, a common discussion across workshops was the desire to gain further exposure and experience with the use of such tools.

4) Crafting the circular proposition

A common theme from observations and group discussions was the increased complexity experienced when crafting the circular proposition. Observations and discussions highlighted two main outcomes from the use of the tool for ideation.

One was to deepen their idea and the reality for how to build it. Within the Riga discussion a user stated "things were much more positive when using the cards [previous workshop], you can just put forward ideas. Now we have to make the idea more realistic. This is much harder and challenging, but good as it creates a reality check for your idea". Here, an Aalto workshop user stated "it feels like a puzzle that you have to try find all the pieces through using the tool to test whether the idea makes sense. It is something you could do a couple of times and play around with different combinations to come to some really solid ideas". Another group member stated "We came up with a really good idea and know who to contact, why and what we might offer them". Similarly, groups in the Amsterdam, Riga, Aalto and Lappeenranta stated that they would take ideas generated from the tool to colleagues to discuss further and the use of the tool had provided insights into a list of assumptions and areas that needed to be worked on. One group in Riga operating within a specialised market, with few competitors, realised that their challenge was legislative. This produced the idea that working with their competitors could reduce research and development costs, since all were required to meet the new material toxicity requirements. The user indicated they would communicate it back to the board of their company to explore this option. The Amsterdam groups, took a different approach: since both teams were from the same company they decided to use the tool to develop a short-term plan and generate a longer-term vision and strategy. Outputs from

this approach were the planning of small-scale experiments to test ideas and a longer-term partnership strategy with key actors.

The other outcome is the realisation that groups needed to pivot or adapt their idea. One group within the Hamburg workshop stated *"the more we go through this tool the more we realise our original idea is [sic: not very good!]"*. The group pivoted their idea from sourcing and supplying reused and bio-based textiles to build a platform-based market place where multiple organisations could sell bulk items for secondary material processing or processed materials ready for reuse to bring scale and promote textile reuse across industries.

5.6.5. Insights on outputs from the circular pitch and action template

Table 18 presents an example output from the workshop produced by LUT team who focused on the region of Lappeenranta built environment challenge. This provides insights into the actions planned via the workshop.

Table 18. *Lappeenranta city project: maximise use of existing building stock*

	Idea	**24 / 7 Public spaces - pilot focus Kindergartens**
Circular Idea Pitch (Appendix K)	Can do	Develop an app that enables reservations to access underutilised public spaces and buildings to fit users' needs e.g. using Kindergarten assets out of school hours.
	Improve Circularity	Maximise capacity of cities buildings. Narrows resource use, promotes sufficiency and reduces city / users need for new buildings
	This can bring	Reduced costs to city and users for community spaces. Share energy costs to run buildings. Aid loneliness, stress and time pressures on families in Lappeenranta. Help avoid waste of building capital and improves quality of life and sense of community

Action Template (Appendix L)	We need to find out	A) Which neighbourhoods are most suitable to survey B) If parents are interested in the idea and costs can be covered
	We can find out now by	A) Engaging municipality building managers to assess building availability: initial focus on kindergartens B) Engage potential users (teacher-parent associations, out of school clubs, sports clubs etc) living in neighbourhoods to assess needs
	We can get support from	A) Kindergartens in the specific neighbourhoods B) Contact Community engagement department in Lappeenranta City offices
	We know we are on the right track if	A) Actors in a neighbourhood agree to develop a pilot B) Desirability metric: 10/100 respondents are interested to participate in a pilot. Viability metric: assess additional costs and users willingness to pay. Do user payments cover additional costs. Circularity metric: does pilot result in reduced need for furniture and equipment purchases. Assess if use life of existing products is affected.

5.6.6. Updated tool

The main tool design and facilitation improvement points, their underlying rationale, and evidence are provided in Table 19 and integrated into the tool, shown in Figure 17.

***Table 19**. Main improvement points from demonstration and evaluation cycles*

	Improvement Point	Rationale	Evidence
	Tool Design		
1	Remove numbered order. Future assess if colours increase separation of sections	Users can dynamically use the canvas to increase ideation. Explore visual separation.	User discussion: appreciated initial order, but also later desired freer ideation approach
2	Adapt and order partner questions horizontally to identify potential partners and engagement strategy	Supports identification of partners and provides an easier ordering to answer questions	User discussion (Hamburg & Riga): how to improve partner section. Observations: showed improved partner identification
3	Action template add question: What do you want to achieve (Immediately, 3 to 6 Months, 1 Year, 1 Year +)	Question aids next step planning for users	User discussion (Aalto and LUT): how to improve output of the canvas
4	In future explore digital interface for the canvas	Support scaling the use of the approach via digitisation	User discussion and feedback forms (LUT)
5	Improve Trigger questions e.g. Add examples where users struggled & questions on circularity and recovery	Examples helped to fill in the tool. Focus on circularity and recovery avoided 'business-as-usual' ideas	Users required and desired increased CE focus questions and examples to be provided to advance answering the trigger question.
	Change "what resources do you have to solve your challenge?" to "what are you good at and	Reframed question focuses on users "who am I" and "What do I know" to	Users aided when prompted to think more directly upon their own skills,

	what do you have to solve your challenge?	increase engagement with effectuations principles	interests and what they have
	Remove “Are they crucial” and add “what are you willing to share with them?”	Increases focus on perceived value for partners and the type of collaboration available	User discussions for how to improve the use of the partner section
	Tool Facilitation		
6	Linked to design change 1: Present proposed order; but can be explored dynamically	Allows both structured and dynamic approaches	Observations: groups used the tool differently. Iterating between or splitting sections. Then aligning to ideate as group.
7	Encourage quick individual answers then group discussion to consolidate ideas	Individual ideation to increase number of ideas and ‘Messy’ ideation can be concretised using the tool	Observation and facilitation notes: Approach more effective for users to balance ideation / consolidation activities and advance more quickly
8	Encourage groups to select a scribe to capture outputs and moderator for discussions	Key discussion points can become lost if not written down: Linked to facilitation points 7	Observation and facilitation notes: Groups who appointed scribes and moderators recorded more discussion topics and translated more ideas to post-its
9	Highlight identified customers can also be partners	Depending on the project focus customers can be partners	Observation & facilitation notes: Some users struggled till

			prompted that customers be partners
10	Create a space within work area for assumptions, unknowns, or to do's	Supports advancing within tool & helps identify knowledge gaps, next steps planning or further work	User discussion & facilitation notes: when used in later workshops aided users
11	Ideal set-up: project canvas. If unavailable print canvas as large as possible	Allows increased space for ideas & gets people up and out of seats	Observation: when projected users more active Feedback forms and discussion: Requested by users in workshops without multiple projectors
12	Prompt: idea development and planning is done via circular pitch and the action templates	Allows users to focus on mapping & visualisation in canvas, then generate multiple ideas from content	Facilitation notes: Informing users helped separate mapping & idea generation activities. Templates supported creation of multiple ideas
13	Prompt: Assign numbers to identified partner & work sequentially numbering each	Helps users to later track partner development & identify answers to specific partners when moving to idea generation	Facilitation notes: prompt helped users

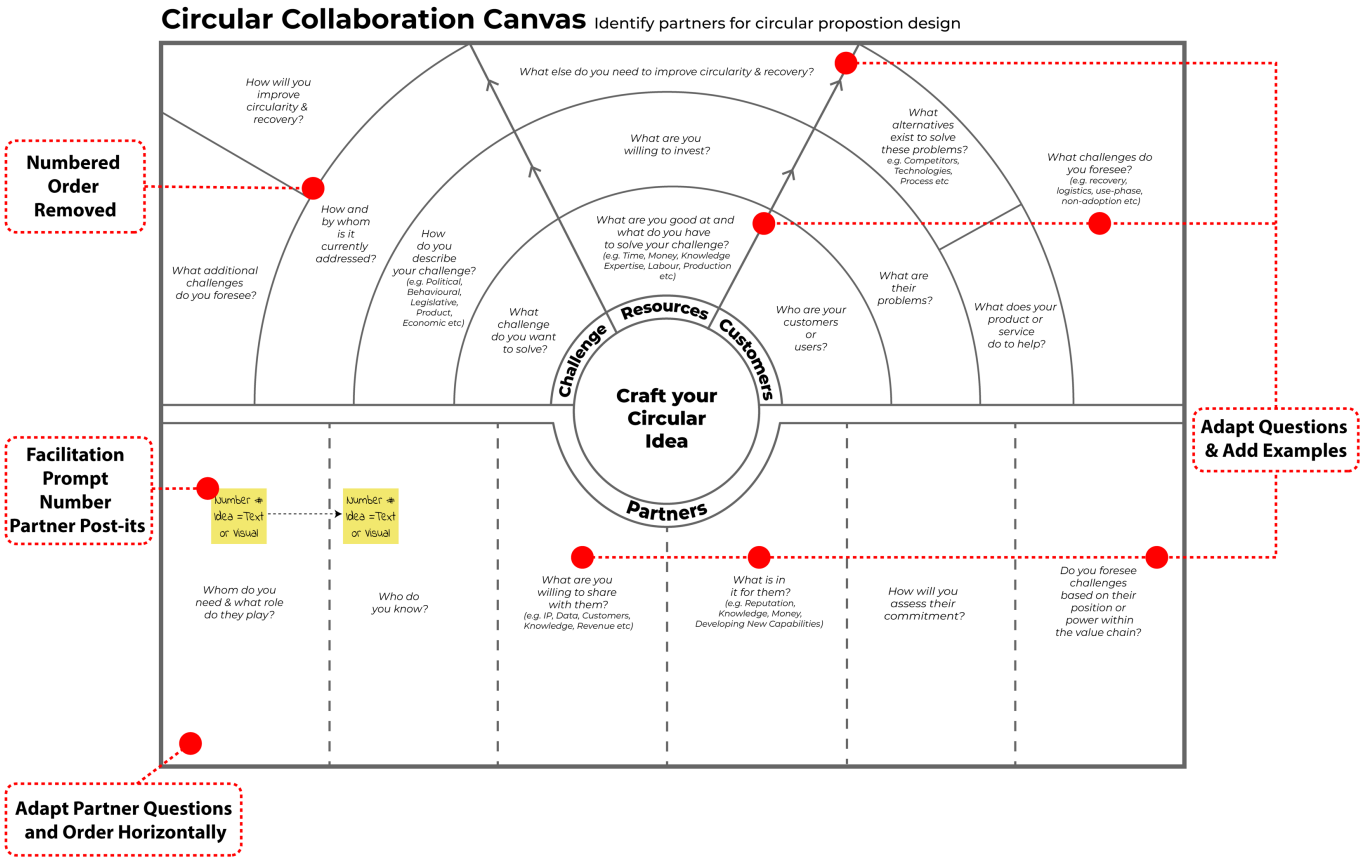


Figure 17. *Updated Circular Collaboration Canvas to identify partners for circular proposition design*

5.7. Discussion

This study has developed and tested a tool to support ideation to identify partners and perceived value to collaboratively design circular propositions to advance COI. Contributions, limitations and conclusions are discussed below.

5.7.1. Mapping and visualising to craft circular propositions

The demonstrations of our tool substantiates the literature findings that propose visualisation tools offer a good way to think and work collaboratively within the more abstract and creative ideation phase (Mansoori & Lackéus, 2020; Peters et al., 2020; Pieroni et al., 2019). The hands on mapping and visualisation, via a canvas, are found to help groups to share their knowledge and interpretation of a circular challenge (Elsbach & Stigliani, 2018; Micheli et al., 2019). Further, York et al., (2016) and Keskin (2015; 2020), propose sustainable entrepreneurs can engage stakeholders differently, based upon their orientation, when crafting a proposition to balance between the sustainability focus, the desirability for customers and feasibility to engage partners or the viability of developing the idea; our canvas supports this required openness, adaptability and perspective to finding synergies. This process supports users to develop scenarios based upon different challenges, customers, and partners. By providing discussion topics the Circular Collaboration Canvas Figure 17 acts as physical artefact to help users collect, share, explore and order ideas (Elsbach & Stigliani, 2018). Further, this supports findings from Badke-Schaub et al., (2007), into mental models across task, process, team and competence, show groups in co-design processes go through divergence and convergence to share mental models, ascertain knowledge that is present and to create a common understanding of both the problem and solution space.

This tool, once filled out, provides an overview that helps users uncover and identify assumptions within their thinking, potential challenges, resources, customers and partners needed to better understand the systemic nature of their circular proposition (Chasanidou et al., 2015). The process challenges users to think deeper and more systemically upon their circular proposition. Here, the use of the ‘circular pitch’ and 'action template' requires users to think about different ways to test the desirability, feasibility, and viability of their ideas. These identify future actions, tests and early insights into potential metrics required to explore

and add detail to the circular proposition. This integrates different approaches to advance the circular proposition and plans tangible actions. This supports with empirical evidence Mansoori & Lackéus (2020) and highlights wider integration could be valuable for tool development to overcome the theory-practice gap, notably proposed by Bocken et al., (2019) within their tool design development checklist.

5.7.2. Use of Effectual based trigger questions

Effectual-based trigger questions supported users to think deeper upon their circular proposition. The presentation of the trigger questions within the canvas directed and led user discussions. This helped them share their knowledge and work together to create a shared brain and narrative for how the circular proposition could work. The integration within an analogue collaborative ideation tools builds on Peters et al., (2020) and aligns with process-oriented criteria and contextual sensitivity for tools to allow contextual aspects to be explored (Bocken et al., 2019; Breuer et al., 2018). Furthermore, trigger questions stimulated users to (re)frame circularity challenges, use empathic thinking to bring in needs and perceived value for stakeholders, and to explore alternatives (Beverland et al., 2016; Micheli et al., 2019). This aids the crafting and design of circular propositions.

Trigger questions presented in the tool focus users on the desirability of their circular proposition to customers or users (‘what challenges do you foresee?’, ‘What does your product or service do to help?’), versus the feasibility of value creation and delivery ('what are you good at and what do you have to solve your challenge', ‘what else do you need to improve circularity & recovery’, ‘who do you need & what role do they play?’) and the viability of value capture (‘what is in it for them?’). This stimulated a more network-oriented and collaborative way of thinking needed to advance the circular proposition and triggered critical thinking around the activities (by whom) that would be needed. This engages with ideas held within the activity systems perspective (Zott & Amit, 2010). Moreover, considering partners by ‘what are you willing to share?’ and ‘how will you assess their commitment?’ stimulated users to think of their engagement strategy and produced discussions on perceived value for potential partners, building on the call by Fernandes et al., (2020). Such trigger questions were found to be valuable to provide a quick and low-cost practice to prototype and test ideas on paper. Asking the right questions to create insights can highlight assumptions or hypothesis that then

prompt potential experimentation routes to test ideas.. Aligning with work by Osterwalder on testing value propositions through experimentation (Bland & Osterwalder, 2019). Moreover, findings indicate the use of effectual-based trigger questions could be a promising approach to stimulate ideation for COI; beyond the current use displayed within this tool to ideate to identify potential partners and value flows. This finding advances the arguments presented within the literature for increased integration of content and rationale from wider disciplines into circular oriented tools.

5.7.3. Practical use of the tool

As a practical contribution, it was found that the mapping and visualisation approach supported users within the early stages of a COI process to create an initial shared vision for a circular project. This develops the proposition by Brown et al., (2020), who identified steps within the COI process that could be supported by specific tool development. Further, the approach of situating a specific tool along a process that uses a range of others tools to advance an idea aids users to overcome complexity and uncertainty within COI. This study showed that this tool has value for both practitioners (to deepen and explore a circular proposition) and educators (to teach the required elements of COI development). Two main outcomes from using the tool are: 1) to improve the initial circular proposition by adding detail (resources, customers, and partners etc) and, 2) to pivot or adapt the circular proposition based upon insights from mapping and visualising processes that indicated it was not feasible, viable, or desirable when bringing in the partner focus. Differences between the maturity and scope of projects were found: when the initial idea is clearer this improves the effectiveness of the tool. The tool is most useful when it is actively facilitated by an expert who is familiar with the background circular concepts to direct and challenge users to maintain a circular and recovery focus within discussions to avoid 'business-as-usual' ideas. Tyl et al (2015), find a similar necessity for facilitation to improve the effectiveness of sustainability tools and this advances upon the notion a knowledgeable expert acting as a 'circular conscience' presented by Brown et al., (2020). Finally, the increasing user scores (Figure 15 and Figure 16) indicates rigorous and iterative user testing supports improvements to the design, use of and guidance for how to facilitate the tool, which supports insights from Bocken et al. (2019) and tool development checklist they propose.

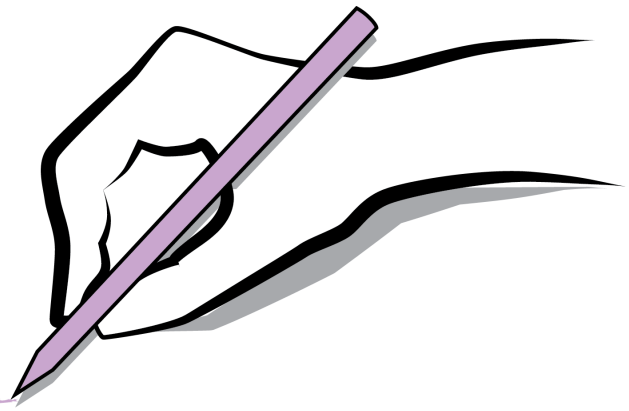
5.7.4. Limitations and future research

This study represents an explorative investigation into tool development for collaborative COI. As such, it holds limitations. Firstly, although the challenges used within the tool were active and brought forth by users, in the workshop the focus was on one challenge per group. We asked users to self-select into a challenge that was of interest to them, but these are not always their direct challenge or knowledge area. This is a slightly artificial setting: ideally the challenge would be shared by all users within a group. Also, since the users formed teams, this meant some time was spent on learning who is present within the team. In an ideal setup, users would share ownership of the challenge and have had some engagement time prior as a team. Secondly, limitations derive from data collection through an action-research approach, which included researchers facilitating workshops. It is acknowledged how this could lead to bias or prompt responses. We aimed to limit this by including multiple researchers collecting data from multiple sources.

Future research should repeat design-demonstration-evaluation cycles to improve the usefulness and ease-of-use of the tool. Advice is to explore, with a preference upon individual companies or existing professional groups who share a common challenge. Additionally, further testing variations in the scope of projects, users, or organisations to understand appropriate contextual sensitivity is needed. Moreover, two interesting avenues for further research are held within conducting longitudinal action-research. One is to follow users to assess the effectiveness of partner ideation and crafting of the circular value proposition by monitoring advancement or implementation. This opens the second possibility to repeat the exercise, using an adapted version of the tool, within the collaborative setting of identified partners. This approach is particularly critical within CE as operationalisation relies upon systems of actors and moving beyond firm-centric approaches towards business models (Bocken et al., 2019; Brown et al., 2019). Adapting the current tool to develop one for a collaborative modelling process holds promise to facilitate and advance collaborative circular proposition and business model design. Finally, more generally, future tools in the field of CE could benefit from a similar iterative design-demonstration-evaluation approach and taking an interdisciplinary perspective on tool development.

5.8. Conclusion

This study contributes through the design and testing of the circular collaboration canvas. The canvas supports users within the early stages of a COI process to quickly ideate to identify partners and perceived values and then map and visualise these to design circular propositions. We contribute to circular oriented innovation literature by demonstrating that: (1) integrating entrepreneurial and innovation approaches to develop tools and guided facilitation processes can increase the usefulness, ideation potential and practical guidance provided to support circular proposition design, and (2) combining visualisation approaches with asking specific questions relevant to topics can support users to trigger effectual-based ideation. This prompts users to identify available means, potential partners, and perceived value to bring in a partner and systemic perspective when designing a circular proposition within a given and uncertain context. This process quickly identifies assumptions, knowledge gaps, required experimentation and actions that are needed to test and improve the desirability, feasibility and viability of the circular propositions. By mapping partners and perceived value promotes users to deepen, improve or pivot their circular proposition. This balances the trade-offs, create synergies or overcome challenges held within these when designing circular propositions. We recommend further demonstration of the tool is required to understand and assess how elements such as the maturity and scope of the circular proposition addressed, skill-levels and mix of participants, as well as levels of facilitation, can affect the perceived usefulness, ease-of-use, and development of tangible outputs of crafting activities and the design of circular propositions. Furthermore, more widely the recommendation is for researchers to increasingly pursue action-based research and testing of tools within practice based contexts to advance the theory-practice gap.



6 Discussion & Conclusion

Chapter 6 - Discussion & Conclusion

This chapter discusses the sum of the findings presented in the above chapters to give our conclusions, contributions, limitations, and implications for practice and theory. Two main contributions stand out from this research; 1) the tool developed and the insights produced from this process, and 2) the finding that collaborative COI needs to focus more on the 'soft' side of collaborative innovation.

The tool developed helps frame the discussion and support the COI ideation process. The trigger questions direct and aid users to think of wider perspectives. The canvas then acts as a physical space to map and visualise these perspectives. This supports ideas to emerge, or presents gaps within the idea and current knowledge, to help the users move from an abstract idea to planning concrete actions. Further, this research shows the value of situating combinations of specific tools within the wider COI process; to support each step, one step at a time. But, we also show how a knowledgeable facilitator is needed to act as a 'circular conscience' to help maintain the focus on circularity or help the users to advance through the use of the tool.

Yet, we discuss that tools and methods that support the COI process will only go so far. We show the 'soft' side of collaborative COI represents a key challenge to truly adapt or create new circular systems. More specifically, we have the technical solutions or the ways to develop these, but we need to overcome our learned behaviours and predominant mindset around the maximisation of individual benefits. Thus, a key focus here is the required mindsets and organisational capacity needed to adapt or create new systems that are intent on producing sustainable impacts. But, above all, actors need to be ready to collaborate and be clear that meeting an identified sustainability challenge will likely not be easy. And, the actors involved should all want to achieve a sustainable impact and have the leadership and foresight to maintain commitment even insight of the risks or challenges inherent within a more systemic COI process. The actors involved need to engage and work with partners who have the right mindset. Here, we identify that collaborators should have a mindset that is; effectual, experimental, systemic, and responsible. Otherwise, the collaborative COI process could be consistently frustrated; due to the lack of a functioning collaborative architecture. This might then result in the wider sense that circular strategies and systems do not work. Rather, than assessing that it might be the mindset needed to collaborate effectively to conduct a systemic COI project that is lacking.

Collaboration is crucial to develop and implement a circular economy (CE). Yet, to date CE research has hardly delved into the underlying aspects of collaboration. This thesis has set out to change this by empirically investigating the collaborations between companies which are working on circular oriented innovation (COI) projects. This thesis aims to answer the main research question which is to understand:

"How can companies be supported when pursuing collaborative circular oriented innovation?"

This thesis is separated into two parts. Part 1 focused on understanding the context of collaborative COI. The aim was to understand the initial conditions (the drivers, barriers and norms), the management approaches and the challenges that are present within the collaborative COI process. This shows that a crucial leverage point and path dependence to support collaborative COI is held within the combination of; 1) the design of the initial circular proposition, and 2) the partner ideation and identification process. Part 2 builds upon this knowledge to design, demonstrate, and evaluate a tool to facilitate the collaborative COI process. A summary of the sub-research questions investigated and the key contributions each chapter developed is provided in Table 20.

Table 20. *Research Contributions from this Thesis*

Chapter	Sub-RQ	Research Contributions
2 Why do companies pursue collaborative circular oriented innovation (Brown, et al., 2019)	What are the motives, barriers and drivers that stimulate or hinder collaborative innovation within the circular economy context?	• Defining Circular Oriented Innovation (COI) and situating it upon an increasingly collaborative, radical, and systemic spectrum of innovation practices • Identifying and assessing 'Hard' and 'Soft' Drivers and Barriers for COI and Collaboration • Presenting normative, intrinsic & extrinsic motives at individual and company level are important for initiating collaborative COI • Identifying; 1) materials and data, 2) context to experiment, and 3) the

		capabilities to operationalise circular business models drive collaborative COI • Highlighting motivations, traits and skills of actors • Showed it is an entrepreneurial source that commonly instigates COI
3 How do companies collaborate for circular oriented innovation (Brown, et al., 2020)	How do companies collaborate for circular oriented innovation?	• Assessment of strategic management approaches and the types of innovation conducted in collaborative COI • Showing the COI scope (incremental or systemic) can result in different collaborative structures and knowledge management approaches • Phases of collaborative innovation are observed for an incremental scope • Collaborative portfolio and layering are observed for a more systemic scope
4 A process model for collaboration in circular oriented innovation (Brown, et al.,n.d)	What processes do companies undertake when designing and implementing collaborative circular oriented innovation?	• Synthesising and testing Strategic Management collaborative process building blocks to explore, validate and deep-dive into the collaborative COI process • Presenting a collaborative COI process model • Presenting key distinctions, challenges and a future research agenda for collaborative COI • Identifying that the formulation of the initial proposition and partner selection is a key leverage point within the collaborative COI process

5 A collaborative partner ideation tool for circular proposition design (Brown et al., n.d.)	How can a tool support companies to ideate partners and identify collaborative value for circular proposition design?	• Designing, demonstrating and evaluating tools to support COI using a design science research approach • Situating the tools within a process to support the collaborative COI process • Showing visualisation and mapping tools can support initial ideation phases • Showing effectual based trigger questions are well received and stimulates ideation for users • Showing that bringing in a wider stakeholder and collaborative partner focus into the early ideation phase can deepen, pivot, or adapt an initial CE proposition to aid the COI process	

This chapter firstly draws together and then reflects upon the body of findings from the empirical work undertaken within Part 1 (section 6.1 of this chapter). Secondly, the focus is drawn to what has been learnt in Part 2 through the design, demonstration, evaluation and use of the tool to support the COI process (section 6.2). The main contributions of this thesis to CE research (section 6.3), the implications for theory (section 6.4) and limitations (section 6.5) follow. Then recommendations for future researchers (section 6.6) and circular practitioners (section 6.5) are given. Finally, this chapter presents the conclusion of this thesis (section 6.6).

6.1. Main research findings: Collaboration within the Circular Oriented Innovation Process

The studies in Part 1 aimed to gain a more profound understanding of the collaborative COI process. We defined COI as the coordinated activities that integrate CE goals, principles, and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product and material integrity and value capture potential across the full life-cycle (Brown et al., 2019). This section summarises the observations from the empirical engagement with practitioners; in particular I draw attention to

the ‘soft’ side of collaborative COI by reflecting on the required mindset practitioners discussed was needed to adapt or create new and increasingly circular systems.

6.1.1. Circular Oriented Innovation Barriers: Overcoming the ‘Soft’ side of collaborative innovation

In Brown et al. (2019) (Chapter 2) it was found collaborations can be earlier, deeper, and driven by normative, intrinsic and extrinsic motives from both the company and the individuals involved. Further, the innovation potential, anticipation of financial returns and a growing sense of urgency and enthusiasm motivated the pursuit of COI. It is commonly the identification of a systemic problem that stimulates a CE champion or entrepreneurial source to engage with collaborators. They do so to source; 1) materials or data, 2) suitable contexts to experiment or pilot, and 3) gain competencies needed to operationalise circular business models. Yet, within the collaborative COI process, the main barriers that were found that companies need to overcome are the ‘soft’ social and culture-based barriers. Specifically, a challenge that arises is how actors involved require a specific mindset; to be collaborative, radical and think systemically. The ‘hard’ technical and market-based barriers are relevant. Yet, from a collaborative viewpoint, the ‘soft’ challenges around the required mindsets can be greater. Especially, concerning the challenges that can result from a mindset that can be brought into a COI project (from both the company and individual), such as the learnt thought processes, assumptions, and a ‘linear’ world-view. These can frustrate aims to radically adapt or create new circular systems.

The studies in Chapters 3 and 4 (Brown, et al., 2020; Brown, Von Daniels, et al., n,d) identified ‘soft’ challenges throughout the collaborative COI process and show that great efforts towards alignment are made. A recurring soft challenge is the ability to align partners. This requires them to share their motives, different interpretations of CE and expectations within a COI process. Chapter 4 highlighted how this is especially relevant within the formation of the ‘collaborative architecture’ that is needed to advance towards collaborative action (currently largely experimentation). The process of alignment can produce adaptions to the original idea but the overall aim should be maintained; to explore solutions to the identified sustainability problem. The challenge here from a collaborative perspective is how to get potential partners to be clear about what their motives, goals and expected returns are.

Chapter 4 (Brown, et al., n.d) signified that partner identification and selection is a crucial leverage point for the development of a 'collaborative architecture' and the overall success of the COI process. This means the implication is that when identifying potential collaborative partners, one needs to be clear on these aspects and factor them into the selection process.

Similar to a product design process, the biggest leverage point and therefore chance to create positive impacts is within the design and ideation phase; as this is where critical decisions are made. Within the ideation and design phase of collaborative COI, we show how the development of the initial circular idea and its combination of circular strategies (that indicates whether the scope is for incremental or systemic innovation) can change the collaborative process, collaborators needed and potential challenges. It is important to understand and consider whether the intended scope is incremental or systemic since Chapter 3 (Brown, et al., 2020) identified how this can result in the use of different collaborative and knowledge management approaches. An increasingly radical scope was found to correlate to increased costs in terms of uncertainty, risks and collaborative management skills and competencies. Thus, potential collaborators need to be able to handle these costs, which is why being clear upon and communicating early the scope of the circular idea is important; so that each partner can assess whether they are prepared and able to contribute, whilst also seeing the value in engaging within the collaborative COI.

The larger the collaboration, in terms of interest, importance, project scale and therefore potential for increased number of participants, the greater the need to understand the motives and expected returns, since this means alignment efforts can be harder. This leads to the implication that the person who instigates or those who join a radical collaborative COI project need to be prepared for and aim to mitigate these challenges. They should be aware that they might be required to change, adapt or grow their mindset. Or, those of the collaborators that they engage with.

A further challenge is whether they have the ability and conviction to maintain a radical COI focus within the project in despite of potential challenges generated by the collaborative COI process or those that arise from the partners involved. This raises a final element of overcoming the 'soft' challenges, which is that to start planning and conducting

collaborative actions firstly requires actors to be open, share and consciously aim to overcome aspects of the 'linear' mindset; especially the predominance to maximise individual advantages. This is critical to collaborate towards a circular and systemic oriented solution; whereby value is intended to flow. The implication here for the companies and those individuals involved is that they should question whether they are able to adapt their thinking, existing processes, assumptions, and 'linear' world-views to embrace this more systemic approach towards dealing with the sustainability challenges. Specifically, can the companies (or the individuals) involved let go of their own centrality or 'ego' and be the one to share their knowledge, ideas, energy, and capabilities to start discussions and planning to instigate collaborative actions.

6.1.2. The required mindset – Collaborative, effectual, systemic, experimental, and responsible

Throughout Chapters 2,3 and 4 (Brown, et al., 2019, 2020; Brown, et al., n.d.) in Part 1 certain traits and competencies are identified that can aid the collaborative COI process. This section highlights how these build a picture of the type of mindset and attitude required by actors (both the companies and the individuals involved) to facilitate collaborative COI. Chapter 4, shows the individuals who engaged within the COI process needed to be able to handle uncertainty, vulnerability, creativity, flexibility and adaptability. This is because pursuing a radical COI process may need fundamental changes to how innovation and business activities operate or are structured; and can simply be 'messy'.

A mindset can determine how a company or individual can bring behavioural norms, thinking processes and their potential values, metrics or biases into a COI project. The mindset can either advance or inhibit the ability to introduce innovations (Boons & Ludeke-Freund, 2013; Breuer & Lüdeke-Freund, 2018; Evans, Vladimirova, et al., 2017b; Freudenreich, Lüdeke-Freund, & Schaltegger, 2019). Reflecting on the findings in Brown et al. (2019, 2020; n.d.) I present below five interconnected elements of a mindset, that this research shows could facilitate more radical and collaborative COI.

Actors need a collaborative mindset; whereby they are open towards working with other companies (and individuals from those companies). This means being able to communicate effectively to build trust, transparency and working relationships to support the easy flow of knowledge. Actors should also hold credibility and the ability to maintain accountability through the use of different collaborative project and knowledge management structures.

Actors need an effectual mindset; whereby they see that possible future innovation directions are shaped or adapted based upon a given set of means they or their network have. 'Being effectual' means they are able to handle uncertainty and understand that their ideas will likely adapt based upon who they work with or what they learn by collaborating. This also indicates a willingness and ability to learn-by-doing using the available means they or their network has to experiment and test ideas.

Actors need an experimental mindset; whereby they are able to bring creativity and competencies to collaboratively identify, ideate and test core assumptions held within a future CE vision through quick collective learning-cycles to validate; such as by using 'collaborative foresight' or 'lean experimentation' to explore and understand possible future systems.

Actors need a systemic mindset; whereby they are able to think in terms of systems and be comfortable with the complexity this brings. The actor should also view the sustainability of an idea or action from the view-point of how it might interact within a system.

Actors need a responsible mindset; whereby they hold themselves and their respective companies accountable to improve what they do. Actors should also be responsible for maintaining the integrity of the circular and sustainability aim within an innovation process to avoid creating 'business-as-usual-ideas'. This also means actors should take responsibility and ownership for the current situations around them and build this into their normative intent to improve things and increase sustainable impact of their innovation activities. This does not mean that the actor needs to take responsibility for everything; but rather hold themselves and their organisation accountable for negative impacts and consistently work towards creating better systems with increased sustainability.

6.1.3. How the mindset can affect the collaborative COI innovation process

The importance of having the required mindset within the COI process is shown in Brown et al. (2019, 2020; n.d.) and reflected on above. This raises an interconnected element within the discussion of what constitutes an appropriate mindset. I argue this is whether an actor sees a mindset as fixed or has the potential to grow; this idea is central to Dweck's work. She distinguishes differences between a fixed mindset (a person or organisation sees their talents and abilities as fixed and cannot change) vs. a growth mindset (a person or organisation sees their talents and abilities as something they can develop over time through effort, practice and instruction) (Dweck, 2015, 2016). The latter growth mindset focuses on putting in individual and organisational effort, learning, and embracing mistakes (Dweck, 2009). When companies (and the individuals involved) have a growth mindset employees can feel more empowered, committed to the company vision and feel safe in the ability to conduct appropriate risk-taking directed towards advancing the company strategy; safe in the knowledge that lessons learnt from any potential failures will be valued (Dweck, 2016). Specifically, employees feel increased support for collaboration in general and collaborative activities directed towards innovation and learning (Dweck, 2016). Thus, the recommendation for radical COI projects that aim to solve wicked sustainability problems is to engage with actors who hold a 'growth mindset'; since this will aid the collaborative COI process. These actors are more suitable to participate within an uncertain, messy and creative learning process, such as COI.

6.2. The design, demonstration and evaluation of a tool to support circular oriented innovation: What was learnt

In Part 2, Brown et al. (n.d.) shows design science research (DSR) offers a good approach to bridge literature and practice to develop and test tools (Hevner, 2007; Peffers et al., 2007; Romme & Reymen, 2018). This advances the use of DSR by the likes of Osterwalder (2004) for the development of the business model canvas to design specific tools for the COI context. Yet, like most creative processes understanding users and how they interact with and use the tool is important. Thus, I recommend to engage with end-users early and often to improve a tool and its facilitation. This empirically supports previous work on tool design, demonstration and evaluation (Bocken, Strupeit, et al., 2019; Breuer et al., 2018; Pieroni et al., 2019). We also found that user feedback (crucial

to help improve our tool and facilitation) based on usefulness and ease-of-use scores were good evaluation topics, since it presented feedback questions in a simple and easy to understand manner (Davis, 1989; Venkatesh et al., 2003). This allowed quick user feedback to be collected and supported the framing of user discussions following the tool demonstration. Our recommendation for future tool development processes would be to use a similar format to gain semi-quantitative (using Likert scales) and qualitative feedback (feedback form answers and user discussions).

The development process of the tool shows the need to increasingly explore, combine and integrate multiple schools of thought and disciplines to create useful and valuable tools to deal with the complexity of COI. This is highlighted in the review by Bocken et al. (2019) and is being implemented by other researchers such as; Nußholz et al. (2018), Guldmann et al. (2019), Blomsma et al. (2019a), Baldassarre et al. (2020), and Konietzko et al. (2020).

Another insight from Chapter 5, that aligns with previous research by Tyl et al. (2015), is that a tools effectiveness is partly based on the tool itself; but also partly on the facilitator's ability to bring their expertise and knowledge to support the use of the tool. We expand upon this by showing how the facilitator can also be required to act as a 'circular conscience' to challenge and maintain the circular focus, whilst using a tool. This increased aspect of facilitation and the need for a 'circular conscience' was similarly found in Brown et al. (2020; n.d), which showed the power of having a facilitator to maintain the circular focus throughout the COI process. This advances upon guidance by Iden et al. (2017) into the facilitation of collaborative strategic foresight workshops, by showing within a COI process the facilitator might be required to take an active role. Such a role can be to act as a teacher educating on potential circular strategy combinations, challenge users to maintain the CE focus or integrate the facilitators expertise within analysis to support users to advance.

6.2.1. Recommendations for further tools and methods to aid the collaborative circular oriented innovation process

Chapter 4 provided a helicopter-view of the collaborative COI process. The tool developed within Chapter 5 supports the first internal steps towards collaborative innovation through the ideation and identification of

potential collaborators to support the circular proposition design process. Yet, within the design and demonstration of the collaboration tool it was developed in conjunction with other tools; albeit these are designed to be able to be used as a stand-alone tools (Brown et al., n.d.; Brown, Baldassarre, et al., 2019). The other tools used were firstly a card deck developed to educate, explore and combine circular strategies to help form an initial circular proposition (Konietzko et al., 2020). And, a subsequent tool that uses a canvas to explore a minimum viable prototype and implementation plan; this has been further developed and tested (Baldassarre et al., 2020).

The approach to combine tools and situate them within a wider process is shown to be an effective way deal with COI complexity and advance a COI process by guiding individuals and their companies. This presents a valuable insight that builds upon work by Frankenberger et al. (2013), Geissdoerfer et al. (2016a) and Evans et al. (2017) for sustainable business model innovation; namely when designing tools for circularity understanding how it supports and fits into the wider COI process is important (presented in chapter 4). I argue that, due to the high levels of complexity and uncertainty throughout the COI process, no single tool or method can fit or capture all process steps. Building on chapters 4 & 5 the recommendation is that researchers should separate specific steps and create tailor made tools for each identified challenge to support the COI process; one step at a time to move towards collaborative actions to create (or adapt) circular systems.

Throughout the chapters in this thesis we observed that for more radical COI currently collaborative action commonly means collaboratively experimenting to explore how circular strategies might function and learn how to operationalise them. This opens up two further possibilities beyond the development of tools and methods to support the identified collaborative COI process steps presented in chapter 4.

Firstly, by expanding support to the collaborative action process step. Developing tools and methods that support collaborators to build, run and assess collaborative and systemic experiments. Currently, this is commonly conducted using ‘lean experimentation’ (Ries, 2011, 2017). Yet, it is not clear whether specific circular experimentation tools or methods could be more effective. Especially, since a challenge in COI is understanding the impacts upon scale and the potential feedback loops

that COI can bring, which is still underexplored (Manninen et al., 2018; Sauvé et al., 2016; Zink & Geyer, 2017). It is assumed that based upon the insights generated within this thesis that once collaborators are at this stage the further development of tools and methods that support such collaborative and systemic experimentation will provide great value and further insights into what might be required to advance beyond the experimentation and 'excitement' phase that is currently observed for CE (Blomsma & Brennan, 2017).

Secondly, the steps beyond collaborative experimentation (out of scope for this thesis), may represent further nuances and challenges from a collaborative and operational viewpoint. Here the challenge is how to collaboratively maintain circular products and services at their highest level and ultimately recover them at the end-of-life. Therefore, these further steps may also benefit from researchers and practitioners exploring the challenges and processes to design, demonstrate, and evaluate further specific tools and methods.

6.3. Contributions to Circular Economy Research

Previous CE research has explored or raised collaborative elements within circular procurement (Sjors Witjes & Lozano, 2016), institutional incentives (Fischer & Pascucci, 2017), supply chains (De Angelis, Howard, & Miemczyk, 2017; Masi et al., 2017), business model innovation (Bocken et al., 2016; Kraaijenhagen et al., 2016; Zils et al., 2016), and innovation barriers (Kirchherr et al., 2018; Rizos et al., 2016). Yet, this research has addressed the gap within CE research into the collaborative process. Specifically, the empirical investigations within this thesis across multiple cases are the first studies to deep dive into the underexplored design and implementation processes that companies undertake when engaging a collaborative COI process.

Taking a process perspective and a conceptual lens and insights from strategic management has aided the understanding of the COI context, initial conditions, collaborative innovation strategies, and the challenges that remain. Notably, challenges remain within the development of a collaborative architecture. These steps are can happen simultaneously and should be repeated if new collaborative partners join before or after collaborative actions have been conducted.

The identification of potential challenges within the collaborative architecture means an increased focus needs to be brought to the 'soft' side of collaborative innovation. If an egocentric mindset to maximise companies or personal value is brought in, rather than a systemic view, then the ability to test, operationalise and implement radical COI can be frustrated. This links to ideas previously developed by Blomqvist et al. (2005; 2006) who present 'collaboration capability', and by Ritala et al. (2009; 2009) who present 'innovation orchestration'. Both focus on the relational skills and competencies needed to transfer knowledge across organisations and individuals to advance collaborative innovation. Further, Evans et al. (2017) highlight that for system transformation it requires system collaboration and collective learning to assess and understand value flows for the whole system. Yet, Scharmer (2016) proposes that the quality and outcomes of a collective learning and creative process depends upon the quality of an individual's awareness of the system. Specifically, an individual (and by proxy the companies they work for) needs to move beyond an egocentric viewpoint to create eco-system awareness to be able to co-create systemic value (Scharmer & Yukelson, 2015). Kraaijenhagen et al. (2016) do highlight this within their work on collaboration for circular business models. But, this is expanded within this thesis by empirically showing that such an ego-centric view will likely limit collaborative COI and the ability to deliver on the proposed circular and systemic transition.

This highlights a challenge and tension. A COI process should account for the full life-cycle of a product. From material choices, the design of multiple-use cycles and clarity on the end of life processes. This means companies need to be clear about and situate the design of new products and services within a system that accounts for externalities and incorporates a view on the constraints; be these environmental, societal, or technical such as material, toxicity, pollution or energy related etc. This increased complexity requires collaborating more widely upstream and downstream to develop a full view of value within a system. The of different timescales and multiple lifecycles should still be profitable. This can require exploring different and complementary business models. Yet, this means value creation, delivery and capture activities extend beyond purely monetary value and the delivery of the products or services to market. This highlights a core principle of a CE; value should flow and be shared to make the system more efficient, innovative, resilient and sustainable in the long-run. This implies being open and able to explore

complementary business models to evaluate how value flows within the system to generate collective gains (especially those beyond purely monetary value).

This supports recent work by Oskam et al. (2020) who show within sustainable and circular oriented collaborations actors go through a process of understanding the value of the system. What they term 'valuing value' to be able to go beyond monetary value for the focal firm by collectively exploring value potential. This signifies collaborators should share what they value, what they expect or desire in return, and crucially any required timelines to be able to create a joint value proposition. This is a crucial part of the collaborative architecture. Such transparency is needed to be able to balance and agree how value flows amongst all partners involved and to assess whether the idea is actually desirable, feasible and viable. This process assesses the possible sustainable impacts and the collective longer-term stability, resilience and viability that circular revenues, material flows and recovery systems could bring to a company's (and the collaborators) current and future operations.

The challenge remains that fully functioning circular business models and recovery systems are largely untested and unproven. So this requires leaders and visionaries who can put forward ideas, capabilities or assets and let go of the notion that they should capture all available value from these; at least immediately to be able to collaborate effectively to develop a circular system. Hence, from a partner selection perspective we need to assess whether the collaborators share this view, or at least understand what they are willing to share. More widely this requires a mindset shift that takes into account what we value, how we define success and what we expect back in return for our efforts. If we maintain the predominate mindset and paradigm; whereby collaborators pursue individual value over those of the systems that we are trying to develop or interact with, then truly circular systems will not be realised. This represents a fundamental bottleneck for collaborative COI activities intent on creating circular systems. Our empirical investigations into collaborative COI shows CE research needs to increase focus on who the actors are and their capabilities to balance and align the needs and interests of the actors they intend to work with; whilst accounting for the system. Innovation is always an act of leadership; especially when the problem is wicked (Waddock, 2013). This is extended within the CE-context since actors

need to be able to maintain the focus on the problem, experiment and prove what is possible to positively adapt or create new systems.

This thesis argues that obtaining clarity on why a company (and individual) wants to be involved within a COI project, what their interpretation of CE is and what they willing to put in and expect to gain from the COI process is a crucial step that should be undertaken as early as possible within a collaborative process, if not before. Specifically, the partner selection process holds the highest leverage to support the creation of a functioning collaborative architecture. If companies want to pursue business opportunities and solve sustainability problems through systemic COI; they need to take the time to focus upon the CE idea and partner selection process. Those involved need to have the capability to build trust, transparency, accountability and assess whether collaborators are committed to the idea, or not. Building and maintaining commitment is important since the desirable approach is for partners to self-select into the project, with the full understanding of the implications that a systemic scope and potential longer COI process can hold. Having potentially uncomfortable conversations about motives and expectations is crucial to be able to assess the 'ingredients' that can be brought into a collaborative COI process. Further, I argue, these ingredients represent an important signifier of how a collaboration might develop over time and future challenges, success, or potential failure; since without the 'right' mix of ingredients (partners and mindsets) the creation of a functioning 'collaborative architecture' might be frustrated. This will either result in the collaborative process failing to produce collaborative actions or the original systemic circular idea being eroded down to an increasingly incremental adaption to existing ways of doing things. Ultimately this will reduce the potential sustainability impact of COI activities. Furthermore, if projects consistently fail due to sub-optimal collaborative ingredients this could lead to a wider sense that CE ideas and systems simply do not work; rather than reflecting upon that it might be the underlying collaborative mindset needed to develop and maintain such a systemic approach that is lacking. This is especially crucial within the current development phase of CE, whereby we need to move from the excitement generated by the ideas towards actually showing that they function, can be operationalised and produce positive results.

6.4. Implications for theory

This thesis sought to integrate and combine the explanatory power from existing theories. Theory from strategic management and entrepreneurship was used to analyse practice data to establish empirical insights within the context of collaborative COI. These insights were used to improve understanding on the nature and dynamics of collaboration and then to design tools to support the COI process. This thesis shows engaging with CE and COI increases the levels of complexity and uncertainty held within innovating systemic benefits. Below I reflect on the linkages between the theories used from strategic management of collaboration, the entrepreneurial theory of effectuation and the tool development process.

Brown et al (2020; n.d.) show that integrating strategic management and open innovation literature aids our understanding of COI. Further, this supports recent calls from George et al (2016) and Bogers et al. (2020), but advances by providing empirical evidence across multiple collaborative COI cases. Moreover, researchers and critics of CE have also highlighted that there is a current lack of focus upon the strategic management aspects of collaboration, especially upon understanding the dynamics and management strategies of collaborative innovation (Khitous et al., 2020; Korhonen, Nuur, Feldmann, & Birkie, 2018). This research also shows how challenges remain, especially around how companies jointly manage and create collaborative business models to implement COI. This thesis has therefore aimed to contribute to both CE and strategic management fields empirical insights.

Effectuation theory developed by Sarasvathy (2009) is used to generate trigger questions. This thesis validates that the effectual decision making logic offers an effective way to prompt ideation within COI. Further we show that this approach in the form of simple trigger questions is well received by users since it is clear, direct, easy to understand and is personal. Making it easier to share their ideas within a group setting, which allows actors to gain a quick understanding of who is present and therefore the potential available means. The effectual process also requires the users to think of what is important to them and directs them to turn their ideas into action by engaging their own network. Furthermore, asking users to present these ideas and what resources they have makes

it easier for potential actors (present within the workshops) to assess whether the COI project is interesting and something to self-select into.

Within the design and development of the Collaboration Canvas we have shown that situating specific tools, within a wider process, that integrates academic and practice based approaches can utilise the benefits from both (Bocken, Strupeit, et al., 2019; Fernandes et al., 2020; Mansoori & Lackéus, 2020). The connection of entrepreneurial theories and innovation approaches within the tool and its empirical testing explores their applicability and use to overcome the challenges of innovating within an increasingly complex, uncertain and resource constrained innovation context, such as COI. Further, this research supports Pieroni et al. (2019), who proposed that a canvas can support the more abstract ideation phase. We show that by integrating effectual trigger questions within a canvas acts as a way to frame the discussion. This ultimately becomes a physical object that directs conversations and allows users to map and integrate a wider sense of the system and value to understand whether an idea is desirable, viable or feasible. Further, this research shows how design thinking approaches within tool development and collaborative ideation can support users to move quickly from abstract ideation to action planning and experimentation, with relative ease and minimal time (Elsbach & Stigliani, 2018; Micheli et al., 2019).

6.5. Limitations

In each chapter, limitations were outlined for the specific study and research method applied. Furthermore, future research has been presented throughout the chapters, especially Chapter 4 with the presentation of a proposed future research agenda. As such, here, instead of repeating these I aim to draw together these insights to provide a more generalisable set of limitations and guidance for future research.

6.5.1. Limitations: of the case study approach used to explore collaborative COI and conduct process research

The exploratory case-study approach adopted throughout Part 1 of this thesis, chosen due to the newness of the phenomenon, enabled data collection and analysis of the design and implementation of collaborative COI processes across multiple contexts. Yet, despite this, the case study approach holds challenges for building understanding of collaborative COI and conducting process research.

One challenge is related to the longer term timeline for COI processes, experimentation and circular business model innovation. These can extend beyond the expected timeline of PhD research. This presents a challenge to research and assess the full case (from the initial ideation and beginning of the project to the EoL recovery) to get the complete picture of a COI process. This resulted in using a backwards and retrospective approach to study collaboration. This meant collecting data from practitioners on their experiences of the collaborative COI projects. Collection of retrospective data can hold implications for the accuracy, completeness and potential for retrospective biases of the experiences shared by participants, who might lose or omit focus on failures or challenges. Another challenge has been the availability and access to collaborative COI cases has meant that a limited sample of cases, which is largely Dutch focussed, has been investigated within this thesis. This limits the generalisability of our findings without further research expanding the number and geographical focus of cases studied.

Finally, since the research approach and focus was on the design and development of collaborative COI. This meant our analysis has predominantly been explorative and descriptive. This met the aim to explain the current challenges for 'why', 'how' and 'what' processes companies undertake for collaborative COI projects. But, this means the COI projects have not been evaluated on their success or failure or their environmental or societal implications. This is out of scope of this thesis, but potential failures to bring COI products or services to market or a lack of environmental or social benefits being realised within these innovations could indicate that the collaborative approach, knowledge management or overall process were not effective. Or, alternatively that the circular proposition is not viable, feasible and desirable. In either case such understanding of failures would provide valuable insights.

6.5.2. Scope of collaborative circular oriented innovation research

The scope of this thesis has been to investigate collaborations at the meso level. This focused analysis on the interactions between companies and how they collaborate. This combined strategic management, collaborative innovation and effectuation theories with design science research to develop and design a tool to support the COI process, at least as we have seen it. Yet, there are other levels of analysis (micro or macro) that have not been investigated. Such as the human psychology of

collaborations, mindset change, or organisational culture and change management processes (micro level). Or wider perspectives of innovation and systemic transition or transition design that take into account views beyond how firms collaborate to incorporate civil society, policy or non-governmental actors (macro level). It is recommended for future research to engage these areas to see what additional insights can be brought into and expand upon the findings held within this thesis.

6.5.3. Tool design, demonstration and evaluation:

This thesis has shown how the design science approach that bridges academia and practice is valuable to codify knowledge from both and to research, develop and test useful tools. A key challenge within this approach is the ability to secure suitable contexts and access to participants to test tools. A further challenge presented by this approach is whether to follow up and investigate the impact upon future collaborative actions derived from using the tool. Due to the scope of this thesis the continuation of analysis to investigate the impact of our proposed tool on the identified collaborations, collaborative experimentations or collective actions was not conducted. This is recommended within future research.

6.6. Recommendations for future researchers

The studies within this thesis indicate two general recommendations for future research beyond those provided in the future research agenda within Chapter 4.

Firstly, for research topics that display high practical relevance and rely on understanding and engaging with a specific context (such as the study of collaborative COI) we show how an increasing engagement between academia and practice, can have benefits for both. Especially, through the development of tools and methods as a way to bridge the academic theory and practice gap. The practice-based setting allows researchers to test and validate whether the logic, models and tactics from theory are suitable, provide guidance or explanatory power, or not. Such real-world settings can challenge theory. This provides the researcher the opportunity to ask questions and to understand what is missing to aid explanatory power or understanding. Or whether variations within the specific context or the application of theory has led to potential challenges. For practitioners, it offers a low-cost way to gain insights and best

practices from the academic theory and valuable ideas or ways of thinking and problems solving approaches from the researcher.

Secondly, further understanding of how to investigate the 'soft' side of collaboration is needed. Specifically, moving beyond 'what' mindsets might be needed to develop effective collaboration over the longer-term. Especially, when considering the more systemic focus required for a CE to facilitate increased sustainable impacts. Future research is thus recommended to deep-dive into and explore 'how' such mindset change, both at the level of organisations and individuals, can be supported. Further, this could inform the design of tools and methods that aim to support mindset change for sustainability. A crucial challenge is to understand 'how' to advance collaborative and ecosystem oriented mindsets, whilst still operating within a competitive market based economy.

The overall recommendation is to situate the researcher within collaborative COI projects and use participatory, ethnographic and action-based research methods. This would allow the researcher to collect data throughout and be able to track impacts of actions or the effectiveness of tools and methods. Alternatively, to avoid potential challenges of researcher objectivity another option could be to initiate longer-term collaborations, using the tools. Then maintaining regular communication, observation and tracking of collaborative activities, rather than the researcher being directly involved. In either case this may directly or indirectly bring further insights to support future tools or methods to support the COI process.

6.7. Recommendations for circular practitioners

The practice based process view identifies the initial conditions, management approaches and the steps within collaborative COI. This also leads to the ability to provide recommendations to companies and managers who are considering to start (or engage with) a more systemic collaborative COI project. Recommendations and questions that one should consider in advance of such a COI project are presented below:

Be clear on your problem and your vision towards solving it. It is important to present a clear vision and an initial CE idea. This identified challenge indicates how innovative (incremental vs. radical) the aim is.

This can dictate the levels of excitement, enthusiasm and act as signals for engagement internally (staff) and externally (collaborators). The initial CE idea and combination of COI strategies within the circular proposition dictates what capabilities are needed and therefore highlights any potential gaps. This will provide a first step towards understanding the level of complexity, complimentary innovations required, expected timeliness, and potential collaborative partners needed for the COI project. So take the time to do these activities.

Be clear upon your desired collaborative approach. Think about how open or closed you would like to be with regards to internal and external knowledge management and sharing. Be clear that this can also be affected by whether competitors need to be involved or not. Do you intend to protect or share knowledge developed for circular product design, business model and value network arrangements. Think about how you would like to structure your project and how open or closed would you like to be with regards to additional partners joining and what levels of commitment they should show before being able to join. Do you intend to maintain hierarchical control or would you like to develop a collaborative consortium or ecosystem, whereby the ultimate aim is to support increased collaborative governance, management and agenda setting for the COI project.

Be clear on whom you want to work with. If you intend to work with previous relationships assess the levels of trust you have. If there is no previous relationship assess whether you can develop this trust easily (or think you can learn how to). Assess what a partner's motives might be to engage with CE or think on whether you can find out. Understand if you have the capabilities or experience to build trust or assess a partners mindset and motivations. This should also lead to an internal assessment of whether you have the right personnel with the right mindset within your own company (see section 6.1.2) to manage the COI project.

Be prepared to give a little more upfront in terms of resources, time, creativity and knowledge. But, also be prepared to potentially accept a little less back than you might normally be used to doing, at least initially. A systemic COI process has a longer timeline and circular business models can have longer development and revenue timelines. Are you prepared for this and can you handle this revenue uncertainty in the short-term? Does the longer-term benefit outweigh the short-term

costs? Assess if others need to be convinced of this internally to be able to fully commit and avoid negotiating with collaborators to then find that internal stakeholders reject the collaborative agreements made.

Be prepared to adapt your initial ideas, based upon the engagement with potential partners. Be prepared for a more effectual approach and process. But, try to maintain efforts and activities towards solving the initial identified problem or at least maintain efforts towards improving the sustainable impacts of your idea by not losing sight of the initial problem you set out to try to solve.

Be prepared to ask yourself; do you have the personal and does your company have the organisational capabilities, vision and mindset to undertake and maintain collaborative and systemic COI activities. Being clear on the above questions or at least have a basic idea before starting or engaging within a radical collaborative COI process. This will support latter steps within the COI process, especially when setting up the collaborative architecture.

6.8. Conclusion

We need to solve the current sustainability and environmental crises we face to avoid a potential collapse of our society and the global economic system. This increases the call for sustainable and systemic oriented innovation activities. As such a transition to a circular economy is being investigated by companies. They are conducting collaborative COI activities to understand whether resource flows and environmental impacts can be decoupled from value creation.

This thesis has taken a closer look at these collaborative COI processes. The empirical investigation into why, how and what collaborative processes unfold has created insights and highlighted challenges. Identifying these and then designing potential solutions to support the process, this thesis hopes to stimulate others to turn their CE ideas into action by providing a compass to guide how to conduct collaborative COI. Further, the tool developed aims to aid the first collaborative steps. If more practitioners can successfully advance their CE ideas through collaborative COI activities to create proofs of concepts or ultimately bring circular products and services to market. The increased clarity such

success cases create can support a quicker and wider circular transition of our global economy.

Humans collaboratively innovated to get to where we are in the world. And, we do need to collaborate differently now; we need to create a shared sense responsibility to develop systems that take into account our environment and the needs of both current and especially future generations. We cannot collaborate anymore to solely maximise individual value and interests. Those who read this thesis who want to be part of a circular transition are urged to set up or join collaborative COI projects. Create or join projects that stimulate personal creativity, passion and commitment towards making sustainable and systemic change and actions in the world. Yet, let go of the notion to keep your cards close to your chest; instead, place them on the table to show what you have and whether it inspires others to want to join in and solve the problem together.

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Appendices

8.1. Chapter 2 – Why

Appendix A: Interview Topics and Sample Questions

Interview Topics	Sample Questions
CE introduction	What does the term circular economy mean to you?
CE Collaborative Innovation	Who or which organisation(s) were involved within the initial collaboration?
	Did this evolve over time?
	Why and how did this happen?
	How long were collaborative activities undertaken, and why did they develop?
	Who or which organisation did you collaborate most closely with to deliver the circular strategy? Please describe why and how you engaged with them.
	How would you describe the benefits/challenges you (and/or your organisation) experienced within the collaborative process?
	What were the results that you (and/or your organisation) experienced through the collaborative processes?
	Can you discuss any specific differences experienced between the collaborative processes when pursing circular strategies in comparison with linear/traditional?
	If in the future (15–20 years) CE is a more standard operation, do you think that collaboration between companies will be different at this point?
Circular Strategies and Vision	What impact has the circular vision had upon your: role or department and organisation?

	Were there any specific skills, capabilities or knowledge missing to complete the required work, and if so, how were these overcome?
	Were there differences experienced compared to non-circular strategy-led projects?

Appendix B: Iterative Codes Developed, and Explanation

Initial Code	Iterative Codes	Code Explanation
Circular Economy Strategies	Motives	Specific intrinsic and extrinsic (personal/organisational) reasons to explore or act
	Vision/Strategy	What the company or individual anticipates or plans, and how they respond to CE recovery strategies
	CE vs. Linear	Direct differences that are discussed in relation to motives, drivers/barriers and actions
	Drivers and Barriers	Hard/soft—in relation to CE concept, vision or strategy and motives
	Vision	Specific role of vision within the collaborative process discussed
Collaboration	Motives	Specific intrinsic and extrinsic (personal/organisational) reasons to explore or act
	Trust	Commitment, credibility or trust between collaborators is discussed
	Partner selection	Process, reasons and actions for partner selection are discussed
	Formal vs. Informal Project Management	Discussion of different ways of project/relationship management to support and enable collaboration

	Collaboration vs. Competition	Instances of tensions discussed: collaborating with competitors, pre-competitive/competition or commercial gain
	Drivers and Barriers	Hard/soft—in relation to collaborative vision, motives, and strategy
	Business Model	Discussion of experimentation with or development of value proposition, creation, delivery or capture
Circular Oriented Innovation	Network/Supply chain	Discussion of network or supply chain actions, skills or capabilities
	Design	Explicit design changes, methods or actions are mentioned
	Drivers and Barriers	Hard/soft—in relation to innovation actions or strategy

8.2. Chapter 3 – How

Appendix C: Interview Questions.

Questions

1. Who or which organisation(s) were involved within the initial collaboration? Did this evolve overtime? If so, why and how did this happen?
2. How long were collaborative activities undertaken and how did they develop?
3. Who or which organisation did you collaborate most closely with to deliver the circular innovation strategy? Please describe how and why you engaged with them
4. Please describe or sketch the process or phases and associated activities you undertook/are undertaking for COI?
5. Is the structure of the project different? And is this the ideal set-up?
    a. If yes, what are the challenges you experienced to get to this point?
    b. If no, what would be?
6. How did you identify the right partners for the project?

    a. Do you choose different partners for COI projects? If so how?
7. How do you choose/identify what experiments or pilots to run?
8. Do you recognise specific differences with regards to how you or your project partners make decisions?
    a. How do you agree actions and decisions to be taken within COI projects?
9. How is IP, contracting and financing decided for these projects? How is it different?
10. How would you describe the benefits/challenges you [and/or your organisation] experienced within the collaborative COI process?
11. What were the results you [and/or your organisation] experienced through the collaborative COI processes?
12. Can you discuss any specific differences experienced between collaborative processes when pursing circular strategies in comparison with linear/traditional?
13. If in the future (15-20yrs) CE is more standard operation, do you think that collaboration between companies will be different at this point?

Appendix D: Codes Developed and their Explanation.

Initial Code	1st Level	Explanation	2nd Level	Explanation
Collaboration	Project	Explicit discussion of collaborative project	Partners	External partner(s) are discussed
			Decisions	Interviewee discusses key decisions
			Ways to Improve	Interviewee mentions ways to improve or experience of how to improve collaborations
			Selection of Partners	Interviewee mentions how partners were selected

		Roles / Capabilities	Interview discusses what actors did within the collaboration process
		Formal vs. Informal Structures for Project management	Interviewee discusses different ways of project or relationship management
Scalability	Scalability is discussed	Project ambition	Scale of the innovation is discussed
		Number of Partners	Scale of partner engagement discussed
Collaboration vs. Competition	Competition is discussed within the collaborative process/ project	Pre-Competitive	Instances of pre-competitive (non-commercial) collaboration discussed
		Coopetition	When collaboration between competitors is discussed
		Competition	Collaborative partners are discussed in reference to elements of competition
Trust	Trust between partners is explicitly discussed	Levels of trust	Interviewee discuss trust required for collaborative innovation
		How to Develop/ Maintain Trust	Ways used to develop trust

Commitment	Interviewees discuss commitment	Project	Commitment to the innovation and project
		Partners	Commitment between partners
Challenges	Interviewee discuss collaborative challenges	Mindset	The mindset of the person, company or collaborating partners is discussed
		Alignment	How to align partners thinking
		Planning	How partners plan innovation
		Resources (In)	How resource decisions are made
		Innovation Outcomes	How decisions on outputs are made
Method for Innovation	Interviewee discusses specific methods or practices used	Collaborative Foresight	Collaborative foresight practices are discussed
		Technical	Technical-based experimentation practices are discussed
		Market	Market-based experimentation practices are discussed
Type of Innovation pursued	Interviewee discuss the type of	Product	Product Innovation pursued
		Process	Process Innovation pursued

	innovation pursued	Organisational	Organisational Innovation pursued
		Market	Market Innovation pursued
COI Context	Interviewee discusses COI project idea	Focus	Interviewee discusses the intended CE strategy of the project
		Scope of COI	Interviewee discusses the intended scope of the project (Incremental or Radical)
Challenges	Interviewee discusses COI challenges	KPI's & Assessment	Interviewee discusses assessment or measurement processes for circular innovation strategies or outputs
		Linear Vs. CE	Interviewee discusses the differences between CE and Linear

8.3. Chapter 4 – What

Appendix E: 'Explore' research cycle semi-structured interviews questions

Interviewee Introduction:

1. What does the term circular economy mean to you?
2. Within your organisation:
    a. What activities are you responsible for?
    b. How is circular oriented innovation pursued?

Collaboration: [Name identified case and ask for others]

1. Can you describe the specific collaborative circular oriented innovation case/project?
    a. What were the reasons for seeking collaboration?

    b. Who or which organisation initiated it?
    c. Who or which organisation(s) were involved within the initial collaboration?
    d. How did this evolve overtime?
    e. If new collaborative partners were involved over-time how and why did this happen?
    f. How did collaborative activities develop?
    g. How were collaborative activities lead and directed?
    h. Who or which organisation did you collaborate most closely with to deliver the circular strategy? Please describe how and why you engaged with them.
    i. How did this change over time and why?
2. How would you describe the benefits and challenges you [and / or your organisation] experienced within the collaborative process?
3. What were the results/impacts you [and / or your organisation] experienced through the collaborative processes?
4. Did the overall collaborative process have a stated aim(s)?
    a. Did the collaborative process meet expectations and achieve the aim(s)? Please indicated if yes why and if no why not
5. Did you monitor or assess the collaboration? If so, please describe how and whether they were affective?
6. Can you discuss any specific differences experienced between collaborative processes for circular strategies in comparison with linear/traditional?
    a. Is there anything specifically unique when pursuing CE processes?
    b. If yes. Do you see these unique elements being maintained as CE develops over time, say in 20 years?

Final questions

7. Are there any other elements you would like to share regards your experience of collaborative circular oriented innovation?
8. Are there any other organisations or contacts that you would recommend to speak with regards the topics we have discussed?

Appendix F: 'Validate' research cycle interview questions

Interviewee background:

1. In your organization what activities are you responsible for?
2. What are the biggest challenges your organisation experience for circular oriented innovation?

Collaborative Project: [Name identified case and ask for others]

1. Who or which organisation(s) were involved in the collaboration? Did this evolve overtime?
2. Who or which organisation did you collaborate most closely with? Please describe how and why you engaged with them
3. Is the structure of the project the ideal set-up?
    a. If yes, what were the challenges you experienced to get to this point?
    b. If no, what would be?
4. How did you identify the right partners for the project?
    b. Do you choose different partners for COI projects? If so how?
5. How do you choose/identify what experiments / pilots to run?
6. Do you recognise specific differences on how you or your project partners make decisions?
7. How do you agree actions and decisions to be taken within COI projects?
8. How is IP, contracting and financing decided for these projects? How is this different?
9. What were the results you [and / or your organisation] experienced through the collaborative COI processes?
10. Can you discuss any specific differences experienced between collaborative processes when pursing circular strategies in comparison with linear/traditional?
11. Please describe or sketch the collaborative processes or any phases and the associated activities you undertook for COI?

[Present and Briefly Describe the Collaborative Process Model]

12. How do the collaborative process steps align with your experience of collaborative COI activities?
13. Do you use tools/frameworks to support collaborative COI?

a. If yes, which stage(s) do they support?
b. If no, which stage(s) do you need support?

Final questions:

14. If in the future (15-20yrs) CE is more standard operation do you think that collaboration between companies will be different at this point?
15. Is there anything you would like to share regards your experience of collaborative COI that we have missed?

Appendix G: 'Deep-dive' research cycle interview questions

Interviewee background:

1. What is your role at Organization X and what is your association with the [Building name]?
2. How would you describe the relationships that were formed to create [Building name]? (Collaborations? Alliances? Standard supplier relationships? Cooperation?)
3. How did your organisation engage in these relationships? (Bilateral / Multilateral)
4. How does this fit into the wider innovation process of building?

Specific insights into one collaborative relationship:

1. How would you describe this relationship with one headline?
2. What were the key phases of this process, if you would have to break it down?
3. What was the main purpose of forming this relationship?
    a. What did your organisation want to get out of it?
    b. What do you think your counterparts were hoping to get from it?
    c. What was its purpose?
    d. What was exchanged/shared? Knowledge? Other resources?
4. How was the relationship structured and governed?
    a. How open or hierarchical were the relationship structured?
    b. What key decisions did it produce or influence?
    c. How could it be classified? Cooperation, collaboration, coopetition, strategic alliance?

Process narrative of the collaborative processes:

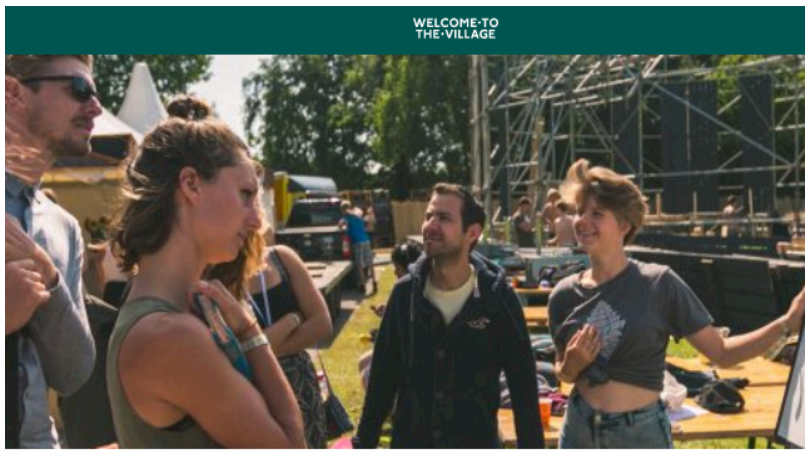
1. How was it initiated?
    a. How was the need to collaborate identified (for initiator)?
    b. How was the collaboration initiated? (for initiator)
        i. How where potential partners identified?
        ii. How where partners selected?
    c. How was the collaboration initiated (for passive partner)?
        i. How did organisation X approach you?
        ii. How was the collaboration pitched to you?
        iii. How did you decide whether to participate or not?
2. How was the governing structure and collaborative approach developed?
    a. Systematic approach? How?
    b. Intuitive approach? What were key criteria/questions asked?
3. What was the key operation of the collaboration?
    a. kind of interaction actually happened?
4. How did this collaborative relationship evolve over time? (Deepen, loosen or constant?)
5. How was value captured from the collaboration?
    a. Was there a contractual agreement? If yes what were the terms roughly?
        i. How were rewards distributed?
        ii. How were risks shared/distributed?
6. Were there points of conflict/disagreement? How was this handled/reconciled?
7. Was the status or the success of this relationship evaluated somehow? If yes how, in what intervals? Did it help to improve it?
8. Is the collaborative relationship still active?
    a. If yes what is its current function?
    b. If no, how and why was the collaboration dissolved?
9. What could be lessons learned from this collaborative relationship?
    a. What were success factors?
    b. What were failures? Points of improvement?

8.4. Chapter 5 – Tool

Appendix H: DORP Marketing information – Website accessed and screen shots made on 15/09/2018

DORP

DORP is the interdisciplinary innovation lab ten days prior to Welcome to The Village. In a limited time frame, we build and test innovations in a festival infrastructure that involve energy, water and whatever you come up with, that can catapult us towards a sustainable future.

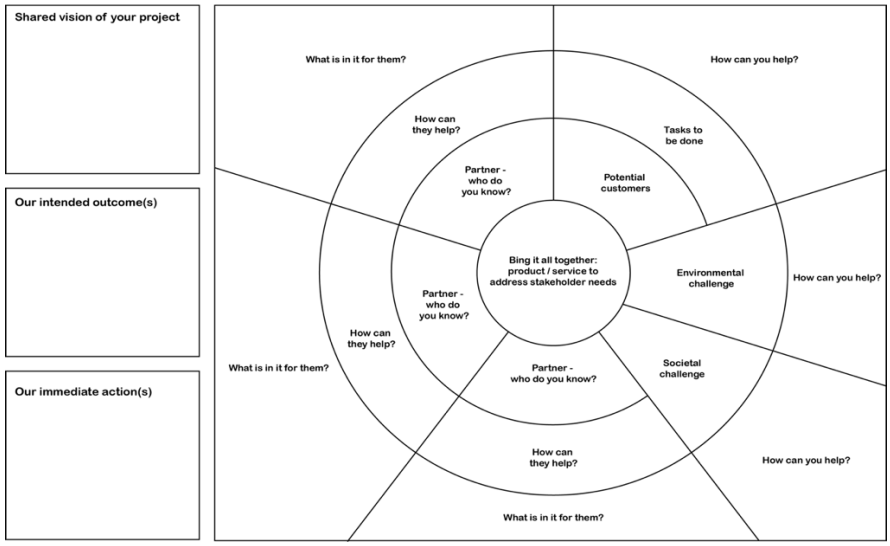


About VILLAGE

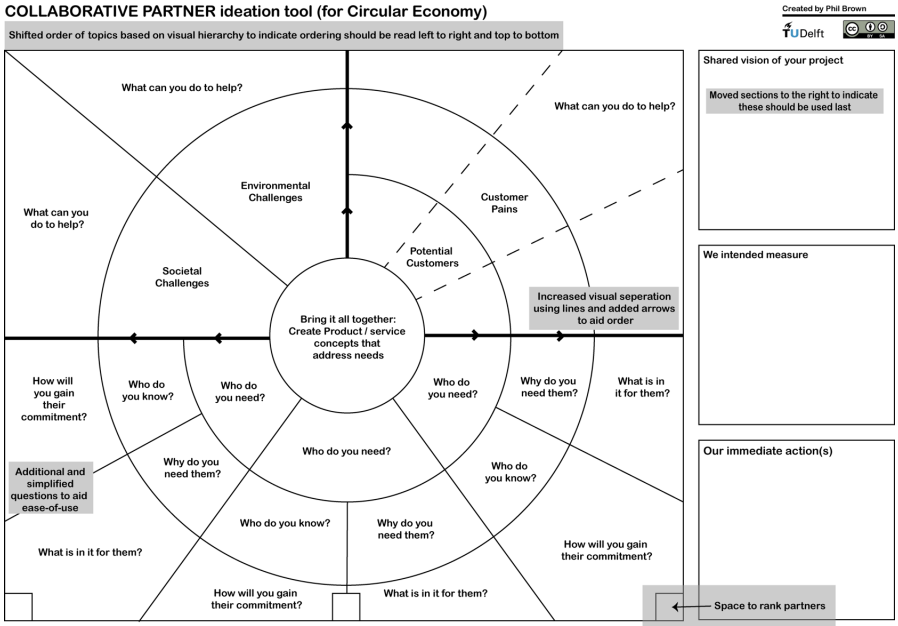
In DORP we use the infrastructure of the festival and its visitors to further develop and test sustainable innovations. In this way we accelerate the transition to a circular economy.

Appendix I: Tool Design Iterations

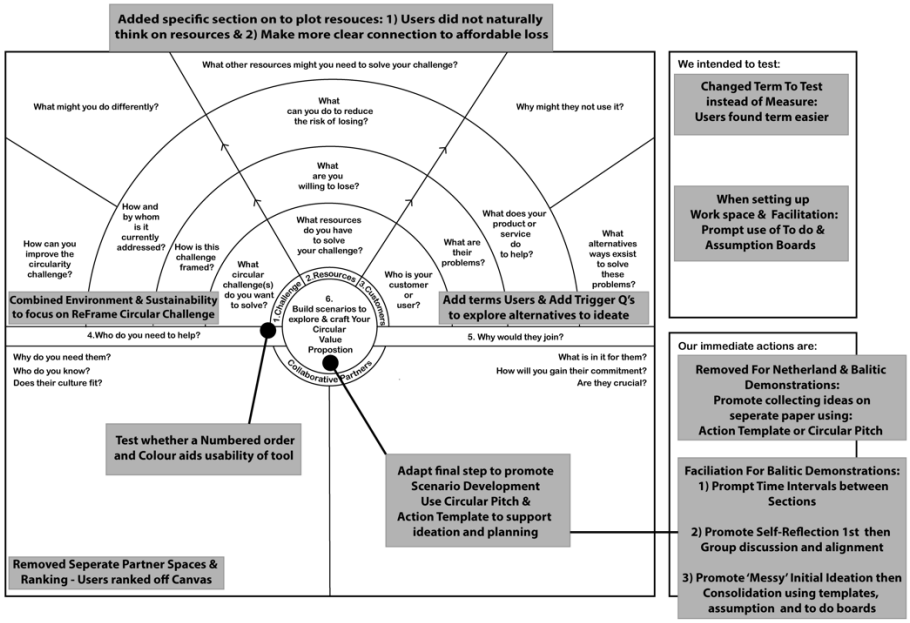
Initial Tool: TU Delft Trial Run



1st Tool Iteration: Tool Demonstrated at DORP



2nd Tool Iteration: Tool and Facilitation Adaption Post-DORP. Tool had minor design changes before Netherland and Baltic Demonstrations (see Figure 3. in text)



Appendix J: In-Take Form used for Netherlands & Baltic Demonstrations

TU Delft

In Take Form: You have signed up for the **collaborative partner ideation workshop.**
Please answer the following questions:
Name:
Organisation/company:
Role:

---

1. I have a clear understanding of Circular Economy innovation strategies

	1	2	3	4	5	6	7	
Do not agree at all	○	○	○	○	○	○	○	Fully agree

Please explain your answer:

---

2. I use Circular Economy innovation strategies within my work

	1	2	3	4	5	6	7	
Do not agree at all	○	○	○	○	○	○	○	Fully agree

Please explain your answer:

---

3. I am comfortable with the use of ideation and design thinking tools

	1	2	3	4	5	6	7	
Do not agree at all	○	○	○	○	○	○	○	Fully agree

Please explain your answer:

---

4. I have a clear circular economy challenge within my business or project

	1	2	3	4	5	6	7	
Do not agree at all	○	○	○	○	○	○	○	Fully agree

Please explain your answer:

---

5. What do you hope to learn from this workshop? Please explain your answer Below:

If extra space is needed please extend answers on the back by numbering responses

Circular idea pitch

(the name of your idea)

can

(description of your circular idea)

to improve circularity by

(how it narrows, slows, closes and/or regenerates resource and energy flows)

This can bring

(describe the possible benefits for your business model, e.g. higher efficiency, more customers)

Appendix L: Action Template

Action Template

We need to find out

(Describe what you do not know about your idea, what you need to know for it to work.

We can find out now by

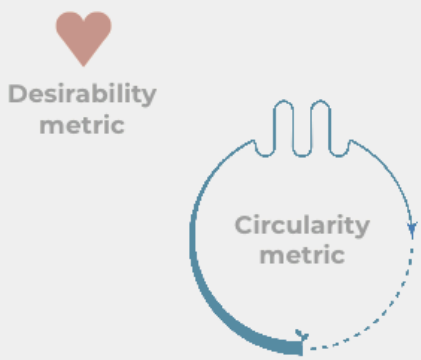
(Describe the actions you can take right now to learn more about this and find it out.)

We can get support from

(Who can help?)

We know we are on the right track if

(What needs to happen to move forward with this idea? Can you put a concrete number / metric to this?



Appendix M: Tool assessment form

TUDelft

Tool assessment form **Name:**

You just used the **collaborative ideation tool**. Its purpose is to identify, ideate, and map the needs and potential value for customers and partners to help craft a collaborative circular value proposition.

Please answer the following questions:

1. The tool is useful to address the purpose stated above.

	1	2	3	4	5	6	7	
Do not agree at all	○	○	○	○	○	○	○	Fully agree

Please explain your answer:

2. The tool is easy to use.

	1	2	3	4	5	6	7	
Do not agree at all	○	○	○	○	○	○	○	Fully agree

Please explain your answer:

3. My key learning and insight(s) from the tool are:

4. Did your circular idea change through using the tool? Please explain your answer

5. Any remarks for how to improve the tool?

6. Any other remarks

If extra space is needed please extend answers on the back by numbering responses

Appendix N: Workshop Protocol:

Timeline	Action	
Pre-workshop Before Date	Issue online In-take form	
Pre-workshop On Date	Get participants into groups (5-7) – Use specific CE challenges from In-take Forms. Issue any missing forms	
Run Card Deck Workshop	2 Hours	
Break between Card Workshop	Confirm groups happy to continue working together + have selected an idea from card deck workshop to use in Collaboration canvas	
0-5 Mins	Present how to use Tool + leave overview visible if projection capability allows	
5-20	Section 1 - Challenge	Sections 1-5 = advise 2-3 minutes solo reflection – Remainder of 15 minute block – group discussion Verbally prompt roughly 5 mins before to users to start thinking on wrapping up section – Highlight that if sections still need to be worked on users can think how to approach this whilst still advancing through the tool with the aim to finish Note: Times adapted slightly when conjoining Who & Why in Partners
20-35	Section 2 - Resources	
35-50	Section 3 - Customers	
50-65	Section 4 – Partner : Who	
65-80	Section 5 – Partners : Why	
80-110	Section 6 - Craft Scenarios	
110-120	Re issue circular pitch templates X2 – if more request provide. Issue action template	Highlight Circular Pitch and Action templates provided to synthesize insights, generate ideas and plan actionable next steps.
120	Issue Tool Feedback Forms Round up workshop with group discussion on experience and insights	Note: Adapted within Demonstrations to be included into 2 hour workshop timeline

Baltic Data Collection:

- Facilitator Observations Notes - X2 Per Workshop (1 per facilitator)
- In-take forms & Evaluation forms – issue to each participant
- Group Discussion – 5 to 10 min feedback following feedback forms

Appendix H: Facilitator Observation Sheets - adapted to reflect observation topics only - when used in workshop extended to double sided A4 to collect notes

Facilitator: Group or groups facilitated:
Workshop Session: (1) (2) (3)

Topic	Facilitator Notes
Order of sections	
Timing of sections	
Which sections need more / less discussion to fill in	
Use of Personal Vs Group Reflections	
Trigger Questions	
CE Idea development	
What works	
What does not work	
Ideas for improvement of the tool	
Ideas for improvement of the facilitation	
General Insights	

Appendix O: Example comments from user feedback from Netherlands and Baltic Demonstrations. Due to the generally high scores the table provides comments linked to and categorised by low scores (3 to 5) and high scores (6 or 7).

Usefulness	
High	Amsterdam: Great questions that need to be thought about. Also like the combination with brainstorming, as this tool helps to give the ideas more substance Hamburg: Great tool! Like a modified version of Design Thinking and Business Model Canvas or Sustainable Business Model Canvas, but better as it is more detailed and this tool explores more perspectives that are necessary to become more specific, realistic and concrete Riga: It makes you look at the topic from all points. It is also good for deepening understanding and answering in groups helps to gain other types of thinking Aalto 1: The tool forces you to think systematically yet in a flexible way on the different aspects needed to develop the idea from fuzzy first thoughts to actionable first steps. I think the focus on partnerships is particularly helpful for selecting circular economy opportunities and building their strategies. Aalto 2: Enables holistic thinking by drawing out stakeholders, their pain points, opportunities & challenges. I also appreciated the format of the tool and the space for uncertainty LUT: It gives a 360° review on the problem and systematic way of handling different relevant aspects or challenges one might face and to map the needs and create a clear plan to follow for a collaborative innovation project.

Usefulness	**Low**	Amsterdam: Circularity as a starting point is adding complexity in the beginning. Maybe shuffle the order. But I also see how it might be needed to deal with the complexity first. Hard to say what is the best approach I suppose there are no easy answers to CE. Hamburg: The questions could be more specific on CE. It was a little bit difficult to differentiate between who are our customers and partners. Plus some examples are needed to help answer the questions Hamburg: Useful to identify partners and what partners are relevant. But, the circular proposition could be emphasised more Aalto 1: Similar structures and tools do exist, but helps focusing on the purpose as stated LUT: Nicely Structured and quite easy to follow. When used together with the card deck, some parts were a little repetitive and the focus on the partnerships can come a bit late
Ease of use	High	Amsterdam: Clear questions that stimulate good discussion. Working through the tool naturally brings a proposition together. But they could apply to non-CE project. Need to increase CE focus. Steps are clear and I also like that the tool is not rigid. I am not a fan of rigid brainstorming tools. Hamburg: I agree the tool is easy to use, as the structure and the questions are neat and clear. However, I feel the process of using it needs excellent facilitation skills, despite the self-explanatory structure. The questions quickly lead into the depth of markets and relationships with partners and customers, so the discussion can become very detailed quite early on, there may be a danger of getting lost in it. It also brings up information gaps and with that anxieties, resistance, etc. Unearthing those gaps is exactly what is needed to get from idea to plan, but it can be disheartening, so some leadership is needed.

Riga: It is easy to understand and work with and makes you think wider than just the product or the challenge

Aalto 1: The different elements of the tool were quite clear. The workflow was left a bit unclear, although it seems it's quite flexible and allows you to go back or forward as needed, which is probably useful for ideation

Aalto 2: Pretty straight forward, but still challenging. Really needs proper thinking, which is very good! But not so easy with a new team. But overall it really helped to think about the partners and the circular proposition

LUT: Clear, logical, and guiding questions to answer. Questions help direct discussions and idea generation

---

Amsterdam: Would like to see more questions that link the challenge, customer and the partners. And also to explore more combinations or variations between these. But I think this is more an issue of time.

Hamburg: Some questions should be stated and formulated more clearly. Too many questions overall. Plus we need a little more time to answer them.

Riga: Mapping and visualisations are great. But some example questions could help more as some questions took time to understand and discuss.

Low

Aalto 1: You needed to consider the questions carefully. Maybe a bit more guidance will be beneficial. If you work in sections it might be easier.

Aalto 2: Too many areas to fill in and the partner section was not super clear.

LUT: While comprehensive it might be too complex, maybe need to take a few questions away from the partner section.

Amsterdam: Nice to structure early stage ideas and explore potential experiments. The tool highlights how developing CE ideas can be challenging and so is better to start small, but have a clear longer-term plan.

Hamburg: Very helpful to have a structured process to take an idea apart and understand its inner workings by asking the right questions. The tool creates a great platform for having a meaningful conversation and turning an idea into a concept with concrete next steps. It also shows how it comes down to the network and that you need to be clear on the value capture potential for everyone involved

Riga: 1) the tool can be used to get deeper into an idea. 2) provides visual and written information about how to solve some issues within the idea and where some more work needs to be done. 3) The open or unanswered questions need further work to progress the idea and to solve the problem

Aalto 1: Methodically thinking and mapping out the needs of different stakeholders in a CE project, and how to start thinking about collaborating with them. Plus it shows how new problems may occur or be created by your idea, which you need to think through

Aalto 2: Partners are key. There are surprisingly a lot of different factors to take into account when thinking about circularity and your developing of a business idea. This manages to teach both circularity as well as just plain business facts. The tool also highlights a lot of uncertainties so a great combination!

LUT: Useful for strategic planning, we received new ideas on how to operate our operations. Also shows there are many players and action areas to think of when implementing a strategic CE proposal

How the idea changed by using the Tool

Amsterdam: The core idea did not change, but we identified a range of potential partners and reasons to reach out to them and propose potential small-scale experiments. The tool offered a nice way to explore and add detail to the core idea.

Hamburg: Enabled for concrete ideas and action steps when thinking through the complexity of our project. Good insights created as we pivoted after using it. The tool enabled us to find out the need to do so really quickly by understanding if the idea was useful or realistic and why or how we should change it.

Riga: After exploring customers, we found that our idea may lead to new challenges and was not very good. So we had to change it. But this also helped us think more about which customers to approach and which partners would then be needed to help.

Aalto 1: Changed a bit, more clear scope. It helped to use the circular strategies that we had learnt. But we did not know the problem so well, but the tool helped to think through it.

Aalto 2: Not really, but it brought into light many critical aspects and I believe made the concept more detailed. Plus we had more of a clear idea on what we needed to find out.

LUT: Our idea crystallised a lot. We got much more understanding of it and felt it become more complicated. But the tool makes an easy way to present the more complicated idea and explore the potential actions.

Samenvatting

Onze samenleving ziet zich geconfronteerd met vele mondiale duurzaamheidsvraagstukken. Velen van deze uitdagingen hebben wij zelf veroorzaakt of verergerd door onvoldoende na te denken op welke schaal onze handelingen impact hebben op onze planeet. We zijn weldra het Antropoceen binnengestapt; een tijdperk waarin menselijke activiteit de dominante kracht is geworden die invloed uitoefent op het klimaat en het milieu van de planeet. Het is helder dat onze handelingen, indien zij niet veranderen, zullen resulteren in het instorten van vele cruciale levensonderhoudende systemen die onze samenleving aangaan.

Een kernoorzaak in het vraagstuk hoe onze huidige handelswijzen niet duurzaam zijn en uiteindelijk de negatieve impact op de planeet tot stand brengen, is de wijze waarop producten en diensten produceren, gebruiken en consumeren. Wat hierbij aan het licht komt is hoe goederenstromen niet meer in balans zijn met Aardse ecosysteem. De structuur waarmee we in onze economie ingericht houdt simpelweg geen rekening met het eindige en beperkte karakter van hulpbronnen of de ecologische capaciteit om bronvoorraden te vernieuwen. Het is duidelijk dat er een kentering moet plaatsvinden in de manier waarop onze productie-, consumptie en economische systemen functioneren. Vooral als we ernstigste antropogenische impact willen voorkomen of zelfs terugdraaien. Dit zal creativiteit vergen en het operationaliseren van nieuwe ideeën om te komen tot nieuwe wijzen waarop wij zaken voor elkaar krijgen. In andere woorden, we zullen moeten innoveren. Alleen ditmaal met het vergroten van de duurzaamheidsimpact als centrale drijfveer en ratio voor innovaties.

Het concept van de circulaire economie (CE) wordt gezien als een veelbelovende benadering, aangezien het een systemisch perspectief voorstelt over hoe goederen (materiaal en energie) kunnen vloeien, neerslaan en circuleren binnen systemen om het functioneren van onze economie te veranderen en meer te stroomlijnen met de wijze waarop natuurlijke systemen functioneren. De kernidee van CE is dat door innovatieve circulaire system men poogt om het gebruik – en crucialer, het hergebruik – van waardevolle grondstoffen die binnen het systeem gebracht worden, te verlengen. Hiermee wordt gedacht de mogelijkheden voor ‘terugploegen’ (value capturing) en de opslagmogelijkheden te optimaliseren en om aan het einde van de levensduur een helder plan te

hebben voor het herwinnen van grondstoffen. De ideeën en innovaties benodigd voor het ontwikkelen van een CE bevinden zich op een terrein met vele uitdagingen en evenzoveel onbekendheden. Tegelijkertijd wordt er gedacht dat er vele nieuwe kansen voor ondernemers zullen ontstaan om zowel hun potentie tot value capturing te vergroten, hun kwetsbaarheid tegen grondstofschaarste te verkleinen en hun impact op het milieu te verkleinen. Niettemin is om circulaire systemen te creëren en toenemend circulaire goederenstromen te operationaliseren het integreren van circulaire strategieën noodzakelijk. Dit is het combineren van ontwerp, bedrijfsmodel en waardeketensamenstelling met het uitdrukkelijk doel om de stroom van grondstoffen te vernauwen, vertragen en sluitend te maken. In deze dissertatie wordt dit gedefinieerd als het ontwikkelingen van een circulair georiënteerd innovatieproces (COI).

COI is een probleemgestuurde benadering van innovatie met het doel systemische duurzaamheidsvraagstukken op te lossen middels het integreren van verschillende combinaties van circulaire strategieën. Het geïdentificeerde probleem helpt in het definiëren van het doel, de streefnormen en de reikwijdte van het COI-proces. Tegelijkertijd wordt hiermee het referentiekader bepaald en gestimuleerd tot het nadenken over ideeën en potentiële combinaties van circulaire strategieën die een probleem zouden kunnen oplossen of de effecten daarvan zouden kunnen verzachten. COI vereist derhalve dat organisaties nieuwe producten ontwerpen en bedrijfsmodellen ontwikkelen die rekening houden met het verlengen van de levensduur. Waar nodig zullen er meerdere levenscycli moeten worden opgenomen, waardoor ondernemers zich zullen moeten richten op het onderhouden van terugwinningssystemen door toepassen van reparatie, hergebruik, renovatie, herproduceren en het herwinnen van grondstoffen. Hier is een meer systemische benadering nodig dan de meeste ondernemingen gewend zijn of de vaardigheden, kennis en middelen voor hebben om dit te ontwikkelen. COI vraagt om gezamenlijk innovatie langs alle stadia van de productiecyclus van een product; vanaf het initiële idee en ontwerp tot aan einde van de levensduur en het herwinnen van materialen. Dit betekent dat actoren die onder normale omstandigheden niet zouden hebben samengewerkt dit nu wel zullen moeten doen om zo circulaire strategieën te integreren. Alleen zo kunnen ze verkennen wat de wegen kunnen zijn naar waardecreatie, waardevangst, waardeopslag en –meest cruciaal – waardeherwinning. Zo ontstaat een gedeelde leerweg naar het

onbekende, waarin bestaande werkwijzen en samenwerkingsvormen worden uitgedaagd.

Hoewel er brede erkenning is voor de noodzaak om samen te werken om circulaire systemen te kunnen ontwikkelen is er weinig bekend over hoe gezamenlijke COI zich ontvouwt en hoe ondernemingen gezamenlijke innovatie opzetten en implementeren in een CE context. Daarnaast is het onduidelijk of gezamenlijk COI processen specifieke uitdagingen of verschillen met zich meebrengen in vergelijking met andere ambities tot gezamenlijke innovatie.

De transitie naar een CE vergt zowel een top-down (overheid, beleid en wetgeving) als een bottom-up (ondernemingen, grass-roots en mensgeoriënteerde bewegingen, en klantvraag) benadering. Samenwerking staat centraal binnen zowel top-down als bottom-up benaderingen, en de wijze waarop deze zijn verbonden. Samenwerking kan worden bestudeerd op en langs verschillende niveau's van analyse op micro- (individuen of teams), meso- (tussen ondernemingen, organisaties, netwerken of regio's) of macroniveau (international/nationaal beleid, juridische of economische systemen). Al deze niveau's van analyse zijn van belang voor het ontwikkelen van een CE. Samenwerking context- en tijdsafhankelijk, wat ertoe leidt dat het mogelijk is om samenwerking te onderzoeken als een momentopname of een proces dat longitudinaal en context-specifiek bekeken moet worden.

Deze dissertatie neemt een procesperspectief in om gezamenlijk innovatie bestuderen lang verschillende gezamenlijk COI processen bij samenwerkende ondernemingen die circulaire producten en diensten proberen te ontwikkelen. Ondernemingen zijn kernspelers in de implementatie van COI strategieën en de daarbij behorende ontwikkeling van circulaire producten, diensten en benodigde circulaire herwinningssystemen. De focus van dit verkennende onderzoek is om te begrijpen hoe ondernemingen gezamenlijk innoveren en voor welke uitdagingen binnen het COI proces zij zich geconfronteerd zien. Het onderzoek is gericht op het beantwoorden op de centrale onderzoeksvraag: Hoe kunnen ondernemingen ondersteund worden in het najagen van gezamenlijke COI?"

Deze dissertatie is in twee delen opgesplitst. Elk deel presenteert exploratieve studies die gevoed door de literatuur en de praktijk specifieke

subvragen beantwoorden, die op hun beurt weer bijdragen aan het beantwoorden van de centrale onderzoeksvraag. COI activiteiten moeten niet alleen kunnen aantonen en verantwoorden dat een circulair wenselijk, haalbaar en uitvoerbaar is; vanuit een samenwerkingsperspectief is het juist de uitdaging hoe ondernemingen aan ideevorming, ontwikkeling, testen en versnelling van COI doen. De studies in de deel 1 borduren voort op bestaande literatuur om te identificeren wat er al bekend is over gezamenlijke innovatie en gebruikt inzichten daaruit om casus data te analyseren om te verkennen waarom, hoe en welke processen zich ontvouwen binnen gezamenlijke COI. Deze exploratieve studies in deel 1 hebben als doel een dieper inzicht te krijgen in de aard van samenwerking binnen een circulaire context. De initiële omstandigheden, managementbenaderingen en processtappen die toegepast worden in gezamenlijke COI kunnen hieruit geïdentificeerd worden en kunnen zo een completer beeld geeft van de samenwerkingsprocessen, mogelijke eigenaardigheden en uitdagingen die de CE-specifieke context genereert in het gezamenlijk innoveren. De uitdagingen komen centraal te staan in deel 2, wat als doel heeft om een instrument te ontwikkelen die ondernemingen ondersteunt in het overwinnen van de obstakels en het integreren van circulair en systemische denken in hun gezamenlijke innovatieprocessen.

Hieronder volgt een kort overzicht van hoofdstukken. Hoofdstuk 1 zet de achterliggende gedachte van het onderzoek, de kernbegrippen, de reikwijdte, de hiaten en de vragen uiteen en presenteert de structuur van de dissertatie. De hoofdstukken 2 tot en met 5 bestaand uit gepubliceerde en ingediende artikelen. Hoofdstuk bevat een discussie en de conclusies uit de bijdragen aan deze dissertatie.

Hoofdstuk 2 – WAAROM: “Wat zijn de motieven, barrières en drijfveren die gezamenlijke innovatie stimuleren of hinderen binnen de context van een circulaire economie?”

Het doel is om te begrijpen waarom gezamenlijk innovatie begint en te verkennen welke initiële omstandigheden kunnen leiden tot samenwerking in een circulaire economie context. Dit hoofdstuk legt het grondwerk op basis van de literatuur om COI te definiëren en situeren als toenemend collaboratief, radicaal en systemisch spectrum in de innovatiepraktijk. Vanuit de literatuur zullen ‘harde’ (technisch en marktgerichte) en ‘zachte’ (culturele en institutionele) drijfveren en

barrières voor COI worden ontleend. Deze zullen dan getest worden door middel van semi-gestructureerde interviews uit praktijkgerichte casus-studies. Deze analyse laat zien dat het overwegend 'zachte' uitdagingen zijn die gezamenlijk COI kunnen verhinderen. Dit werk identificeert het 'waarom' de beoefenaars en hun respectievelijke ondernemingen besluiten over te gaan tot gezamenlijk COI; het proces combineert normatieve, intrinsieke en extrinsieke motivaties voor zowel betrokken individuen als ondernemingen. Daarnaast laat de analyse zien dat het binnen gezamenlijk COI van cruciaal belang is dat een entrepreneur gemotiveerd raakt door een geïdentificeerd systeemfalen, maar tegelijkertijd zich bewust is van de onderlinge afhankelijkheid die inherent is in het zoeken naar mogelijke COI. Een dergelijke actor is dus gestimuleerd om actief gezamenlijke innovatie en experimenteren op te zoeken.

Hoofdstuk 3 – HOE: "Hoe werken ondernemingen samen voor een COI?"

Hier wordt voortgeborduurd op het 'waarom' om het 'hoe' te verkennen en begrijpen. Dit hoofdstuk ontleend elementen uit de literatuur op het gebied van strategisch management om te begrijpen hoe gezamenlijke innovatiemanagement ingesteld zou kunnen worden. Hieruit vloeien de strategische beslissingen die de mate van openheid binnen gezamenlijke innovatie bepalen, de verschillende kennismanagementbenaderingen, de potentiële wrijvingen die kunnen ontstaan en de verschillen soorten innovaties die mogelijk zijn. Een cruciaal raamwerk die uit het voorgaande resulteert, roept de vraag op of de reikwijdte van activiteiten in een COI incrementele of systemische intenties vertegenwoordigen. Deze principes uit de literatuur zullen afgezet worden tegen verschillende praktijkgerichte casus-studies om gelijkenissen en verschillen te ontwaren. De analyse laat zien dat verschillende collaboratieve benaderingen en mate van collaboratieve openheid (intern en extern) binnen COI projecten het gevolg is van de reikwijdte van innovatieve activiteiten. Dit bepaald namelijk de noodzaak voor concurrentie of meer collaboratieve partners. Uitdagingen die het aantal of type partners omgeven (vooral of er concurrenten inzicht zijn of niet) binnen een project lijken van invloed te zijn op kennismanagementbenadering en hoe gezamenlijke projecten gestructureerd kunnen worden. Bij incrementele innovatie is er meer gefaseerde samenwerking gevonden, terwijl bij systemische innovatie er

meer gezamenlijke dossiers en gelaagde benaderingen te zien zijn. Dit helpt ons begrip van de verschillende redenen die leiden tot verschillende COI benaderingen.

Hoofdstuk 4 – WAT: "Welke processen ondergaan ondernemingen als ze gezamenlijke COI ontwerpen en implementeren?"

Dit hoofdstuk heeft als doel te begrijpen welke ontwerp- en implementatieprocessen er worden ondernomen binnen COI. Hierbij wordt strategisch managementonderzoek betrokken om wat bekend is over gezamenlijke processen samen te vatten om te komen tot voorstellen voor 'procesbouwstenen'. Deze literatuur wordt gebruikt om COI cases te onderzoeken op basis van drie onderzoekscycli; het verkennen, het 'waarderen' en doorgronden van gezamenlijke ontwerp- en implementatieprocessen. Deze studie komt tot een gezamenlijk COI procesmodel. Deze kan als basis dienen voor een mogelijk toekomstige onderzoeksagenda, die kan helpen actuele uitdagingen te identificeren en de gebieden kan aanwijzen waarin een instrumentarium oplossing zou kunnen bieden in het ondersteunen en bevorderen van het gezamenlijke COI proces. Een van de primaire uitdagingen binnen het proces (die kan doorwerken in latere processtappen en het uiteindelijke resultaat van de samenwerking) is het vinden en kiezen van de 'juiste' partner(s) voor een gezamenlijk COI-project. Dit is een voorwaarde om een werkend samenwerkingsverband te ondersteunen die het verkennen van een circulaire idee voorwaarts kan stuwen.

Hoofdstuk 5 – Instrument: "Hoe kan een instrument bedrijven ondersteunen in het denken over mogelijke partners en gezamenlijke waarde om te komen tot een circulaire ontwerpvoorstel?

In dit hoofdstuk wordt het proces van het ontwikkelen van het instrument belicht waarbij benadering uit de ontwerpwetenschap worden gebruikt om te komen tot een herhaalbaar ontwerp, deze te demonstreren en te evalueren op gebruiksgemak en nut. Inzichten uit deel 1 worden gebruikt, waarbij de aanvankelijke uitdaging bestaat hoe na te denken over en te komen tot een selectie van partners wanneer met een circulair voorstel ontwerpt. Dit hoofdstuk doet een greep uit de literatuur over duurzame en circulaire ontwerpprocessen voor instrumenten om ontwerpcriteria te distilleren. Het instrument bouwt voort op de literatuur en vertaald effectieve besluitvormingsprincipes naar activerende vragen (triggers)

binnen een zogenaamde ‘canvas’ die helpen om de uitdaging, grondstoffen, consumenten en potentiële samenwerkingspartners te visualiseren. Het doel hierbij is om het nadenken te stimuleren over het ontwerpen van een wenselijke, haalbare en uitvoerbare circulaire propositie. Het hoofdstuk toont de belangrijkste leerpunten en voordelen die deelnemers hebben ervaren in het gebruik van het instrument. Het instrument helpt (1) het concentreren op het in kaart brengen en visualiseren om zo te bewegen van abstract en creatief denken naar testen van assumpties en het plannen van concrete handelingen; (2) het creëren van een initieel gedeelde visie; en (3) het diepgravend onderzoeken van een circulair voorstel of het belichten van de noodzaak tot kanteling of aanpassing van dat voorstel. Het instrument stimuleert vaardigheden om snel na te denken over de wenselijkheid, haalbaarheid en uitvoerbaarheid van een idee, door het perspectief te verplaatsen naar een samenwerkingspartner. Dit hoofdstuk draagt bij aan de centrale onderzoeksvraag door een mogelijkheid voor te stellen waarmee ondernemingen ondersteund kunnen worden in het najagen van gezamenlijke COI.

Hoofdstuk 6 – Discussie en conclusies:

De som van de bevindingen uit voorgaande hoofdstukken worden hier bediscussieerd om te komen tot conclusies en een reflectie op de bijdrage aan en implicaties voor de praktijk en theorie. Twee algemene bijdragen uit dit onderzoek springen in het oog; (1) de instrumentaria en inzichten die uit het voorgaande processen zijn gewonnen; en (2) de bevinding dat gezamenlijke COI meer focus nodig heeft op de ‘zachte’ kant van gezamenlijke innovatie.

De ontwikkelde tool helpt bij het kaderen van de discussie ter ondersteuning van het COI-ideevormingsproces. De triggers sturen en helpen gebruikers om bredere perspectieven te bedenken. Het canvas fungeert dan als een fysieke ruimte om deze perspectieven in kaart te brengen en te visualiseren. Dit ondersteunt ideeën, of hiaten in een idee en de kennis, om de gebruikers te helpen om van een abstract idee naar het plannen van concrete acties te gaan. Verder toont dit onderzoek de waarde aan van het situeren van combinaties van specifieke tools binnen het bredere COI-proces; om bij elke stap, stap voor stap te ondersteunen. Maar het laten ook zien hoe een deskundige facilitator van belang is om als een ‘circulair geweten’ te handelen; deze kan de focus op circulariteit

behouden of de gebruikers helpen vooruitgang te boeken door het gebruik van de tool.

Dit hoofdstuk concludeert dat het instrumentarium en methoden die het COI-proces ondersteunen, slechts een gedeelte van de puzzel vormen. De studies laten zien dat de 'zachte' kant van COI-samenwerking een belangrijke uitdaging vormt om echt aan te passen of nieuwe circulaire systemen te creëren. Meer specifiek, we hebben de technische oplossingen of de manieren om deze te ontwikkelen, maar we moeten ons aangeleerde gedrag en de overheersende mentaliteit rond het maximaliseren van individuele voordelen overwinnen. Een belangrijke focus hier is dus de vereiste mentaliteit en organisatorische capaciteit die nodig is om zich aan te passen of nieuwe systemen te creëren die bedoeld zijn om duurzame effecten te produceren. Maar bovenal moeten actoren bereid zijn om samen te werken en duidelijk zijn dat het waarschijnlijk niet eenvoudig zal zijn om een geïdentificeerde duurzaamheidsuitdaging aan te gaan; de betrokken actoren moeten allemaal een duurzame impact willen bereiken en het leiderschap en de vooruitziende blik hebben – zelfs inzicht in de risico's of uitdagingen die inherent zijn aan een meer systemisch COI-proces – om zich te engageren. Daarom moeten de betrokken actoren zich engageren en samenwerken met partners met de juiste mentaliteit hebben: effectief, experimenteel, systemisch en verantwoordelijk.

Als een functionerend samenwerkingsverband ontbreekt zou het gezamenlijke COI-proces consequent kunnen worden gefrustreerd. Dit zou men ertoe kunnen leiden te denken dat circulaire strategieën en systemen niet werken, in plaats van te zien dat het aan de mentaliteit ontbreekt om effectief samen te werken om een systemisch COI-project uit te voeren.

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Thirdly, I would like to thank my friends from the University of Manchester and London, we have had great times and continue to do so, I hope to see you again soon. I would also like to thank Maialen Irazoqui

Apecechea, we sadly did not make the whole journey together, but without you, the drive to return to the Netherlands to start my PhD studies and have a fun and caring home while doing it would have made the journey harder. We had great years together and I appreciate all we shared. I wish you all the best. To my good friend Pedro Roco, you welcomed me into the Zoutman and Den Haag. You have been there through good times and bad and helped throughout. I am grateful for the friendship we have forged. Finally, a big thank you to all my friends in Den Haag and the Netherlands who have helped me feel at home here while researching my PhD. The many hours of boot camps, surfing, climbing, petanque, music, festivals, beach fun times, Corona time board games and general laughter have kept my mind, body and soul together. Thanks to you all.

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Sincerely,

Phil Brown

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About the Author

Phil Brown was born in Huddersfield, West Yorkshire in the United Kingdom. He graduated on his BA (Hons) in philosophy and social sciences at the University of Manchester in 2009. He then worked in business development, firstly, for a market intelligence company. He then moved to Ecometrica, who developed carbon calculation and environmental mapping software services. However, Phil wanted to go deeper and learn more to be able to support and implement sustainable ideas within businesses. So he decided in 2013 to pursue his MSc at Cranfield University in Environmental Management for Business. Here, he successfully applied to the Ellen MacArthur Foundation's (EMF) Schmidt MacArthur Circular Economy Fellowship. His MSc thesis became a circular economy innovation project, whereby he investigated the feasibility of recovering waste plastic for 3D printing materials.

The EMF network and his research introduced him to the Better Future Factory, a start-up based in Rotterdam. Following his MSc, they decided to work together and turn their ideas into action to deliver 100% recycled 3D printing material to market. Whilst, presenting his work at Resource London 2015 Phil caught the attention of UK based High Speed Sustainable Manufacturing Institute (HSSMI), who offered for him to join their Circular Value Chains Team. Here he worked on UK and EU circular innovation projects on business models, manufacturing processes and supply chains. These experiences highlighted the need for increased collaboration and that many questions were outstanding on how to support companies to collaborate effectively to develop circular products and services.

This brought Phil back to the Netherlands in June 2016 to join the design for a circular economy research group to work on his doctoral research. Throughout his research, Phil has engaged with companies to deepen understanding into the collaborative circular oriented innovation process and its challenges. His aim was to develop tools to support companies to collaborate to turn circular economy ideas into action. Phil has also supervised multiple MSc graduation projects. And, he has worked with the Leiden, Delft, Erasmus centre for sustainability, Climate KIC and numerous innovation hubs to demonstrate and evaluate tools to support the circular oriented innovation process. His aim throughout was to help and stimulate others to turn their circular ideas into action.

CIRCULAR STRATEGIES

Our society faces many environmental and sustainability challenges created or exacerbated by our unsustainable actions. One set of unsustainable actions is how we produce, use or consume products and services, and finally dispose of them and their materials. Our current production and consumption systems are out of balance with planetary systems; as we do not fully account for the finite and limited nature of resources, their capacity to be renewed or the environmental impacts of their production, use and deposal. We need to change how our production and consumption systems function, especially if we are to reverse or avoid the worst environmental and sustainability challenges we face.

The role of innovation to explore and bring about such changes is widely recognised by academia, industry and policy. Furthermore, the circular economy is increasingly explored as a way to innovate and integrate a systemic perspective necessary to change how our production and consumption systems function. The circular economy proposes systemic circular oriented innovation strategies, which aim to narrow, slow and close resource loops. This requires companies to explore new combinations of product design, business models and crucially new configurations of relationships. The aim is to create new systems that transform how materials, energy, products and value flows within a system and ultimately design how they can be recovered. This thesis argues that this requires increased attention to the way that companies collaborate to bring about such changes.

This thesis presents exploratory research that first set out to understand and secondly support collaborative circular oriented innovation. It does so by exploring why, how and what collaborative processes unfold between companies when conducting circular oriented innovation. Based on these insights and the identification of current challenges this thesis then designs and tests a tool that aims to stimulate ideation on the design of a desirable, feasible, and viable circular proposition by bringing in a focus on collaborative partners. The overall aim of this research and the developed tool is to support companies to advance and turn their ideas into action.