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ABSTRACT

Circular oriented innovation commonly requires collaboration. Yet, to date, circular research lacks empirical investigation into collaborative processes. Collaborative processes are, however, highly researched within strategic management literature, thus offering valuable insights. The purpose of this paper is to investigate, identify and order the processes that companies undertake when designing and implementing collaborations for circular oriented innovation. Firstly, we integrate disparate strategic management literature to identify collaborative process 'know-how' and relevant 'building blocks'. Secondly, we generate practice-based insights, via semi-structured interviews and desk-research, across three research cycles to understand how companies collaborate within circular oriented innovation. Theoretical contributions stem from the assessment and integration of strategic management collaborative process knowledge into the circular context. Managerial contributions derive from the process model that describes how to build collaborative circular oriented innovation. Furthermore, the principal result is the empirical investigation and identification of collaborative circular oriented innovation challenges. Challenges relate to how to; 1) formulate an initial 'circular proposition', 2) involve the 'right' people, 3) align upon a shared circular purpose, 4) develop circular oriented governance and decision-making, and 5) develop a circular oriented value capture model focused on collective outcomes. These form the basis for our proposed future research agenda. This research agenda aims to stimulate researchers and practitioners to further demystify collaborative processes to accelerate the transition towards a circular economy.

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 and 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., 2019; Bocken et al., 2017; Boons and Bocken, 2018; Lüdeke-freund et al., 2019). Instead, COI requires connecting expertise from upstream and downstream actors to create 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., 2019; Geissdoerfer et al., 2018a). Leising et al. (2018) 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

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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 on collaborative innovation.

Collaborative innovation process research comes from diverse disciplines and can incorporate different levels of analysis. This positions boundaries concerning the study focus; 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 and Seitanidi, 2012a; Valkokari and Rana, 2017). How collaborative innovation processes develop and function overtime between organisations has long been a highly researched topic within strategic management (Provan et al., 2007, 2008), and continues to be a core research focus (e.g. Bogers et al., 2019; Burgelman et al., 2018; Fjeldstad et al., 2012; Möller and Halinen, 2017; To and Ko, 2016)[1].

Research into the collaborative process between organisations (meso level) aims to identify how to formulate, select, and implement specific strategies and actions to secure competitive and collaborative advantages. Yet, Bryson et al. (2015) state collaborative process knowledge is fragmented within strategic management literature, exhibits low-levels of consensus and presents a large portfolio of processes and practices. Aligning with the high context-dependence identified by Wood and Gray (1991), later expanded in work by Gray and Purdy (2018), recognised amongst foundational contributions to collaboration research (Purdy et al., 2018). Despite this contextual nature several themes, regarding strategic, cultural and organisational capabilities (Bogers et al., 2019; Davis and Eisenhardt, 2011; Majchrzak et al., 2015; Ritter and Gemünden, 2003; Swink, 2006) and process 'building blocks' (Bryson et al., 2015; Clarke and Fuller, 2010; Emerson et al., 2011; Gray and Stites, 2013) have emerged that share some degree of consensus for how to conduct collaboration.

There is also a growing exploration into how strategic management research can engage with CE and sustainable grand challenges, yet there is currently limited empirical investigation into the circular context (Bogers et al., 2020; George et al., 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. (2018b). This is substantiated by the lack of real-world examples and operationalisation of CE (Blomsma et al., 2018; Blomsma and Brennan, 2017; Bocken et al., 2017).

To investigate this knowledge gap for collaborative processes within COI, we use a process research approach. Process research asks how and why things (people, organisations, strategies, environments) change over time (Langley, 1999; Langley et al., 2013). Process studies can take a 'weak' (change in phases) or 'strong' focus (change as continuous) (Langley, 2007; Langley et al., 2013; Sandberg et al., 2015) and can trace backwards using retrospective analysis or forwards using longitudinal analysis to understand how change unfolds (Langley, 2007). In this paper, we take a 'weak' process focus to identify phases of collaboration via integrating disparate strategic management research. We generate practice-based insights through retrospective analysis of the experiences of actors inside the COI projects who directly managed collaborative activities. 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 2 outlines collaborative processes from strategic management literature, to derive a set of process 'building blocks' relevant to the design and implementation of collaborative innovation. Section 3 presents the research cycles, case-study data, and analysis. Then section 4 presents our empirical findings and a structured process model. Section 5 discusses the model, proposes future collaborative COI research, and presents the limitations of this study. Finally, section 6 presents our conclusions.

2. Literature background: understanding the process to design and implement collaborations

Section 2.1 presents key definitions for collaborative innovation and section 2.2 distinguishes collaborative process phases from literature. Section 2.3 presents dynamic aspects of collaboration, which are not a specific phase in themselves, but factor into the overall collaborative process. Lastly, section 2.4 consolidates these insights into our conceptual framework to aid our study and understanding of collaborative COI.

2.1. Defining collaborative innovation

Collaboration is difficult to define (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 et al., 2010; Wood and 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.

[1] Other approaches beyond strategic management used within this paper offer valuable insights for understanding collaborative COI, e.g. innovation literature, such as sociological approaches; Social Construction of Technology (SCOT, e.g., Klein and Kleinman, 2002; Martin-Rios, 2016; Nyström et al., 2014) or Actor-Network Theory (ANT, e.g., Aka, 2019; Corsaro et al., 2012; London and Pablo, 2017), or Transitions research such as; multi-level perspective (MLP, e.g., Geels, 2011, 2002; Schot and Geels, 2008) or Technology Innovation Systems (TIS, e.g., Hekkert et al., 2007; Lindgren, 2016; Planko et al., 2017).

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 and Crosby, 2015; Clarke and Fuller, 2010; Emerson et al., 2011; Gray and 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.

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 et al., 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 and 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 and 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 (Bocken et al., 2013; Breuer et al., 2018; Evans et al., 2017b; Schaltegger et al., 2016; Stubbs and 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. (2018), Kraaijenhagen et al. (2016, p. 67), and Leising et al. (2018) 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.

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 (Davis and Eisenhardt, 2011; Dyer and Singh, 1998; Romero and 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 and Cummings, 2009; Simonin, 1997). Cummings and 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 and Santamaría, 2007; Powell et al., 1996; Provan et al., 2007; Thorgren et al., 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 and Manzini, 2009; Pisano and 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 (Gray and 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; Brown 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).

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. (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 (Gray and 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., 2018). Such practices should highlight the participant's background, perspectives, and interests and are intended to explicate the desired innovation value.

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 and Crosby, 2015; Emerson et al., 2011; Ritter

and 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 and 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 and 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.

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 (Gray and 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 and Molina, 2011). Yet, understanding how new business models are collaboratively implemented is nascent (West and 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 (Bocken et al., 2019; West and Bogers, 2017). This challenge is increased when the focus is on sustainable value capture, due to the wider scope of value and actors needed (Bocken et al., 2013; Evans et al., 2017a, 2017b; Yang et al., 2017).

In COI, Leising et al. (2018) 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.

2.3. Employ dynamic aspects of collaboration within design and implementation

Several relational factors influence the overall collaborative design and implementation process. Gray and 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 and Salmelin, 2018; Goodman et al., 2017; Kraaijenhagen et al., 2016; Leising et al., 2018; Zucchella and Previtali, 2018).

Secondly, effective communication drives collaborative performance and is characterised as civil, reasoned, open, inclusive, and active (Emerson et al., 2011; Kähkönen et al., 2017). Collaboration requires communication to espouse and integrate values, norms, and discuss behaviours (Koschmann et al., 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 (Davis and Eisenhardt, 2011) or tensions arising from collaborators characteristics (Bryson et al., 2015; Gray and Stites, 2013; Lichtenthaler and Lichtenthaler, 2009; Weare et al., 2014), is crucial to successful collaborative relationships.

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 1, 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 1 forms the conceptual framework we use to empirically investigate our collaborative COI cases.

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 3.1), 'Validate' (section 3.2), and 'Deep-Dive' (section 3.3), (shown in Fig. 1), 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 et al., 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

Table 1
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 and Seitanidi, 2012a; Eisenhardt and Schoonhoven, 1996; Powell et al., 1996; Tidd, 1995; Tidd et al., 2005)
	Need identified based on organisational characteristics	Lack of existing competencies, a strong corporate culture, low management comfort	(Faems et al., 2005; Felin and Zenger, 2014; Tidd, 1995; Tidd et al., 2005)
	Articulate intent	System sketch of processes	(Kraaijenhagen et al., 2016; Leising et al., 2018)
		Road mapping and Business modelling	(Rohrbeck et al., 2013; Wiener et al., 2018)
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 and Seitanidi, 2012b; Cummings and Holmberg, 2012; Holmberg and Cummings, 2009; Simonin, 1997)
		Shared or complementary material flows	Kraaijenhagen et al. (2016)
		Existing partners	(Austin and Seitanidi, 2012b; Bryson et al., 2015; Provan et al., 2007; Seitanidi and Crane, 2009)
		Control over partners	(Lazzarotti and Manzini, 2009; Pisano and Verganti, 2008)
		Openness of collaboration	(Bengtsson et al., 2015; Lazzarotti and Manzini, 2009; Pisano and Verganti, 2008)
	Partner selection based on complementarity and fit	Complementary capabilities and resources	(Austin and Seitanidi, 2012b; Davis and Eisenhardt, 2011; Dyer and Singh, 1998; Kraaijenhagen et al., 2016; Majchrzak et al., 2015; Romero and Molina, 2011; Seitanidi and Crane, 2009)
		Shared understanding	(Kraaijenhagen et al., 2016; Leising et al., 2018; Seitanidi and Crane, 2009)
		Shared interests	
		Risk tolerance	Gray and Stites (2013)
Aligning partners on a shared purpose	Formulating a shared purpose	Preparation of partner background (interests)	(Gray and Stites, 2013; Kraaijenhagen et al., 2016; Leising et al., 2018)
		Invite competitors	Kraaijenhagen et al. (2016)
		Goal Alignment for collaborative advantage	(Bryson et al., 2016; Majchrzak et al., 2015)
	Principled engagement	Discovery, Definition, Deliberation and Determination of key ideas, interests and ambitions	Emerson et al. (2011)
		Linked interests & value	(Austin and Seitanidi, 2012b; Seitanidi and 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 and 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 and Gemünden, 2003)
		Rules of conduct	
		Development of joint decision-making processes	(Cao and Zhang, 2010; Majchrzak et al., 2015)
	Network governance mechanisms	Shared governance	(Provan and Kenis, 2008; Valkokari and Rana, 2017)
		Lead organisation Governance	
		Network Administrative Organisation governance	(Kraaijenhagen et al., 2016; Provan and Kenis, 2008; Valkokari and Rana, 2017)
	Conflict management	Defined mechanisms to resolve difference of opinion	Gray and Stites (2013)
Defining a value capture model	Managing risks, responsibilities and rewards	Definition of accountability criteria	Gray and Stites (2013)
		Intellectual property rights	(Bogers, 2011; Majchrzak et al., 2015; Provan and Kenis, 2008; Romero and Molina, 2011; West and Bogers, 2014)
		Introduction of shared vision and circular principles into contract	(Kraaijenhagen et al., 2016; Leising et al., 2018)
		Simplistic contracts	Kraaijenhagen et al. (2016)
		Combination of multilateral and bilateral agreements	
		Defined valuation methods for EOL products	
		Collaborative mind-set	(Gray and 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., 2018; Majchrzak et al., 2015; Zucchella and Previtali, 2018)
		Attracting Sponsorship	
		Evoke commitment	

(*continued on next page*)

Table 1 (*continued*)

Process Phase and Category	*Key Aspect (What is needed)*	*Sub aspect (How to achieve or understand what is needed)*	Contributing authors
		Provide Guidance	
	Leadership characteristics	Self-awareness	(Dietrich et al., 2010; Kraaijenhagen et al., 2016; Pitsis et al., 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)
	Communication	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	(Gray and Stites, 2013; Tidd et al., 2005)
		institutional security	
		legitimized self-interests	
		Length and frequency of positive experience	
	Conflict resolution	Reconciliation through recombination	Davis and Eisenhardt (2011)
		Balancing and resolving tensions	(Bryson et al., 2015; Gray and Stites, 2013; Lichtenthaler and Lichtenthaler, 2009)

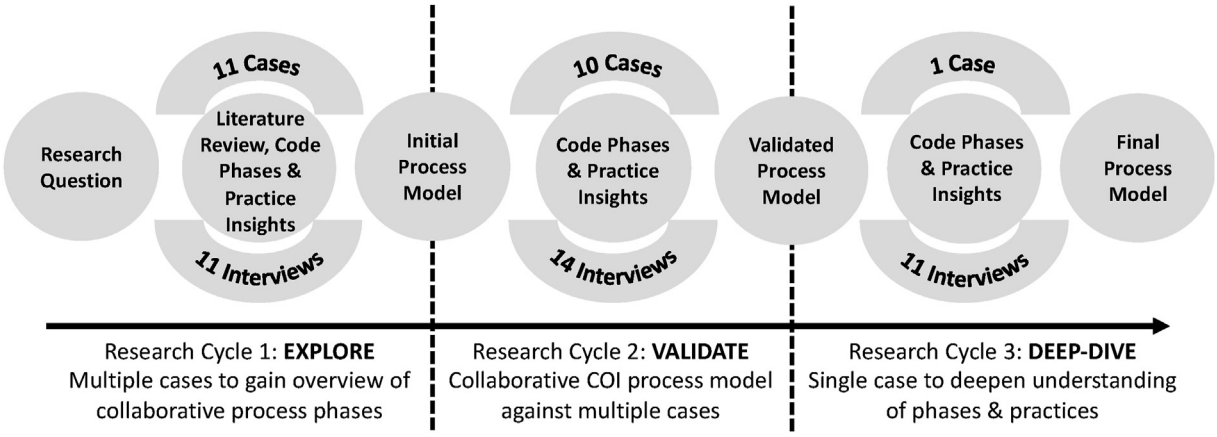

Fig. 1. Research cycles and methodology used to develop a collaborative circular oriented innovation process model.[21].

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.

3.1. Research cycle 1: Explore

We reviewed collaborative process literature[3] to identify an initial set of 'building blocks' (Table 1). An overview of interviewees is given in Table 2 and interview questions are provided in Appendix A. These explorative interviews were coded, using NVivo software[4] 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.

3.2. Research cycle 2: Validate

An overview of interviewees is given in Table 3 and interview questions are provided in Appendix B. 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.

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

[3] 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.

[4] 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.

Table 2
Research cycle 1 explore – overview of the interviewees.

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

Table 3
Research cycle 2 validate - overview of the interviewees.

Company	Interviewee(s)		No. Of Interviews	Total Length (Mins)	Industry	Product Category/Type	No. Of Employees
	Code	Position					
2	V-A	2 X CE Design and Business Model Researchers	1	70	Electronics	Consumer products	>70,000
6	V-B	Research Engineer	1	73	Furniture	Beds and Mattresses	>200
12	V-C	Program Manager Sustainable Entrepreneurship	2	125	Tourism Hospitality	Holiday accommo-dation	>3000
13	V-D	Head of Sustainable Development (EMEA) + Concept Designer	2	175	Flooring	Carpet	>3000
14	V-E	Project Manager Business Development	1	80	Waste Management	Material collection & recovery	>8000
15	V-F	Co-Founder	1	75	Sports Equipment	Refurbished race bicycles	<5
16	V-G	Material Resource Manager	1	75	Waste Management	Material collection & recovery	>80,000
17	V-H	Circular Economy Business Developer	2	140	Material Producer	Waste to biological composites	>60
18	V-I	Project Manager Sustainability EMEA + Sourcing Manager Packaging and Waste	2	125	FMCG	Coffee Retailer	>250,000
19	V-J	Sourcing Manager + Corporate Sustainability + Commercial Market Manager	1	90	Energy	Energy infrastructure management	>150,000

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.

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 Fig. 2. 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.

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

[2] Data from research cycles 1 & 2 have been used respectively within Brown et al. (2019; 2020). These data sources provided early insights (research cycle 1) into the collaborative processes to support the development of our initial process model and then validate this model (research cycle 2). Research cycle 3 then deep-dives into the process model to highlight further challenges.

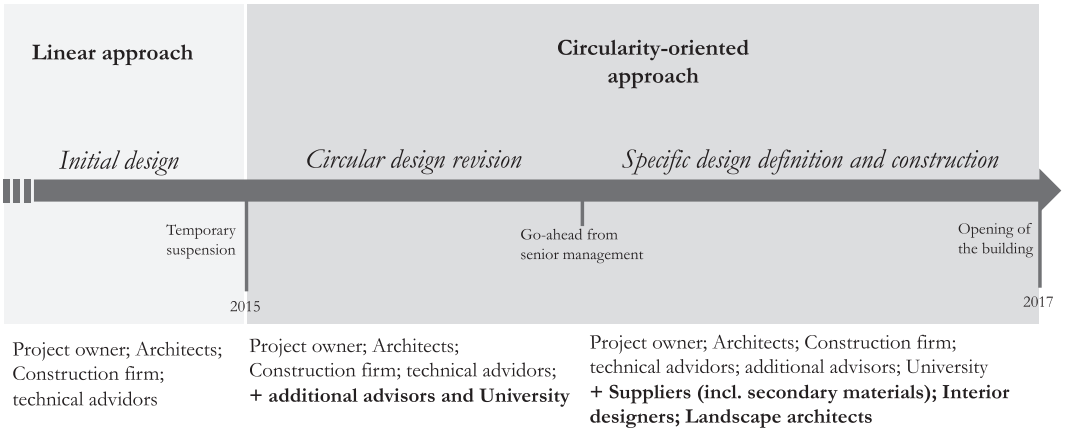

Fig. 2. Timeline of the innovation process of the Case.

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 4 and semi-structured interviewees in Table 5. Interview questions are provided in Appendix C.

3.3.3. Data analysis

Interviews were coded using software (Atlas.ti 8) and the collaborative process 'building blocks' (Table 1). Deductive analysis allowed themes to emerge from the case data (Corbin and Strauss, 1990). 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. Results

Firstly, we present a summary of results and key insights from research cycles 'Explore' (section 4.1) and 'Validate' (section 4.2). Results on the aggregated collaborative process dimensions (section 4.3), collaborative dynamic capabilities and attributes (section 4.4) and process insights (section 4.5) from our deep-dive case are then presented. We finally present our updated process model (section 4.6).

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 (Fig. 3). 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.

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,*

Table 4
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 min	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	Recap of the development process of the building from idea to final construction	web page format ca. 20 pages	Public

Table 5
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

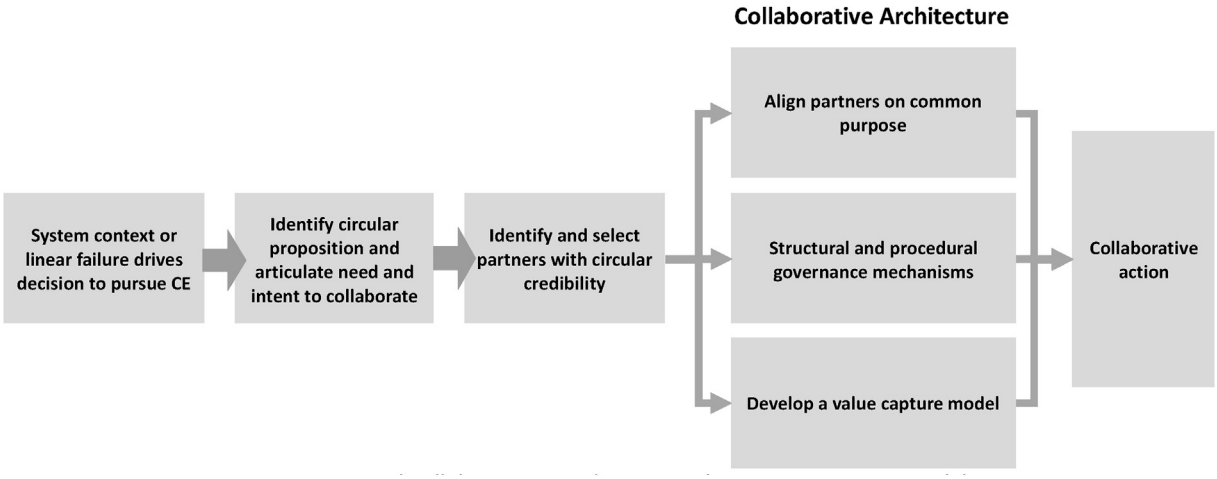

Fig. 3. Initial Collaborative Circular Oriented Innovation Process model.

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.*".

4.3. Research cycle 3 Deep-Dive: Results on aggregated collaborative process dimensions

Each subsection provides case data on the associated process phase.

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 (Fig. 2), 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.

4.3.2. 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.*".

4.3.3. 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.*".

4.3.4. 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[5] and final decision-making power of the focal firm (Project owner).

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) 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. 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*

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

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 6.

4.6. Updated collaborative circular oriented innovation process model

By combining the reviewed literature and our case insights we present our updated process model (Fig. 4). 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 5). 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.

Table 6
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

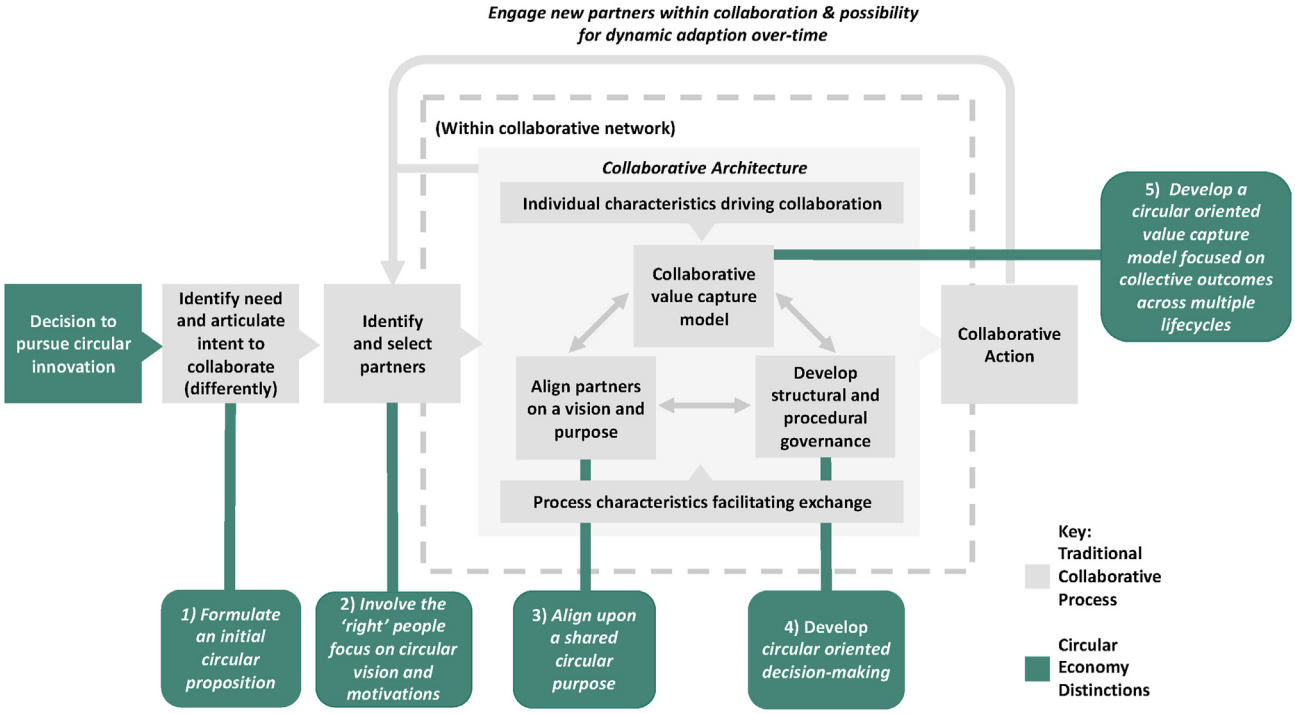

Fig. 4. Final Collaborative Circular Oriented Innovation Process model.

5. Discussion

We sought to understand and identify the process that companies undertake when designing and implementing collaborative COI. In Fig. 4 we present COI distinctions; each is discussed below and we propose promising future research questions. Limitations and our conclusions are subsequently given.

5.1. 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; Gray and 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. (2018), Wiener et al. (2018), 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?

5.2. 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 and 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 (Gray and 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 (Brown 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. (2015), and uses effectual practices (whom do you know?) (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; Brown 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) (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 et al., 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?

5.3. 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 and 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?

5.4. 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 and 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?

5.5. 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 and 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 and 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?

5.6. Limitations and future research agenda

Our study is subject to limitations. Firstly, our study focused on strategic management literature. Integration of other innovation perspectives could bring new insight into collaborative design and implementation processes, e.g., to resolve the potential tensions within a collaborative COI or seek alignment across partners. 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.

6. 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 collaborative 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.

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CRediT authorship contribution statement

P. Brown: Conceptualization, Methodology, Investigation, Data curation, Writing - original draft. **C. Von Daniels:** Conceptualization, Investigation, Data curation, Writing - review & editing. **N.M.P. Bocken:** Writing - review & editing, Supervision. **A.R. Balkenende:** Writing - review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. '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

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

Appendix B. 'Validate' research cycle interview questions

Interviewee background

1. In your organisation 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?
   a. 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 question

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 C. 'Deep-dive' research cycle interview questions

Interviewee background

1. What is your role at Organisation 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?

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