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Valuing value in innovation ecosystems: How cross-sector actors overcome tensions in collaborative sustainable business model development

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Abstract

This article aims to uncover the processes of developing sustainable business models in innovation ecosystems. Innovation ecosystems with sustainability goals often consist of cross-sector partners and need to manage three tensions: the tension of value creation versus value capture, the tension of mutual value versus individual value, and the tension of gaining value versus losing value. The fact that these tensions affect all actors differently makes the process of developing a sustainable business model challenging. Based on a study of four sustainably innovative cross-sector collaborations, we propose that innovation ecosystems that develop a sustainable business model engage in a process of valuing value in which they search for a result that satisfies all actors. We find two different patterns of valuing value: collective orchestration and continuous search. We describe these patterns and the conditions that give rise to them. The identification of the two patterns opens up a research agenda that can shed further light on the conditions that need to be in place in order for an innovation ecosystem to develop effective sustainable business models. For practice, our findings show how cross-sector actors in innovation ecosystems may collaborate when developing a business model around emerging sustainability-oriented innovations.

Keywords: sustainable business model, innovation ecosystem, value creation, value capture, cross-sector collaboration

Sustainability-oriented innovations are increasingly created by collaborating cross-sector actors, such as businesses, public organizations, non-profits, knowledge institutes and users (Bryson, Crosby & Stone, 2006). Following Adner (2017) and Walrave, Talmar, Podoynitsyna, Romme and Verbong (2017), we refer to this as an "innovation ecosystem". An innovation ecosystem consists of multiple actors that aim to create and capture value from collaborative innovation activities around a joint value proposition (Jacobides, Cennamo & Gawer, 2018; Ritala, Agouridas, Assimakopoulos & Gies, 2013). Field examples of these innovation ecosystems are found in settings such as smart city projects that use sustainable technology to contribute to solving societal challenges. In such innovation ecosystems, municipalities, non-profits, businesses, and citizens may collaborate to transform a city's waste management system or to develop a smart energy grid for households. An important element of these sustainability-oriented innovation ecosystems is the development of a sustainable business model that integrates environmental and social value with economic viability (Evans et al., 2017; Schaltegger, Hansen & Lüdeke-Freund, 2016; Stubbs & Cocklin, 2008). For example, an initiative related to local upcycling of residual materials may result in a sustainable business model that combines reusing waste (environmental value) with increased local employment (social value) and new entrepreneurship (economic value). As this field grows, so does the need for insights into how these innovation ecosystems function. A particular challenge for actors in these innovation ecosystems is to manage the tensions that occur during the process of developing a joint business model. Relatively little is known about how innovation ecosystems collaboratively develop viable sustainable business models (Jacobides et al., 2018).

The way in which actors create and capture value around a value proposition is at the core of the sustainable business model and innovation ecosystem concepts (Adner, 2017; Walrave et al., 2017). A growing body of literature has studied value creation and value capture in collaborative settings and shown that value creation and capture occur simultaneously (Aarikka Stenroos & Ritala, 2017; Lepak, Smith & Taylor, 2007; Santos, 2012). The literature also reveals three sources of tension between value creation and value capture, caused by the divergent interests and goals of the actors in the innovation ecosystem (Bankvall, Dubois & Lind, 2017; Lepak et al., 2007; Gummerus, 2013). First of all, a difference in emphasis on value creation and value capture may occur, which changes over time when a value proposition becomes clearer (Dattée, Alexy & Autio, 2018; Jacobides, Knudsen & Augier, 2006; Santos, 2012). Secondly, whereas value creation is considered to take place at the level of the innovation ecosystem, value capture often takes place primarily

at the level of individual actors (Lepak et al., 2007; Ritala et al., 2013; Zott & Amit, 2010). Third, tension may occur between gaining value and losing value, leading to a process called "value slippage" (Lepak et al., 2007; Santos, 2012). All three of the above-mentioned tensions are particularly acute in innovation ecosystems in which cross-sector actors with diverse goals and interests collaborate to develop a sustainable business model (Lepak et al., 2007; Gummerus, 2013). The way in which cross-sector actors in innovation ecosystems resolve these tensions has not been sufficiently studied (Bankvall et al., 2017; Lepak et al., 2007; Santos, 2012). More insights into this process may explain how actors in an innovation ecosystem can collaboratively develop a viable sustainable business model.

According to Adner (2017), ecosystems develop over time; therefore, a process perspective may help to answer the question how actors in an innovation ecosystem resolve the above-mentioned tensions and how this affects their joint efforts to develop sustainable business models. By using a process perspective, we respond to the emerging call to study these dynamics in innovation ecosystems (Tsujimoto, Kajikawa, Tomita & Matsumoto, 2018; De Vasconcelos Gomes, Facin, Salerno & Ikenami, 2018). We have adopted a qualitative research approach and executed longitudinal case studies. Building on a study of four smart city projects in which actors in four different innovation ecosystems collaboratively develop a sustainable business model, we propose that the actors in the innovation ecosystem engage in a process we call "valuing value". We define valuing value as the discovery process through which multiple actors search for agreement about what environmental, social and economic value to create, how to share this value, and thereby how to satisfy each actor's interests. In this definition, value is subjective (Breuer & Lüdeke-Freund, 2017; Gummerus, 2013; Lepak et al., 2007). Each actor may weigh environmental, social, and economic value differently and will have to perceive that it gains sufficient value to remain active in the innovation ecosystem. We find two different patterns of valuing value that actors in innovation ecosystems may follow depending on their starting conditions.

This article continues with a discussion of the theoretical background of this study. Then the research methods and data collection are presented, followed by a description of the findings. Finally, the article ends with a discussion of the results, implications and limitations of the study, and avenues for further research.

Theoretical Background

To study how actors in innovation ecosystems resolve the tensions that occur when searching for a sustainable business model, we first define the innovation ecosystem- and sustainable business model concepts. Next, we explore the tensions associated with value creation and capture in collaborative settings.

Theoretical Concepts and Research Framework for this Study

Innovation ecosystem. We define an ecosystem as the "structure of the multilateral set of actors that need to interact in order for a focal value proposition to materialize" (Adner, 2017, p. 41). For the purposes of the present study, we focus on ecosystems that develop emerging innovations that create new types of value for customers and stakeholders (Aarikka-Stenroos & Ritala, 2017). The literature refers to this type of ecosystem as an "innovation ecosystem"; that is, an ecosystem that aims to create and capture value from collaborative innovation activities and evolves as it tries to develop an initially envisioned value proposition (Adner, 2017; Ritala et al., 2013; Jacobides et al., 2018). An innovation ecosystem may include business, universities, nonprofits, media, communities, and governments (De Vasconcelos Gomes et al., 2018; Tsjuimoto et al., 2018), and is therefore an example of cross-sector collaboration (Bryson et al., 2006). In the case of sustainability-oriented innovation ecosystems, these actors typically aim to address social and environmental sustainability issues by means of their innovative activities (Evans et al., 2017; Stubbs & Cocklin, 2008).

At any point in time, the boundary of the ecosystem is defined by the actors that contribute to the value proposition it delivers (Adner, 2017; Tsujimoto et al. 2018; Williamson & De Meyer, 2012). Innovation ecosystems are not static: an innovation ecosystem "starts with a value proposition and seeks to identify the set of actors that need to interact in order for the proposition to come about" (Adner, 2017, p.41). Therefore, the creation of an innovation ecosystem calls for a process collective discovery (Dattée et al., 2018).

Sustainable business model. Sustainability-oriented innovations often require new business models (e.g. Bocken, Short, Rana & Evans, 2014; Schaltegger et al., 2016). We build on the notion of the business model as a boundary-spanning activity-system (Zott & Amit, 2010) that focuses on value creation as well as value capture activities that serve the purpose of realizing a value proposition (Zott, Amit & Massa, 2011). Sustainable business models are a special type of business models that distinguish themselves through the application of four basic design principles (Breuer, Fichter, Lüdeke-Freund & Tiemann,

2018). First, a sustainability-oriented orientation in itself is a key requirement, intentionally including sustainability goals and values that provide a shared normative reference for the collaborating actors (Breuer et al., 2018). Second, sustainable business model development includes a broad notion of value beyond mere economic value. Actors negotiate about the creation and capture of social, environmental, and economic value to improve sustainability (Breuer et al., 2018; Evans et al., 2017; Schaltegger et al., 2016; Stubbs & Cocklin, 2008). Third, sustainable business model development requires a systemic approach that entails life-cycle thinking, design of product-service systems, and reflection on the potential outcomes of the new business model (Breuer et al., 2018). Fourth, sustainable business model development not only considers customers or end users, but also addresses the interests of a large variety of actors and stakeholders, including nature and society (Breuer et al., 2018; Evans et al., 2017; Lüdeke-Freund, Massa, Bocken, Brent & Musango, 2016; Schaltegger et al., 2016).

Sustainable business model of an innovation ecosystem. For the purposes of this study, we view the business model as a collective device (Doganova & Eyquem-Renault, 2009) that enables collaborating actors to iteratively discover and shape the sustainable multiple value (the social, environmental, and economic value) they aim to create and capture (McGrath, 2010; Oskam, Bossink & De Man, 2017). The original innovation ecosystem starts with an initially envisioned sustainable value proposition; that is, the environmental and/or social value in concert with economic value the innovation ecosystem as a whole aims to provide to end users and other stakeholders involved (Bocken et al., 2014; Boons & Lüdeke-Freund, 2013). Through collaborative value creation and value capturing activities, the value proposition evolves over time (Adner, 2017; Dattée et al., 2018; Walrave et al., 2017), as does the innovation ecosystem itself, as actors may enter and leave the initiative (Chesbrough & Appleyard, 2007; Tsujimoto et al., 2018; Williamson & De Meyer, 2012). Value creation refers to the innovation ecosystem's activities to generate more value with the combined resources than the cost of utilizing these resources (Santos, 2012). Value capture can be seen as the innovation ecosystem's activities to distribute the value among its actors, and appropriation of a portion of the value by each of these actors (Santos, 2012; Walrave et al., 2017).

This collaborative development process should ultimately result in a viable sustainable business model that, according to the perception of the actors in the innovation ecosystem, creates and captures environmental, social and economic value.

Tensions Associated with Collaborative Value Creation and Capture

Value creation and value capture in collaborative settings are two distinct processes that often occur simultaneously (Aarikka Stenroos & Ritala, 2017; Lepak et al., 2007; Ritala et al., 2013; Santos, 2012). More specifically, value creation and value capture are interlinked, as actors all contribute to and benefit from the activities of the innovation ecosystem (Freudenreich, Lüdeke-Freund & Schaltegger, 2019). Actors' perceptions of what outcome is valuable play a key role in determining whether and how a sustainable business model will be viable (Freudenreich et al., 2019). Because innovation ecosystem actors often have different and sometimes conflicting goals and interests, tensions can occur between the actors (Gummerus, 2013; Lepak et al., 2007; Santos, 2012). The literature has identified three sources of tension.

Tension 1. Value creation versus value capture. Strategic management scholars agree that value creation often takes place at the level of the ecosystem, whereas value capture oftentimes primarily takes place at the actor level (Della Corte & Del Gaudio, 2014; Lepak et al., 2007; Ritala et al., 2013; Zott et al., 2011; Zott & Amit, 2010). A tension can occur based on a difference in emphasis on value creation activities or value capture activities. On one hand, value creation is a necessary condition for sustainable innovation ecosystems to develop and succeed (Santos, 2012; Lepak et al., 2007). On the other hand, value capture should not be lost out of sight (Chesbrough & Appleyard, 2007) as it is important to ensure the existence and growth of the actors in the innovation ecosystem (Santos, 2012). Contributing to value creation does not automatically imply value capture, which is a different process or game, in which participants can win or lose more than they would expect based on their input in the value creation process. Based on a study of ecosystem design by large firms, Dattée et al. (2018) proposed a process of dynamic control "to navigate strategically the process of discovering value creation to ensure eventual value capture" (p. 46).

Tension 2. Mutual value versus individual value. Emerging literature that discusses tools and approaches for developing a new business model by multiple actors has proposed that the collaborative effort may lead to a system-level business model (De Man & Luvison, 2019; Lindgren, Taran & Boer, 2010; Palo & Tähtinen, 2013; Rohrbeck, Konnertz & Knab, 2013; Stubbs & Cocklin, 2008). Yet, each actor should also be able to benefit by adjusting its individual business model (Hellström, Tsvetkova, Gustafsson & Wikström, 2015; Breuer & Lüdeke-Freund, 2017). This creates tension, as all actors in the innovation ecosystem have to contribute to the mutual value of their collaborative efforts, but also need to ensure that they

will benefit individually (Chesbourgh & Appleyard, 2007; Vanhaverbeke & Cloodt, 2006; Williamson & De Meyer, 2012).

Tension 3. Gaining value versus losing value. A third tension stems from differences among actors in their perceptions of what is valuable and who is benefiting from value creation (Breuer & Lüdeke-Freund, 2017; Gummerus, 2013; Lepak et al., 2007; Tsjuimoto et al., 2018). Whereas Tension 1 concerns the ability of actors in the innovation ecosystem to create as well as capture value per se, Tension 3 concerns whether the actors perceive the division of value captured across the actors as being fair (Dhanaraj & Parkhe, 2006, Williamson & De Meyer, 2012). Each actor values their inputs and benefits independently and differently, because of differences in knowledge, visions, goals, and contexts (Breuer & Lüdeke-Freund, 2017; Lepak et al., 2007; Lindgren et al., 2010; Rohrbeck et al., 2013). It can be argued that all actors in the innovation ecosystem should gain enough value from their participation to ensure their continued support of the initiative (Chesbrough & Appleyard, 2007; Vanhaverbeke & Cloodt, 2006). However, if one actor invests little but captures a lot of value, while another actor invests much and captures little, the latter actor may perceive this as losing value. This 'value slippage' "obviously provides little incentive for a source to continue creating value in the long term" (Lepak et al., 2007, p.187).

These three tensions are particularly acute in innovation ecosystems with cross-sector actors (Lepak et al., 2007; Gummerus, 2013). Such actors may have widely diverging economic, social, or environmental goals (Florin & Schmidt, 2011), which increases the risk that the tensions are present and difficult to resolve. We propose that these tensions need to be resolved during the process of valuing value. The literature identifies several mechanisms that trigger and enhance collaborative value creation and capture, and may contribute to resolving these tensions. These mechanisms are: building a common vision and identity (Ritala et al., 2013; Williamson & De Meyer, 2012; Dhanaraj & Parkhe, 2006), learning and experimentation (Chesbrough, 2010; Sosna, Trevinyo-Rodríguez & Velamuri, 2010; Walrave et al., 2017), fostering complementarity (Hellström et al., 2015; Williamson & De Meyer, 2012), sharing knowledge and open communication (Dhanaraj & Parkhe, 2006; Ritala et al., 2013), adopting new and differentiated roles (Dedehayir, Mäkinen & Ortt, 2018; Williamson & De Meyer, 2012), ecosystem governance through flexible alignment structures (Adner & Kapoor, 2010; De Vasconcelos Gomes et al., 2018; Williamson & De Meyer, 2012), procedural justice and joint asset ownership and protection (Dhanaraj & Parkhe, 2006; Ritala et al., 2013), and building of trust, commitment, and reciprocity (Dhanaraj & Parkhe, 2006; Ritala et al., 2013; Rohrbeck et al., 2013). We use these mechanisms to inform our data

analysis to study how cross-sector actors in an innovation ecosystem overcome the tensions when collaboratively aiming to develop a viable sustainable business model.

Research Design

In order to research the processes of developing a sustainable business model in an innovation ecosystem, we took a qualitative research approach using a case study methodology. This enabled us to gain in-depth insight into how the innovation ecosystem's actors manage the tensions over time. To improve the external validity of this study and increase robustness of the outcomes, we used a multiple comparative case study design consisting of four cases (Yin, 2017, Eisenhardt & Graebner, 1998). Each case study is based on longitudinal data that are used to identify unique patterns for each case, and to analytically generalize patterns across cases by means of cross-case comparison (Yin, 2017).

Case selection. The phenomena we studied are innovation ecosystems in which cross-sector actors develop innovative sustainable business models through collaboration. We found these innovation ecosystems in four smart city projects. The general characteristics of the cases are presented in Table 1. All four cases met two selection criteria. First, these projects are embedded in innovation ecosystems in which business, governments, non-profits, and communities cooperate to develop a new sustainable business (Bryson et al., 2006). Secondly, these actors specifically focus on creating social and/or environmental value, whilst also striving towards a financially viable business model (Schaltegger et al., 2016). Given this, the selected cases are expected to show ample tensions, due to a high variety of actor types involved, as well as a high diversity in these actors' goals and interests.

Accordingly, we followed a theoretical sampling strategy (Eisenhardt, 1998). The cases are comparable as they all concern the sustainable business model archetype: "creating value from waste" (Bocken et al., 2014). The cases also differ in that each is initiated and coordinated by different combinations of actor types (see Table 1). This provided both focus and variation and enabled us to identify patterns for this type of case, as well as cross-case differences (Eisenhardt & Graebner, 2007). All cases are situated in the Amsterdam Metropolitan Area in the Netherlands, providing a comparable and interesting context as the Netherlands aims to be a frontrunner in the transition towards a circular economy, and Amsterdam is a renowned example of smart city development (Prendeville, Cherim & Bocken, 2018). The cases started between 2012 and 2015 and are all still progressing.

Table 1. Description of the Four Cases: the Ecosystem's Actors and their Initially Envisioned Business Model.

	Cleantech Playground De Ceuvel (Clean)	**Local Growing of Industrial Crops (Grow)**	**Neighborhood Composting (Compost)**	**Wasted Lab (Collect)**
Ecosystem start	2012	2013	2015	2015
Initiating actor(s)	Group of creative entrepreneurs	Municipalities, SMEs and large corporation	Citizen, municipality	Non-profit organization
Other actors of the ecosystem	Citizens, public organizations, non-profit organizations, private companies (mostly SMEs), knowledge institutes	Public organizations, non-profit organizations, private companies (SMEs & large corporations), knowledge institutes	Citizens, public organizations, non-profit organizations, private companies (mostly SMEs), knowledge institutes	Citizens, public organizations, non-profit organizations, municipality, private companies (mostly SMEs), knowledge institutes
Initial ecosystem's value proposition	Temporary cultural and creative breeding place and living lab to test sustainable and regenerative technologies	Sustainable use of local vacant land to grow bio-based crops for industrial use	Local recycling of organic household waste based on vermicomposting	Separation and local reuse of plastic household waste
Envisioned value creation	Creating a sustainable office park for creatives Reusing waste streams and closing material cycles by testing sustainable technologies	Growing of various crops (e.g., flax) and process these into bio-based products (e.g., sustainably sourced paint) Yearly assessment of (temporarily) available uncultivated land	Placing street corner composters throughout the city that are managed by residents	Implementing a low-tech reward system encouraging citizens to separate plastic household waste Making building blocks out of this plastic waste for local application
Envisioned value capture	Cleaning of the heavily polluted soil of the former ship wharf (society and municipality)	Providing locally sourced materials for a competitive price (SMEs)	Local reuse of organic waste as compost (citizens)	Increasing awareness of plastic problem (non-profit and public organizations)

	Regenerative system with less waste (SMEs, society) Increasing creative entrepreneurship (SMEs)	Reduction of costs for maintaining the land (land owners: public organizations and large corporations)	Substitution door-to-door collection (municipality)	Increasing separation of plastic household waste (municipality) Increasing engagement of local communities (municipality)

Data collection. To achieve in-depth insights, our investigation pursued data triangulation for each case (Yin, 2017), with the data comprising interviews, audio-visuals, and documents. Table 2 presents an overview of the data. We conducted 20 interviews with actors in the innovation ecosystem, including the initiators (17 semi-structured interviews with an average length of 60 minutes, recorded and transcribed verbatim, and three informal interviews in which notes were made). The first round of interviews was conducted in late 2015 and early 2016. A second round of interviews, revisiting each case to discuss changes in the innovation ecosystem and perceived value, took place in late 2017 and early 2018. These interviews were complemented with 14 interviews available from archived audio-visual data sources, which also provided insights into the period prior to the first round of interviews for the two cases that started earlier. Appendix A provides an overview of the interviewees and their roles, from both the interviews conducted by the researchers as well as the audio-visual material. We studied a total of 24 audio-visual sources (with a total length of 185 minutes), 38 project documents and 62 external documents, covering a time period from the start of the project until the second round of interviews.

Table 2. Data Sources.

Data sources	**Clean**	**Grow**	**Compost**	**Collect**	**Total**
- Semi-structured interviews (recorded and transcribed)	3 (210 min)	7 (396 min)	2 (156 min)	5 (216 min)	17
- Informal interviews	1		2		3
Number of interviews	**4**	**7**	**4**	**5**	**20**
- Video presentations and interviews	8 (77 min)	3 (8 min)	6 (38 min)	3 (34 min)	20
- Radio interviews			2 (18 min)	2 (10 min)	4
Number of audio-visual sources	**8**	**3**	**8**	**5**	**24**
- Project publications	4	5	1	7	17
- Descriptions on partner websites	6	6	4	5	21
Number of project documents	**10**	**11**	**5**	**12**	**38**
- Case study reports	3	3	2	1	9
- Newspaper articles	9	12	9	9	39
- Other documents	4	3	6	1	14
Number of external documents	**16**	**18**	**17**	**11**	**62**
Total data sources	**38**	**39**	**34**	**33**	**144**

Data analysis. The analytical process consisted of three stages combining strategies for analyzing process data (Langley, 1999) with a coding procedure, following the Gioia methodology (Gioia, Corley & Hamilton, 2013). The first stage of data analysis involved detailed reading of the interview transcripts and documents and viewing of the audio-visual material. This resulted in case narratives and a graphical history timeline for each case, focusing on value creation and value capturing activities, tensions that occurred during the process, actors entering and leaving the innovation ecosystem, and other key events over time.

During the second stage of analysis we followed an abductive research approach that balances inductive concept development with consideration of relevant existing theory (Gioia et al., 2013). Following Gioia et al.'s (2013) methodology, we started with a first-order empirical analysis, coding text segments reflecting actions, events, and mechanisms that contributed to collaborative value creation and capture and that positively or negatively

influenced the resolution of tensions. In this inductive approach we stayed close to informant terms (following Strauss & Corbin's [1990] notion of open coding), creating over 100 first-order concepts. Using the qualitative data analysis software Atlas.ti, we searched for similarities and differences among the concepts, reducing the number of concepts (following Strauss & Corbin's [1990] axial coding). We then searched for patterns and relationships between the empirical concepts guided by a cross-case replication logic (Eisenhardt & Graebner, 2007; Yin, 2017), with the aim of finding general empirical practices among the four case studies. By clustering the concepts, we found several empirical themes that mark those mechanisms that reduced or resolved the tensions that occurred. These second-order empirical themes were then linked to theory, as we went back to the relevant literature to integrate prior concepts from the literature and to check if we had found any nascent concepts that did not have precedents in existing theory. Finally, we combined the themes we had found into aggregate dimensions, building a data structure by cycling between emergent concepts and themes, and existing theory (Gioia et al., 2013). This iterative empirical-theoretical analysis, in which we found first-order concepts, bundled them into second-order themes inductively, and then aggregated these second-order themes into dimensions, which were sensitized to the literature, resulted in the data structure provided in Appendix B.

In the third and final stage, we returned to the case narratives and mapped the second-order themes and aggregate dimensions to the case history timelines to establish a process representation (Langley, 1999), capturing relationships among the themes that summarize how in each case the ecosystem and its value proposition evolves over time. Based on this last step and through cross-case comparison (Yin, 2017; Eisenhardt, 1998), we found a process we call "valuing value", which occurs in two different patterns, each comprising several mechanisms.

Findings

Using this methodology, we first identified the tensions that occurred in each case. Tension 1 (value creation versus value capture) emerged in the Compost and Waste cases. These two cases emphasized value creation, while both innovation ecosystems searched for ways to also capture value from their activities. In these cases we also found evidence of Tension 3 (gaining value versus losing value) as actors placed varying levels of emphasis on environmental, social, and economic value. Tension 2 (mutual value versus individual value)

was primarily found in the Clean and Grow cases, where individual value goals needed to align with clear mutual goals.

The detailed analyses of the four cases (second stage of analysis) show that several mechanisms played an important role in relieving the tensions that occurred. The development process started with "defining common ground" among the innovation ecosystem's actors. This led to an initial envisioned value proposition, based on shared visions and goals. First, the collaborative value creation activities that are subsequently undertaken to bring this value proposition about can be characterized by a process of "learning and experimentation" and by "open boundaries", welcoming new opportunities and partners. Second, the collaborative value capture activities can be characterized by "mutual adjustment" and "flexible alignment and governance", guiding the collaboration and fair distribution of benefits among the actors. However, each case reveals different mechanisms within these four aggregate dimensions. A detailed overview is provided in Table 3.

By taking a process perspective (third stage of analysis) we found that the tensions that occurred during collaborative value creation and value capture are managed by an interplay of these mechanisms in an iterative process of valuing value; that is, the discovery process through which multiple actors search for agreement about what environmental, social, and economic value is created and how this is shared, thereby aiming to satisfy all actors' interests. This process altered the initial innovation ecosystem's value proposition several times and may cause individual actors to decide to enter or leave the initiative, subsequently changing the innovation ecosystem.

Mapping the mechanisms to the narratives and timelines of the four cases shows that valuing value takes place in two different patterns. Each pattern emphasizes other mechanisms and has a different effect on the innovation ecosystem and its value proposition.

Table 3. Tension-relieving Mechanisms found in the Case Studies.

Mechanism	**Case study**			
	Clean	*Grow*	*Compost*	*Collect*
Learning and experimentation				
Planned experiments and deliberate learning	- Deliberate learning, based on a thorough plan with well-designed experiments - Assessment of technical feasibility and environmental impact of experiments	- Yearly experiments based on availability of resources - Yearly assessment of the crop output, evaluation of environmental value and economic costs	- Starting with public pilot cases to evaluate environmental and social impact	- Starting with well-designed pilot with low-tech solution
Action-based learning and trial-and-error experimentation	- Actual building things for learning purposes	- Extension of experiments based on motivation to close the loop	- Followed by action-based learning from peers - Trial-and-error experimenting based on personal motivations and resilience to deal with negative results	- Followed by action-based learning, assessing sustainability of intermediate results - Resilience to setbacks and personal motivation to continue experimenting
Open boundaries				
Openness to new opportunities			- Embracing unexpected value outcomes that contribute to overall sustainability - Grasping opportunities and setting up new collaborations	- Grasping new opportunities, e.g. setting up educational program, international collaboration and setting up open source knowledge base

			to extend value and find funding for continuation; e.g., educational program, breeding farm	
Openness to complementary partners	- Open to new partners that fit the overall vision and provide leverage for innovation Assessing new partners (e.g., knowledge institutes, creative entrepreneurs) based on complementarity and fit with vision	- Open to new partners to expand the acreage and for new applications of bio-based materials New partners are involved to cover the whole chain; e.g., windmills to press the oil from the seed		
Mutual adjustment				
Engaging in reciprocity and concurrency	- Sharing risks and responsibilities between partners of the association - Community building around the breeding place	- Open communication based on trust, contributing to a community feeling at innovation ecosystem level - Seeking publicity to strengthen the common identity	- Community building around each new street corner composter	- Community building around the users (residents and entrepreneurs) as part of the reward system
Adapting roles and goals to mutual interests	- Evolving roles; e.g., from architects to project developers, from users to volunteers	- Taking up the role of user; e.g., using the paint by the owners of the land	- Association takes up new roles as producer of street corner composters	- Adjusting the value goals to interests of new partners - Municipality takes up various roles with different departments

Flexible alignment and governance				
Open value exchange	- Value exchange at the level of the association based on blockchain technology	- Agreement between key actors to work through open bookkeeping		- Reward system as part of the sustainable concept, giving residents benefits with local entrepreneurs for each bag of waste
Formal and informal agreements	- Setting up an association for a part of the 10-year lease of the ground - Formal contracts with suppliers and knowledge institutes	- Informal agreements, explicating responsibilities of each partner	- Contract for first pilot between association and municipality - Loose agreements with suppliers neutralizing risk of value slippage	- Informal agreements between individual actors

Valuing Value by Collective Orchestration

This first pattern is derived from Clean and Grow. In these cases, valuing value took place through a discovery process we call "valuing value by collective orchestration". This process involves making changes to the sustainable business model that are in line with the innovation ecosystems' original vision and goals. In both cases, we find that the innovation ecosystem and its value proposition remain relatively stable, and only minor adaptions of the value propositions are made. The innovation ecosystem evolved with minor changes as well. Although actors stepped out and new actors stepped in, the type of actors involved stayed the same. Each new actor entering the ecosystem is evaluated along the ecosystem's vision and goals, and when actors failed to align individual goals with the mutual interests, they left the innovation ecosystem and made room for other prospective actors, which are sought by the remaining actors. Figure 1 provides a graphical representation of this pattern.

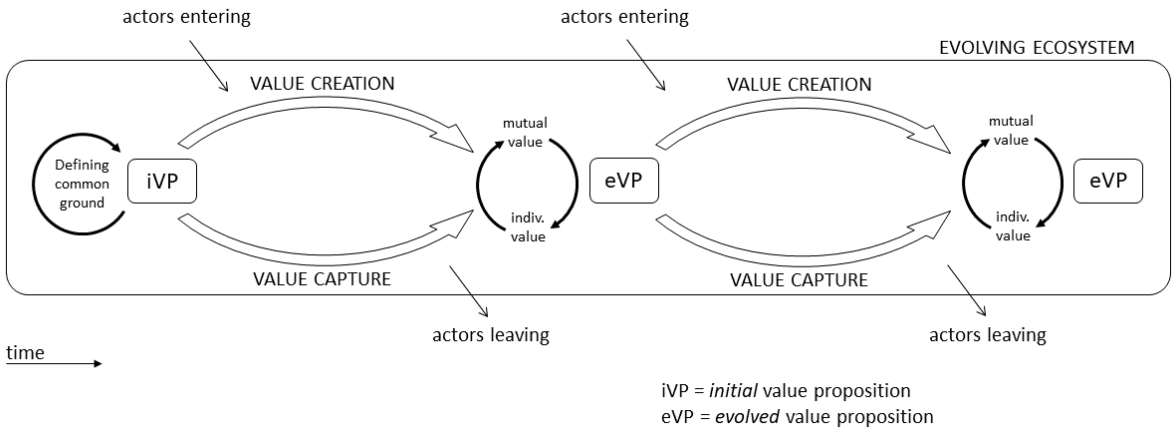

Figure 1. Valuing Value by Collective Orchestration.

In this pattern, defining common ground results in an initial value proposition that integrates economic and environmental and/or social value from the start. In Grow, for example, actors from three complementary initiatives combined their efforts to use vacant land for growing and processing crops for bio-based products, and to evaluate whether this could result in a viable sustainable business model: *"The main goals were to see and test whether you can make things useful, do it better and more sustainably, and thereby also circular. And especially to evaluate if the whole chain is viable"* (Grow, landowner). The main tension found in the Clean and Grow cases is related to tension 2: continuously finding a balance between mutual and individual value. An example of the tension felt between mutual and individual value is a quote from one of the landowners: *"That is exactly the individual*

deliberation each actor should make in such a collaboration. It only works when it holds for everyone" (Grow, landowner at utility provider).

In these cases, the value creation process is characterized by "planned experiments and deliberate learning" and an "openness towards complementary partners" that fitted the overall innovation ecosystem's vision. In Grow, pilots and experiments are executed according to plan, and a regular assessment of outcomes took place. Based on the results, additional experiments are set up *"that you can later benefit from or learn from at a higher and larger level"* (Clean, creative entrepreneur). For new experiments, partners are selected that fit Clean's vision of the innovation ecosystem: *"We have always been very open to new partnerships. Of course it is always evaluated, so I always check whether it is indeed so valuable that it is worth the time investment or … actually brings something new or can bring old plans further"* (Clean, manager society). In Grow, every year the innovation ecosystem evaluated the yield and results of the previous year and decided how experiments would be continued. In its effort to close the whole chain, new actors are welcomed that complemented the existing innovation ecosystem.

Value capture in this pattern is particularly supported by "engaging in reciprocity and concurrency", as both cases made an effort to create a common identity and worked on community-building: *"with a mutual goal, there was a lot of enthusiasm and reciprocal inspiration"* (Grow, landowner at airport). For a fair distribution of the value created among the actors, methods for "open value exchange" are used to make the value transaction between actors explicit and transparent. In Clean, the mutual value was evident, as the breeding place served as a living lab and example for circular urban development for the municipality, and served as an inspiration for visiting creatives, environmentalists, and researchers. Each actor also gained individually: *"We create value for all members"* (Clean, manager society) as they extended their knowledge on sustainable technologies, and benefited from collaboration with partners and from the external recognition of the project. Blockchain technology is introduced to balance individual gains and contributions to mutual goals. This facilitates value exchange between members of the association *"so that this can be better tracked and become more transparent"* (Clean, manager society). In Grow, the innovation ecosystem's actors agreed to *"work the first years with open book keeping"* (Grow, landowner at utility provider) to yearly assess the contributions and gains for each actor in order *"to make it worthwhile for all"* (Grow, farmer). Working this way, the innovation ecosystem managed to keep the distribution of costs and benefits balanced for several years. However, when economic conditions improved, the land was needed for other

purposes, and some of the landowners could not continue active support of the initiative. Nevertheless, all actors were positive about the outcomes and the remaining actors continued to collaborate and seek new partners to expand the acreage.

Valuing Value by Continuous Search

The second pattern is found in Compost and Collect. In these cases, the initiating actors iteratively explored what environmental, social, and economic value can be created and captured; a pattern we call "valuing value by continuous search". By taking up new opportunities and roles and by setting up collaborations with new partners, the innovation ecosystem and its value proposition changed more rapidly. Each major change in the innovation ecosystem also required a redefinition of common ground between the new set of actors, and subsequently led to redesigns of the value proposition. Figure 2 provides a graphical representation of this pattern. Although the adaptions may be quite substantive, Compost and Collect show that this can open up an interesting arena of additional and unexpected value outcomes. In Collect, for example, this process led to including multiple waste streams in the value proposition, which increased the chances of economic viability in the long run, but also extended the environmental and social impact.

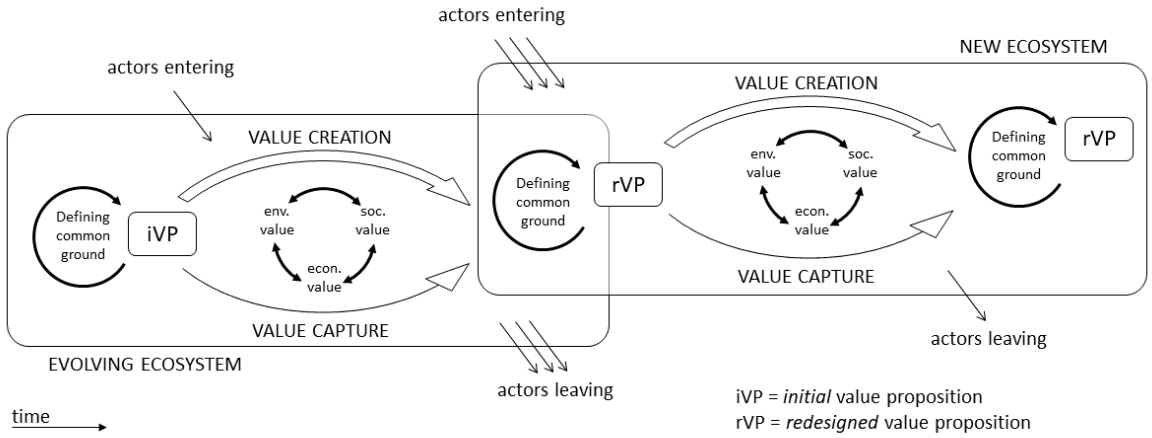

Figure 2. Valuing Value by Continuous Search.

Based on defining common ground, the initial value propositions in these cases showed a focus on environmental value creation (for example, reuse of materials, using underused resources, CO_2 reduction), and/or social value creation (such as creating awareness, social cohesion, educational value). Although profit seeking was not the primary objective, both

innovation ecosystems are looking for ways to combine environmental and social value goals with some sort of economic value capture that enables the actors to continue collaborating for a longer period of time. In Collect, for example, the goal was to *"increase the awareness of the public so it* [separate collection of plastics waste] *would pay itself"* (Collect, initiator). The tension that occurred in these cases is primarily related to Tension 1 (value creation versus value capture). Tension 3 (gaining value versus losing value) also occurred as some actors tried to appropriate an overly large portion of the value for themselves, which other actors of the innovation ecosystem considered to be unfair, leading to increasing perceived value slippage.

The value creation activities in this pattern are characterized by more "action-based learning and experimentation" and an "openness towards new opportunities" that improved overall sustainability. Both Compost and Collect started with a well-designed pilot, followed by new pilots and trial-and-error experimenting that was initially not foreseen: *"It's really just trying, trying, trying ... You're actually looking for a perfect upscaling strategy, so you know exactly what you need to do to launch successfully in a new area"* (Collect, project manager). The actors evaluated the value outcomes of experiments, which resulted in renewed value goals for the next pilot, alternating the focus on environmental, social, and economic value goals over time. For example, Collect encouraged residents to gather waste by awarding benefits for each bag with collected plastics, which would then be collected by one of the ecosystem's partners. When the project progressed, this turned out to be too expensive. It was then decided to collect the waste using the garbage trucks of the municipality. Although this was a less environmentally friendly solution, it did enable scaling-up with the hope that it would also be more cost-effective. Once the number of participants grew, the municipality reconsidered its participation, as its goal to establish a higher separation rate while reducing costs was not met: *"As a government, we have an important role in raising people's awareness, but also in the factually separated collection of waste. But we also want to do that in the most cost-efficient way possible"* (Collect, municipal officer). The key actors had to find common ground again. By redesigning the system, including digitizing the reward system and broadening the scope to other waste streams than plastic, the innovation ecosystem was able to continue and set up a new pilot. This solution extended the environmental and economic goals, but left the social component neglected – about which some early users expressed their disappointment. To rebalance the three goals, a new collaboration was set up with local community centers to integrate the social aspects back into the proposition.

In Compost, a similar alternating emphasis on environmental and social value creation and economic value capture was found. It started with a resident and the municipality joining forces in their effort to compost organic waste at a local scale. They set up a pilot for placing 25 street corner composters throughout the city. Although this initiative was mainly environmentally driven, the elevation of social cohesion due to the collaborative use by neighbors is immediately recognized as an unexpected but welcome mutual benefit that is embraced in further experiments: *"I almost think that social cohesion, as they call it, is actually more fun than vermicomposting itself"* (Compost, social entrepreneur). Over time, several additional experiments were set up, including an education program and a breeding farm. Each new experiment was seen as a new learning experience but also supported efforts to find extra funding or yield economic results *"as all those small initiatives together will find a solution for the future"* (Compost, municipal officer). For these and other experiments, collaboration was sought with several companies and the innovation ecosystem evolved into a growing community with enthusiastic users, and other composting initiatives and companies *"that learn from each other"* (Compost, social entrepreneur).

Value capture received less concerted attention. For alignment some "formal and informal agreements" between individual actors in the innovation ecosystem were set up. In Compost, for example, an association was set up between several initiatives and a formal contract was established with the municipality for a pilot. Collaborations between other actors in the innovation ecosystem were more informally organized. This sometimes caused friction when some actors tried to capture economic value for themselves, but it also created flexibility to grasp new opportunities that fitted mutual and individual value goals. For mutual adjustment, we found an emphasis on "adapting roles and goals to mutual interests". In Compost, when the municipality and a producer did not reach agreement for production of the composters, the association involved took up this role to support continuation of the initiative: *"We were only supposed to do the guiding* [of the community building around a street corner composter] *... but now we are also the producer"* (Compost, social entrepreneur).

Discussion and Conclusions

Based on four case studies, this research finds that cross-sector actors engage in a process of valuing value, which is a search and discovery of environmental, social, and economic value creation and capture, whereby satisfying each actor's individual interests is a condition for

the continuing existence and further development of the innovation ecosystem. This valuing value-process helped to manage the tensions that emerged from the collaborating actors' divergent goals and interests. Our findings indicate that valuing value unfolded in both patterns we identified; that is, in the patterns of collective orchestration and continuous search. A comparison of the two patterns of valuing value (see Table 4) shows differences in relation to the starting conditions, the tensions that occurred, the mechanisms that contributed to resolving these tensions, and the effect on the stability of the value proposition and the innovation ecosystem.

Table 4. Valuing Value Patterns: Starting Conditions, Tensions, Mechanisms and Effects.

	Valuing value pattern	
	Collective orchestration (Clean + Grow)	***Continuous search*** (Compost + Collect)
Starting conditions		
Key actors	Private actors + public organizations	Non-profits + public organizations
Common ground	Clarity about mutual goals and time horizon, integrating environmental, social and economic value	Mutual interest, focusing on environmental and social value
Main tensions	Tension 2. Mutual value versus individual value	Tension 1. Value creation versus value capture Tension 3. Gaining value versus losing value (value slippage)
Key mechanisms		
Learning and experimentation	More deliberate learning and well-designed experiments	More action-based learning and trial-and-error experimenting
Open boundaries	Openness to complementary partners fitting the innovation ecosystems' vision and goals	Openness to new opportunities improving sustainability
Mutual adjustment	Reciprocity and concurrency between actors	Flexibility in individual roles and goals over time
Flexible alignment and governance	Open value exchange at different levels of the innovation ecosystem	Some formal, mostly informal agreements between individual actors

Effects		
Stability of innovation ecosystem	Relatively high (ecosystem evolves, core innovation ecosystem stays intact)	Low (new innovation ecosystems are built up)
Stability of value proposition	High (value proposition evolves)	Low (value proposition is redesigned, and new additional value propositions emerge)

In this section, we first discuss how different mechanisms help in overcoming the tensions in both patterns. Next, we explore how the starting conditions may explain the occurrence of the two different patterns, and how they relate to previous findings from the literature. Finally, we propose how our findings contribute to research and practice and discuss the limitations of this study.

Mechanisms to Overcome Tensions

Valuing value started with defining common ground in which the cross-sector actors collaboratively developed mutual visions and goals leading to an initial sustainable value proposition (cf. Breuer & Lüdeke-Freund, 2017; Ritala et al., 2013; Rohrbeck et al., 2013; Walrave et al., 2017). This is followed by an iterative process, in which a number of mechanisms are deployed to manage the tensions. The mechanisms that resonate with existing theory are deliberate as well as action-based learning and experimentation (cf. Chesbrough, 2010; Sosna et al., 2010; Walrave et al., 2017), mutual adjustment through engaging in reciprocity and concurrency, adapting roles and goals to mutual interests (cf. Breuer & Lüdeke-Freund, 2017; Dhanaraj & Parkhe, 2006; Rohrbeck et al., 2013; Dedehayir et al., 2018; Williamson & De Meyer, 2012), and setting up formal and informal agreements for flexible alignment and governance (cf. Adner & Kapoor, 2010; De Vasconcelos Gomes et al., 2018; Williamson & De Meyer, 2012). Novel mechanisms we found in the cases are related to open boundaries (cf. Rohrbeck et al., 2013; Zott & Amit, 2010) – that is, openness towards new opportunities and openness towards complementary partners – which advance the innovation ecosystem's ability to reach the mutual sustainability goals. Second, our findings revealed a mechanism we call open value exchange as an important means for flexible alignment and governance.

In collective orchestration, the main tension that occurs is related to balancing mutual and individual value (Tension 2). In this collective orchestration pattern we find two mechanisms that specifically contribute to overcoming this tension. First, by engaging in

reciprocity and concurrency the innovation ecosystem's actors are able to mutually adjust the individual and innovation ecosystem's value goals. Second, through setting up measures for open value exchange (for example, through open bookkeeping and blockchain technology), the innovation ecosystems have found a flexible and transparent way to evaluate the actors' contributions and distribution of value among the actors. This has resulted in a fairly stable innovation ecosystem and value proposition that both evolve along the collaborative value creation and capture process (see also Figure 1).

In continuous search, first of all a tension was found between value creation and value capture (Tension 1). Although openness to new opportunities may also increase the emphasis on value creation, in our case studies it also helped the innovation ecosystems to take chances for capturing value and so supported the continuity of the initiative. The other tension found in this continuous search pattern (gaining value versus losing value; Tension 3) benefited in these case studies from more informal agreements. Both tensions were also reduced by flexibility in individual roles (such as taking up a more entrepreneurial role) and adjusting value goals over time. Although in this continuous search pattern the innovation ecosystem was less stable, the value creation and capture activities continued through these mechanisms. The new innovation ecosystem redefined common ground, resulting in a redesign of the value proposition (see also Figure 2).

Starting Conditions

An important explanation for the differences in tensions that occurred and the mechanisms that relieved these tensions lies in the different starting conditions of the two patterns (see also Table 4).

First, we look at the key actors of the case studies that shaped each pattern and their goals and interests. Collective orchestration is characterized by a combination of private and public organizations; key actors that were able to formulate clear mutual goals that integrate environmental, social, and economic value. In contrast, the key actors in the cases that shaped continuous search are from non-profit and public sectors. Their mutual goals and interests are focused on environmental and social value creation, whereas economic viability is seen as a longer-term goal. Following Santos (2012), who proposed that private and non-profit organizations pursue different types of value, the type of actors involved could offer a logical explanation for the differences between the patterns. However, our findings indicate that most actors involved pursued at least two sustainability goals, regardless of their type (public, private, non-profit, etc.). Therefore, it is interesting to research further whether specific

combinations of cross-sector actors always coincide with one or the other pattern. It is also interesting to further explore the extent to which goal differences coincide with the differences between actors.

Second, a possible explanation for the differences in the patterns can be related to different time horizons. We found differences in respect to *when* actors thought their collaborative efforts should reach specific value goals. In the two collective orchestration cases, the time horizon in which the project had to yield results was made explicit, and was based on a common understanding; for example, a 10-year plan in Clean and an agreement on yearly assessments of costs and benefits in Grow. In the two continuous search cases the actors' time horizons varied within the innovation ecosystem, causing friction between actors. These differences are additional to the divergent views of actors about *what* is valuable (Gummerus, 2013; Lepak et al., 2007). Nevertheless, this pattern showed that, over time, actors started realizing it could take considerable time until a viable sustainable business model would be realized, and that continuous search is *"more a kind of investment in the future instead of in results for the here and now"* (Collect, municipal officer).

Third, although the sustainable business model literature speaks of integrating all three sustainability aspects (Evans et al., 2017; Schaltegger et al., 2016; Stubbs & Cocklin, 2008), our cases indicate that it is not always possible to envision a value proposition where environmental and/or social value ex ante concurs with economic value, as was the case in Compost and Collect. Each situation appeared to lead to other tensions. Collective orchestration is more related to balancing Tension 2 (mutual value versus individual value). Continuous search is primarily related to balancing Tension 1 (value creation versus value capture) and, to a lesser extent, Tension 3 (gaining value versus losing value). Some scholars typify Tension 1 as a trade-off between social and environmental value creation and economic value capture (Bocken et al., 2014; Santos, 2012). Other scholars state that economic, social, and environmental value should be integrated and balanced (Evans et al., 2017; Schwartz & Carroll, 2008). With regard to this debate, our results suggest that the processes behind integration and trade-off differ substantially. Based on the cases, we suggest that different starting conditions may explain whether a trade-off or integration is more likely to result.

Implications for Research

Our findings allow us to make three contributions to the literature on innovation ecosystems and collaborative sustainable business modeling.

First, our findings provide a first step to help understand how cross-sector actors in an innovation ecosystem may collaboratively develop a viable sustainable business model. When actors in innovation ecosystems are able to develop a clear mutual vision and time horizon with integrated sustainability goals, a pattern of valuing value by collective orchestration (see Figure 1) may develop, which, according to one of the interviewees may reinforce itself: *"You start with a group of people and a nice plan and when that plan is becoming more concrete it happens that people apostatize. But the people that join, they also fit that plan better …and with that the plan also becomes more and more specific. It is kind of self-reinforcing"* (Clean, creative entrepreneur). The mechanisms associated with this pattern (see Table 4) support this reinforcing effect, and helped to overcome the tensions that occur between mutual and individual value. However, when the mutual interest of the actors is primarily driven by environmental and/or social value creation, a pattern of valuing value by continuous search (see Figure 2) developed, supporting the discovery of value propositions that aimed to balance all three sustainability goals in the long run. The mechanisms in this pattern (see Table 4) helped to create some level of (economic) value capture, which was necessary for the continuation of the initiative and growth of the actors as well as their shared innovation ecosystem (Chesbrough & Appleyard, 2007; Santos, 2012). If the differences between the two patterns are indeed explained by their starting conditions, this helps explain which starting conditions are more effective with which pattern. These insights may be used to extend existing tools and approaches for collaborative sustainable business modeling; for example, by developing a tool to analyze starting conditions or to give advice about which mechanisms to use to bridge the different viewpoints of the actors (Breuer & Lüdeke-Freund, 2017; Lindgren et al., 2010; Rohrbeck et al., 2013). Further research could explore whether there are other conditions that determine whether collective orchestration or continuous search should be followed. Cases in which the innovation ecosystem fails to develop a viable sustainable business model, and cases in which hybrid patterns are followed, may shed further light on this question and possible answers.

Second, whereas recent literature has mostly studied innovation ecosystem design from the perspective of a focal firm (Dattée et al., 2018; De Vasconcelos Gomes et al., 2018; Tsujimoto et al., 2018), valuing value through collective orchestration or continuous search shows how innovation ecosystems aiming for sustainability may evolve without having a focal actor orchestrating the process. In this regard, Dattée et al. (2018) made a notable contribution to innovation ecosystem design, proposing an iterative process of dynamic control by the focal actors to support them in managing the uncertainties of the collaboration.

Our case studies raise the question of whether dynamic control is also relevant for the two identified valuing value patterns, where an initial innovation ecosystem and a joint value proposition form the starting point of sustainable business model development. Another question is whether the dynamic control varies for each pattern, and what kind of dynamic control could be applied in settings without a focal actor orchestrating the process. Moreover, our findings indicate that collective orchestration occurs in public-private collaborations, and continuous search occurs in collaborations between non-profits and public organizations. Other patterns may occur in cross-sector collaborations for sustainability (for example, between academia and public or private organizations) and may require other mechanisms of dynamic control. Further research incorporating more cases and studying other collaborative constellations of cross sector actors is needed to identify possible additional patterns.

Third, the process of valuing value and its two patterns could serve as a framework for understanding how cross-sector actors in innovation ecosystems collaboratively develop sustainable business models over time. The two patterns provide a first analytical insight into how specific combinations of cross-sector actors manage the tensions, and find an appropriate balance of environmental, social, and economic value creation and capture for the actors involved. However, as our findings are based on qualitative research that builds on the analysis of informants' data, the process of valuing value is grounded on subjective notions of value. A main source of complexity in developing sustainable business models is given by the uncertainty of actors' behaviors regarding the three sustainability dimensions (Evans et al., 2017) and actors' perceptions of when a sustainable business model is viable or not (Freudenreich et al., 2019). Hence, further research could focus on the changes in value propositions and increasing or eroding value goals by deploying more objective measures. The process of valuing value could serve as a starting point to objectify the value outcomes and study how individual actors make considerations over time in respect to the three sustainability dimensions. A related issue may be to study how actors' perceptions influence the process and outcomes. It may also be interesting to compare how different types of actors (private versus public, profit versus non-profit) enact the process of valuing value in their internal organization and which roles actors can enact over time (Dedehayir et al., 2018). It may help to shed further light on the conditions that underpin the two patterns.

Implications for Practice

Practitioners are advised to study the starting conditions of their ecosystem and discuss with their partners which pattern they expect to follow. The corresponding mechanisms may

subsequently be used as prerequisites for the collaborative value creation and capture process. When sharing visions and expectations and formulating mutual value goals, the actors could also address the time horizon in which the initiative should yield results for each actor individually, and for the innovation ecosystem as a whole. This can help manage expectations for all partners and may avoid misunderstandings later on in the process of sustainable business model development. Actors may also openly discuss the tensions and possible ways of dealing with them in order to ensure alignment on the pattern they will enter. In addition to goal alignment, process alignment also seems to be a contributing factor in our cases.

Policy makers are advised to take notion of the two patterns of valuing value that innovation ecosystems may follow and evaluate their consequences for their policies. Subsidy providers, for example, may use the findings to evaluate the composition of innovation ecosystems developing sustainability-oriented innovations, and assess their research plans against the insights the two patterns provide. For example, the two patterns may ask for more flexibility in how smart city projects are funded, such as by granting funds to the initiative instead of to the partners, as the composition of the innovation ecosystem is likely to change over time.

Limitations

The empirical setting of this study involves certain limitations. Because the research is based on four case studies of cross-sector innovation ecosystems aiming for sustainability, statistical validity is absent. The findings are only analytically valid for comparable cases (Yin, 2017). Furthermore, this analytical validity is limited because the context of the sustainable ecosystems is an emerging, varied, and multi-faced field (Geissdoerfer, Savaget, Bocken & Hultink, 2017). Therefore, the results may not apply to other settings. A valuable avenue to increase the analytical validity of the research results would be to further study whether and how the process of valuing value takes place in different settings, with varying constellations of cross-sector actors, and other types of sustainable business models. It could also be fruitful to further study what kind of tensions and patterns that may yield.

Other limitations relate to the data gathering and analysis. Because we analyzed the data from the perspective of the innovation ecosystem, we did not specifically focus on individual motivations and specific circumstances of actors, their influence on collaborative activities, and their individual decisions to enter or leave the innovation ecosystem. Case studies that include all actors and delve deeper into their individual considerations, including the exit of actors as suggested by Ritala et al. (2013), could provide additional insights into

the process of valuing value, its patterns, and contributing mechanisms. Also, as some cases already started prior to the first interview round and the cases are still progressing, our data and analyses did not cover the whole development process. An in-depth longitudinal case study from start to finish could extend our findings and also explore the relation between the two patterns over time. For example, research might show that valuing value by collective orchestration succeeds valuing value by continuous search once there is consensus about the core elements of an innovation ecosystem's business model.

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Appendix A. Interviewees and their Roles in the Project per Case Study.

Cleantech Playground **De Ceuvel** (Clean)	**Local Growing of Industrial Crops** (Grow)	**Neighborhood Composting** (Compost)	**Wasted** (Waste)
1st Interview round (2015–2016): -1- Project manager co-operative (initiator / member society DC) -2- Creative entrepreneur (initiator / member society DC) -3- Project manager co-operative (manager society DC) * **2nd Interview round (2017–2018):** -3- Project manager co-operative (manager society DC) ***Archived interviews (2014–2016):*** -4- Creative entrepreneur (initiator / member Society DC)	**1st Interview round (2015–2016):** -1- Entrepreneur (paint producer) -2- Project manager public utility (landowner) **2nd Interview round (2017–2018):** -1- Entrepreneur (paint producer) -2- Project manager public utility (landowner) -3- Municipal officer (landowner / project leader) -4- Manager sustainability airport (landowner) -5- Entrepreneur (farmer) ***Archived interviews (2014–2016):***	**1st Interview round (2015–2016):** -1- Citizen / social entrepreneur (initiator)* -2- Researcher knowledge institute (researcher)* **2nd Interview round (2017–2018):** -1- Citizen / social entrepreneur (initiator) -3- Waste manager municipality (initiator) ***Archived interviews (2015–2017):*** -1- Citizen / social entrepreneur (initiator) -4- Creative entrepreneur (designer)	**1st Interview round (2015-2016):** -1- Project manager non-profit (initiator) -2- District director municipality (financer reward system) -3- Consultant philanthropy (financer) **2nd Interview round (2017-2018):** -4- Project manager non-profit (new project manager) -5- Waste manager municipality (waste collection) ***Archived interviews (2015-2016):***

-5- Founder co-operative (initiator / member Society DC) -6- Consultant co-operative (community developer DC) -7- Owners Café De Ceuvel (member Society DC) -8- Social entrepreneur (member Society DC)	-1- Entrepreneur (paint producer) -4- Manager sustainability airport (landowner) -5- Entrepreneur (farmer) -6- Entrepreneur (miller)	-5- Citizen (user) * Informal interviews, not recorded	-6- Project manager non-profit (initiator) -7- Founder non-profit (initiator)

Appendix B. Data Structure.