Chapter 4
Initiating a Minimum Viable Ecosystem for Circularity

Jan Konietzko, Brian Baldassarre, Nancy Bocken, and Paavo Ritala

Abstract To achieve a transformation toward the circular economy, organizations need to take an ecosystem perspective and consider multiple complementary actors that are needed to deliver circularity as a collective outcome. However, practitioners and scholars lack an understanding of the initial phases of ecosystem creation, in terms of how to get started, and what to consider. We therefore investigate *how organizations can initiate an ecosystem for a circular economy.* The method consists of a concise review of the ecosystem literature and three instrumental cases, to identify important activities that are needed when initiating an ecosystem for circularity. The cases include: (1) an alliance for circular safety footwear, (2) a startup that turns old coffee ground and orange peel waste from another company into new products, and (3) a multi-stakeholder project aimed at recovering resources from wastewater. We propose a framework for a Minimum Viable Ecosystem for Circularity (MVEC) that includes a set of key activities to perform when building ecosystems for a circular economy. These activities provide a useful roadmap for scholars and practitioners for establishing and assessing ecosystems for circularity. We call for further research and practical applications to test and demonstrate the utility of this framework in different contexts.

Keywords Circular economy · Circular business model · Business ecosystem · Ecosystem perspective · Systems thinking

J. Konietzko (✉) · N. Bocken
Maastricht Sustainability Institute, School of Business and Economics, Maastricht University, Maastricht, the Netherlands
e-mail: jan.konietzko@cognizant.com

B. Baldassarre
TU Delft, Industrial Design Engineering, Delft, the Netherlands

P. Ritala
LUT University, Business School, Lappeenranta, Finland

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4.1 Introduction

In a circular economy, organizations maximize the value of products, components, and materials, and minimize absolute resource use, emissions, waste, and pollution (Geissdoerfer et al. 2017). To innovate for a circular economy, organizations need to collaborate with external actors, often beyond classical industry and supply chain boundaries (Konietzko et al. 2020a). Coordination and alignment are needed to, for example, ensure the compatibility of products, components, and materials to enable repair, reuse, and recycling, or to support higher resource efficiency by sharing assets among several organizations and end customers (Brown et al. 2021a).

In the strategy and management literature, the concept of "ecosystem" has received increasing attention in the past years. It describes complex forms of inter-organizational alignment and coordination, and extends beyond formal alliance networks to incorporate broad complementarities among loosely connected actors (Aarikka-Stenroos and Ritala 2017; Shipilov and Gawer 2020). Compared to other cross-organizational concepts like supply chains or networks, an ecosystem is primarily characterized by a joint value proposition or an ecosystem-level outcome, delivered by complementary organizational actors (Adner 2017). An example of such an outcome is a seamless, affordable, and sustainable mobility system in a city. The ecosystem then describes the diverse participants that are needed to deliver a joint value proposition and achieve the ecosystem-level outcome. These participants are mostly not hierarchically governed (although some formal relationships might exist), and they have varying degrees of multilateral interdependence (Brown et al. 2021a; Thomas and Autio 2020).

Circularity can be described as a particular ecosystem-level outcome. To ensure that products, components, and materials are kept in use for as long as possible, diverse and loosely connected actors from across industries need to align and coordinate their activities (Konietzko et al. 2020b). These actors usually include customers who will buy or use recirculated products and components, service providers who will maintain, repair, refurbish, and remanufacture them, and recycling companies who will recover their materials. The ecosystem serves as a useful analogy to explain the inter-organizational coordination and alignment needed to achieve circularity (Aarikka-Stenroos et al. 2021).

However, the question of how organizations can initiate circular ecosystems remains unclear in the current literature. In general, the initiation of an ecosystem in business innovation — along its lifecycle of birth, expansion, leadership, and self-renewal or death (Moore 1993) — has received little attention (Dedehayir et al. 2018). Furthermore, research on ecosystems for circularity is still in its infancy (Baldassarre et al. 2020; Konietzko et al. 2020b). As a consequence, organizations lack support in effectively initiating ecosystems for a circular economy, and researchers lack visibility to the necessary processes and practices relevant for the early stages of circular economy ecosystems.

In this chapter, we therefore address the following research question:

How can organizations initiate an ecosystem for a circular economy?

To address this question, we first describe the theoretical background, including the origins and evolution of the ecosystem concept in management research and its application to a circular economy context. We then describe the method: a concise literature review and three case studies to identify important activities during the initiation of ecosystems for circularity. We then present the results in the form of the following six activities: (1) Develop a circular economy vision, (2) Design an ecosystem value proposition and outcome, (3) Identify and engage relevant actors, (4) Develop an initial governance model, (5) Develop fair value capture mechanisms, and (6) Keep track of environmental and social impact. We then discuss the contributions and limitations of this chapter, and provide some concluding remarks and outlooks for future research.

The goal of this chapter is to guide innovators with these proposed activities to ensure successful initiation of ecosystems for circularity. To theory, we contribute a review of important activities during ecosystem initiation in the context of a circular economy, which is based on prior findings on generic ecosystem roles and activities (Dedehayir et al. 2018).

4.2 Theoretical Background: How to Initiate Ecosystems for a Circular Economy

4.2.1 Origins and Evolution of the Ecosystem Concept

The analogy of an ecosystem in business innovation emerged in the early 1990s, to describe a new industrial landscape shaped by competition among groups or communities of collaborating organizations rather than competition among single organizations (Moore 1993). Since then, the ecosystem concept has evolved and become distinct from other community concepts in business and management, like supply chains, networks, or organizational fields (Adner 2017; Shipilov and Gawer 2020; Thomas and Autio 2020). The main distinction is a coherent, customer-facing value proposition or ecosystem-level output (Adner 2017). Furthermore, the ecosystem concept consists of non-hierarchical governance and primarily non-contractual relationships, it contains diverse and heterogeneous participants, and the participants in an ecosystem have varying levels of technological, economic and cognitive interdependencies (Thomas and Autio 2020; Thomas and Ritala 2022; Shipilov and Gawer 2020; Möller et al. 2020).

Central to the ecosystem concept is an ecosystem value proposition or defined system-level outcome that requires multiple actors to be realized (Adner 2006, 2017; Talmar et al. 2020; Lingens et al. 2020). Ecosystems are often driven by an "orchestrator" – a central actor that coordinates the complementarities across the ecosystem by utilizing economical or technological (e.g., a digital platform) mechanisms to do so (Thomas and Ritala 2022). Oftentimes the orchestrator (one organization or a group of organizations) also proposes the initial vision of the ecosystem and its value proposition and desired outcome, concretely in the form of an offering idea or a business model concept, sometimes backed with relevant intellectual property rights.

An example of an ecosystem value proposition in the context of a circular economy is "Loop", an online platform for groceries shopping in reusable packaging. Their value proposition is "*A new way to shop, waste-free*" (Loop 2021). To deliver this value proposition (a new way to shop) and ecosystem outcome (no waste), Loop had to convince a minimum viable number of food brands to provide their products in reusable packaging. It had to organize a supplier for the reusable packaging, organize a delivery service that takes back the empty food packaging, and it had to organize a cleaning service for the reusable packaging. Loop orchestrates these complementors and suppliers through an online platform that customers can order from. This example shows how the ecosystem orchestrator does not only need to establish a multi-sided market structure (Kretschmer et al. 2020), but also to create initiatives for circularity together with different participants of the ecosystem.

4.2.2 Ecosystems and the Circular Economy

The example of the Loop store shows that an ecosystem – next to a customer-facing value proposition – can generate circularity as an outcome. In a circular economy, organizations redesign and reorganize materials, products, business models, and supply chains, to narrow, slow, close, and regenerate inter-organizational material and energy flows (Konietzko et al. 2020a; Bocken et al. 2016). Circularity can be characterized as an ecosystem outcome, because it results from how a diverse set of actors — like manufacturers, users, suppliers, and recycling firms — interact with and relate to each other, to enable the circular flow of resources over time (Konietzko et al. 2020b; Aarikka-Stenroos et al. 2021).

The discussion on the ecosystem concept in relation to the circular economy can be traced to seminal ideas about resource-efficient manufacturing, focusing on tangible, inter-organizational material and energy flows, and how these can be influenced to achieve environmental gains (Frosch and Gallopoulos 1989). In this context, the concept of ecosystem has been leveraged by the discipline of industrial ecology, which seeks to translate the working principles of natural ecosystems (e.g., balanced, self-sustaining interdependencies) into industrial settings, processes, and products (Blomsma and Brennan 2017). Emulating nature, industrial ecosystems seek to optimize the consumption of materials and energy, and minimize waste by channeling them as inputs into other processes (Harper and Graedel 2004). This may happen within one factory (Despeisse et al. 2012), an eco-industrial park with a variety of organizations exchanging materials and energy (Côté and Cohen-Rosenthal 1998), or within an extended urban context, which goes beyond production, and includes the consumption and end-of-life stages of products (Harper and Graedel 2004; Leduc and Van Kann 2013).

One of the older and most renowned examples of industrial ecosystems catalyzing a circular economy in Europe is the Kalundborg eco-industrial park in Denmark (Jacobsen 2006). Here, several companies exchange waste and/or energy, materials, infrastructure to jointly optimize their environmental and economic performance (Massard et al. 2014). Recent research provided insight into how such industrial ecosystems for circularity function both from a business and sociotechnical perspective, illustrating a case in the south of the Netherlands (Baldassarre et al. 2019). Here, residual heat and carbon emissions from a chemical company are collected and channeled through a piping system into nearby greenhouses, where farmers use them as inputs for growing tomatoes (see Kokoulina et al. 2019, for a similar example). The circular outcome is based on several years of collaborative trial-and-error efforts of several actors, including the chemical company, farmers, a commercial bank, a construction company, the local government, as well as an ecosystem coordinator taking care of project development, implementation, and management. In this chapter, we follow the recent conceptualization of circular ecosystems (Aarikka et al. 2021) and view the ecosystem more broadly than the industrial ecosystem, to include any multi-actor ecosystem that focuses on circularity as the ecosystem outcome.

4.2.3 Research Gap and Contribution

An ecosystem is subject to an evolutionary lifecycle of birth, expansion, leadership, and ultimately self-renewal or death (Moore 1993). Research on the birth phase of ecosystems — which consists of invention and startup sub-phases (Dedehayir and Seppänen 2015) — has emerged only recently. Early research has suggested that organizations need to create a “Minimum Viable Ecosystem” to start an ecosystem, i.e., an initial alignment structure that can create economic value (Adner 2012; Pidun et al. 2020). This alignment structure can be seen as a boundary object that helps people across disciplines to generate the knowledge needed to succeed in the innovation process (Carlile 2002). A Minimum Viable Ecosystem as a boundary object can take different forms. It can be, for example, in the form of a “value blueprint”, a visual graphic of the complementary innovations needed to jointly deliver an end-user facing value proposition (Adner 2012). Dedehayir et al. (2018) have offered a detailed account of roles and activities during ecosystem genesis. Baldassarre et al. (2019) outlined a high-level process, as well as underlying methods and tools, to iteratively turn an initial shared vision of the proposition into a business that generates circular impact. Further contributions include visual tools that help establish an early alignment structure, for example, the Ecosystem Pie

Model, a pie-shaped canvas to map out the needed complementary actors for an ecosystem value proposition (Talmar et al. 2020), or the Circular Collaboration Canvas, a tool that aids in identifying needed partners to deliver a value proposition for a circular economy (Brown et al. 2021b).

In this chapter, we build on this emerging body of work by identifying important activities that facilitate the initiation of an ecosystem for a circular economy, based on literature and the experience from three cases. We investigate these activities and develop a boundary object (Carlile 2002) – a framework for a Minimum Viable Ecosystem for Circularity (MVEC) – with key activities that can serve as guidance when forming an initial alignment structure to solve a circular economy problem. So far, research on the types of activities needed to initiate ecosystems is scant, especially in the context of a circular economy. This refers to aspects of, for example, ecosystem governance, partnership building, and value management (Dedehayir et al. 2018). We assume here that the initiating actor is an orchestrator or ecosystem leader. In the following, we describe how we identified these activities.

4.3 Method: Identifying Important Activities from the Literature and Three Cases

This research identified relevant activities during ecosystem initiation for circularity by concisely reviewing relevant ecosystem literature and by analyzing three cases of organizations that have initiated an ecosystem for a circular economy.

As a first input, we used the 90 articles on ecosystem genesis identified in earlier research (Dedehayir et al. 2018) and in addition, searched for literature since 2018, using the search string (ecosystem AND genesis OR creat* OR design OR initiat* OR start* OR emerg*), filtered for titles, and limited to business, management and accounting literature (117 results). We reviewed the literature and applied snowballing to identify further relevant articles.

We read the studies in the search of knowledge that uses design and theory building to inform and propose how to "*devise courses of action aimed at changing existing situations into preferred ones*" (Simon 1996, p. 111). In the context of innovation practice, this refers to knowledge that can help to improve the process of innovating (Romme and Reymen 2018). This knowledge usually comes in the following forms: (1) as an explicit purpose of the article, for example, to develop a tool or boundary object to improve practice (see e.g., Talmar et al. 2020), (2) in the managerial implications sections of the publications, (3) or implicitly in the form of normative statements about what organizations should do. We filtered the articles that contained any of these forms of useful knowledge and coded important and recommended activities of initiating innovation ecosystems. The final pool of articles for review contained 37 studies.

Second, we used three instrumental case studies to provide further insight into the activities particular to the context of initiating innovation ecosystems for a circular economy (Stake 1995): The Circular Footwear Alliance, Unwaste, and Clean Water. Case studies can be based on rich and diverse data to inform the analysis (Eisenhardt 2021). The analysis in the cases focused on how the ecosystem was initiated. During the case interviews and workshops, themes discussed included how the ecosystem started, who was involved, what the goal was, and what activities were pursued in the initiation process. Data on the Circular Footwear Alliance consists of notes from two interviews and one co-creation workshop with people from the orchestrating company (EMMA Safety Footwear), several internal presentations, and online information (websites, social media posts). Data on Unwaste includes notes and visual outputs from three co-creation workshops to develop the business ecosystem. Data on Clean Water include 21 interviews and two co-creation workshops with the 20 involved organizations that aimed to develop their business ecosystem. We describe the three cases in turn.

Circular Footwear Alliance The Circular Footwear Alliance was founded by two competing safety footwear manufacturers (EMMA Safety Footwear and Allshoes Safety Footwear), as well as a service company called FBBasic, to enable the circularity of safety footwear. Both manufacturers realized that they could achieve more together than alone. They joined forces to develop a project to enable the returning, sorting, separating, and recycling of old safety shoes.

Unwaste Unwaste is a startup from Amsterdam, Netherlands that provides personal care products like soap and handspray, made from recovered ingredients such as old coffee ground and orange peel waste. The company is embedded in an ecosystem that organizes the separate collection, processing, and manufacturing of the ingredients into new products. The ambition of Unwaste is to close the loop for its clients' waste.

Clean Water Clean Water (project name has been anonymized to ensure confidentiality) is a EU innovation project related to the wider policy framework of the Circular Economy Action Plan. The project is a large cross-organizational endeavor where multiple stakeholders are collaborating to pilot a solution to recover valuable minerals from industrial wastewater in a European Port Area, to then put them back on the EU market.

4.4 Results: Activities to Initiate an Ecosystem for a Circular Economy

We propose that the following activities need to be performed to initiate an ecosystem for a circular economy: (1) Put forward a circular economy vision, (2) Design an ecosystem value proposition and outcome, (3) Develop an actor engagement strategy, (4) Develop a governance model, (5) Develop fair value capture mechanisms, and (6) Keep track of environmental and social impact (Fig. 4.1).

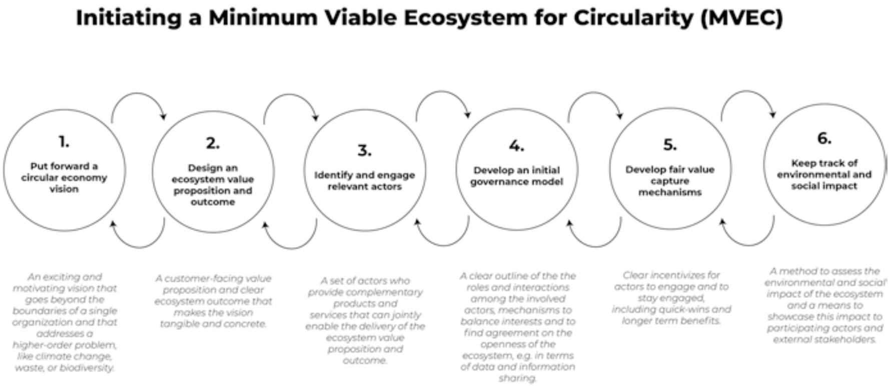

Fig. 4.1 A framework of key activities to initiate a Minimum Viable Ecosystem for Circularity (MVEC)

In practice, people can initiate an ecosystem by starting with any of these sets of activities. Here we propose them in a clear order observed in the cases. The innovation process ideally starts with someone who puts forward a vision (1), which is translated into a defined and more concrete ecosystem value proposition and outcome (2), which in turn can be used to engage actors (3). Actors are identified who share the same vision to make the ecosystem value proposition a success. This engagement then requires a governance model (4) to facilitate effective exchange and interactions among the actors, as well as mechanisms for fair value capture (5). For example, in terms of how revenue streams are divided among the different actors. Finally, to ensure the intended impact, it is important to keep track of the environmental and social impacts (6). The latter step, perhaps because of the complexity, is often omitted, but the ample research on unintended consequences of innovation suggests that this is an essential step. Along the process, the innovators may need to jump back and forth between these sets of activities, hence the arrows in Fig. 4.1.

4.4.1 Put Forward a Circular Economy Vision

An important set of activities for a Minimum Viable Ecosystem is the development of a convincing and ambitious vision, one that puts forward an exciting and motivating idea about a desirable future state (Bocken et al. 2021; Wiek and Iwaneic 2014). This may start with ideas for a new technology or new way of doing business, often driven by passionate individuals (Dedehayir and Seppänen 2015). Communicating a vision is a key skill among individuals who are aiming to orchestrate the emerging ecosystem, as well as a key capability for orchestrating organizations (Dhanaraj and Parkhe 2006; Ritala et al. 2009). This future state transcends the boundaries of a single organization, leading to a higher-order collaborative intent, aiming at transitions of entire systems (Quist et al. 2011). In the case of a circular economy, this higher-order collaborative intent lies in designing out waste and regenerating natural ecosystems within economies (European Commission 2020; MacArthur 2013).

A vision can be developed through joint workshops and activities with relevant stakeholders, and requires interactive and creative elements like storytelling, or drawing (Wiek and Iwaneic 2014). It may align differing perspectives and reveal what different stakeholders find important about the future. Different narratives about a circular future may emerge in this process (Bauwens et al. 2020). Recognizing different viewpoints, acknowledging them, and negotiating different elements of a future vision are important aspects to legitimate the birth of an ecosystem and to arrive at a framing that can gain traction among various stakeholders (Wiek and Iwaneic 2014).

In the case of Unwaste, this vision is about eliminating the word "waste", about creating a world in which waste is seen as something beautiful. Its vision reads as follows:

> We cross out the word waste. Literally: ~~waste~~. The Dutch language does not yet have a good term for the way Unwaste looks at human-produced waste streams. Well, except for 'human-produced waste streams'. But that is not only very abstract, but also much too long to put on our packaging, for example. That is why we stay close to a word that many people know, but also makes our vision clear: ~~waste~~ is too beautiful to throw away.

Similarly, the vision of the Circular Footwear Alliance is about a future without waste. It reads as follows:

> The future is circular. Together we can make great strides. We believe in a future without waste. A future in which resources and raw materials are continuously recycled and reused. A circular future, to be precise. Together, we will bring this future closer. And we'll start at your feet…

In the case of Clean Water, the vision of the collaborative project is the following:

> Collaboratively transforming the supply chain of water and minerals in a European Port Area.

Developing a vision is an often underestimated but crucial part of developing an ecosystem for circularity. For innovators and managers, it is crucial to dedicate time and effort to joint workshops and opportunities for potential partners to engage in shaping the vision. In addition, it is important to check quality guidelines for a vision (Wiek and Iwaneic 2014). For example, visions should not be abstract statements, but tangible, measurable, and time-bound statements about the desired future.

4.4.2 Design an Ecosystem Value Proposition and Outcome

Another set of activities relates to the design of a tangible ecosystem value proposition and outcome, often put forward by the ecosystem orchestrator (Adner 2017), but developed and legitimized in a discursive and performative process among all ecosystem actors (Thomas and Ritala 2022). This should be built on the collective drive and motivation put forward by a shared vision (Den Ouden 2012). Ultimately, the shared vision should be transformed into a customer-facing value proposition and clear ecosystem outcome; this requires a lot of work in terms of designing, iterating, and communicating different aspects of the value proposition among ecosystem actors.

As perceptions of value are subjective, an ecosystem value proposition needs to integrate the value notions of various stakeholders. This can take place by critiquing existing institutions, i.e., widely shared norms, beliefs, rules, and values (Scott 2008), to open up space for new discussions, and to reshape these institutions. Part of this reshaping involves the joint development and acceptance of new symbols, a new language, and physical objects (Vink et al. 2021).

In a circular economy, where institutional drivers and barriers play a key role (Ranta et al. 2018), institutions can be reshaped around the ideas of reuse and repair, and waste as a resource (Konietzko et al. 2020b). New symbols like loop diagrams and graphics that portray the circular flow of resources, a new language around "waste as a resource", a life-cycle perspective, and regeneration can stimulate the design of an ecosystem value proposition. Core to the idea of a circular economy is that resource efficiency and product life extension can be aligned with business and financial incentives. That is why the customer-facing offering is an important element of an ecosystem value proposition for a circular economy.

In the case of the Circular Footwear Alliance, the ecosystem outcome is the recycling of safety footwear. EMMA Safety Footwear, one of the initiating companies, realized that it could not achieve this alone. It calculated that it needed around 250,000 pairs of shoes to establish the business case for recycling, i.e., to make it financially viable and operationally feasible. Therefore, the company partnered with its competitor, Allshoes Safety Footwear, to generate the needed volume, and to encourage other actors to send back old safety footwear. The value proposition was framed for their customers who need to send back the old footwear. They could get help in improving their carbon emissions and waste metrics, as well as exchange knowledge on how to design the footwear for circularity, for example in terms of easy disassembly and mono-material components. In addition, the customers realized that joining this initiative could help them mitigate future regulatory cost around waste disposal.

Similarly, Unwaste makes products from recovered materials. The company has assembled an ecosystem of actors around it – waste management firms, office spaces, processing plants, and personal care product manufacturers – to enable the circularity of wasted orange peels and coffee grounds, to turn them into new products. It aligns the different actors around the following customer-facing value proposition:

> Waste is too good to throw away. It doesn't even need to exist. Because if human-generated waste is always relevant, then there is nothing left to throw away. Unwaste takes care of that. We give waste a new function in our care products, so you can experience its beauty every day.

The ecosystem value proposition to the customers of Unwaste taps into the emotional value of doing something good for the environment, and to be part of a changing mindset that sees waste as a resource. In general, an ecosystem value proposition for circularity communicates both emotional and functional value to the end customer, as well as the systemic outcome that is achieved by delivering the value proposition. This is an iterative process and requires careful validation of the systemic outcome that can be achieved, as well as the value perceptions of different stakeholders and the end customer.

4.4.3 Identify and Engage Relevant Actors

The ecosystem value proposition needs to be broken down into single independent modules that are contributed by different actors with defined roles and responsibilities (Lingens et al. 2020; Vink et al. 2021). Before engaging other actors, the orchestrator needs to be clear on its own role and position in the aspired ecosystem (Bosch-Sijtsema and Bosch 2015; Dedehayir et al. 2018). We assume here that the ecosystem is initiated by the ecosystem leader or orchestrator, which is typically the case. The role of the orchestrator is best performed by a start-up-like organization that can develop products fast, is agile and flexible. If the founding organization of the ecosystem is a large multinational, consultancy, a political, or an academic institution, it makes sense to consider founding a spin-off or external organization (Lingens et al. 2020; Gastaldi et al. 2015). On the other hand, an established and well-known orchestrator can bring the necessary legitimacy and related resources for the new ecosystem (Thomas and Ritala 2022), which shows, e.g., in the well-known circularity initiatives by multinationals such as IKEA and H&M. Once the orchestrator's own role is clear, the actor engagement strategy requires identifying and engaging relevant external actors (Dedehayir et al. 2018).

Actors can be identified based on prior collaboration, as well as based on the need to involve the right representatives who bring in key capabilities (Cobben and Roijakkers 2019; Overholm 2015). This may or may not include competitors (Ritala et al. 2013; Almirall et al. 2014). If uncertainty is high, less actors can help to limit the attention on core actors. If uncertainty is low and the path is clear, more actors can be included (Lingens et al. 2020; Bosch-Sijtsema and Bosch 2015). In the context of circular economy, it might be necessary to involve relevant actors from different parts of the value chain early on (see also Ritala et al. 2013).

Once actors are identified, the engagement strategy requires clear incentives for others to join and a clearly articulated vision and ecosystem value proposition that others can identify with, see value in, and are willing to commit to (Dedehayir et al. 2018). Initial engagement can then happen through joint meetings and activities to develop shared goals and a common point of departure. To attract new actors, an ecosystem needs to build an ecosystem identity that new actors buy into, which can happen by leading the discourse on new ways of doing business in a circular way and by showing an exceptional performance in delivering an ecosystem value proposition (Thomas and Ritala 2022). This can happen through forums, associations, meetings, and other communication channels. Developing an engagement strategy for all the partners that are expected to contribute to the ecosystem also requires ongoing negotiations to accommodate different needs (Overholm 2015).

In the case of the Circular Footwear Alliance, for example, EMMA Safety Footwear decided to partner with its competitor in a cooperative alliance to generate the needed volume of old safety shoes to make recycling viable and feasible. It also partnered with two recycling companies that could support the sorting, separating, and recycling of the shoe material. Further, the Alliance partnered with FBBasic for software that could help identify shoe material and organize the reverse logistics. FBBasic also helped to provide a dashboard for participating companies so that they could showcase the impact of returning and recycling old shoes in terms of CO_2 savings.

In the case of Clean Water, a scientist and innovator drove multilateral efforts for creating the foundations of a collaborative business aiming to put back on the market minerals recovered from wastewater. To this end, a large supplier of demineralized water based in the European Port was engaged to provide infrastructure and wastewater streams for the recovery of the minerals. A firm that might commercialize such minerals was also included in the consortium. A leading European University was included to provide technological expertise needed to separate minerals from wastewater in an energy-efficient way. Other research institutions and multiple technology suppliers were also included for the design and implementation of the Clean Water innovative wastewater treatment system. Eventually, this led to the creation of a Clean Water consortium, with complementary expertise coming from 22 academic and industry partners based in different European countries.

As these two examples show, the exact engagement strategy depends on the context and may be born out of the need to join forces and maximize impact and achieve feasibility, or because of personal contacts that people have, to help build the required network around an ecosystem vision for a circular economy.

4.4.4 Develop an Initial Governance Model

The governance model defines the roles of the actors and their intended interactions, and the openness, for example in terms of data and information sharing (Almirall et al. 2014; Bosch-Sijtsema and Bosch 2015; Dedehayir et al. 2018; Wareham et al. 2014).

In terms of roles and interactions, the governance model needs to find a balance between the stability and evolvability of the ecosystem (Wareham et al. 2014). On the one hand, the ecosystem needs to be stable enough to deliver quality and ensure that the investments of complementors will pay off (on the role of stability in networks and ecosystems, see also Dhanaraj and Parkhe 2006; Ritala et al. 2009). On the other hand, the governance model needs to allow for evolution in how complementors operate and adapt to changing environments, and the related changes in the governance mechanisms implemented by the orchestrator.

An important first step in establishing a governance model is therefore to identify important tensions and find ways to address them (Wareham et al. 2014). These tensions can be found in a potential disbalance on two spectra: (1) between standards and variety of ecosystem outputs, and (2) between the individual versus collective identity of participating actors. To govern an ecosystem, the outputs need to be standardized over time to ensure efficient processing and delivery. But there also need to be incentives for variety to bring in novelty, and actors should feel encouraged to innovate. Similarly, the individual identity needs to be balanced with the collective ecosystem identity, where the former leads to variety in behavior and more innovation, and the latter ensures a consistent ecosystem outcome (Thomas and Ritala 2022; Wareham et al. 2014).

These tensions can be governed depending on the power and influence of the orchestrator to steer the actors in a common direction while ensuring variety. The governance model can be based on a more hierarchic model, where one stakeholder has the power to lead and coordinate others, or on a more horizontal model, where there is no formal decision-making power on the side of the orchestrator (Kapoor and Lee 2013; Williamson and De Meyer 2012). Formal governance mechanisms include contracts and intellectual property regimes (Ritala et al. 2013), informal ways of governing an ecosystem include trust building, a clear business case, and a growing positive reputation (Bosch-Sijtsema and Bosch 2015).

Oftentimes, there is a need for data and knowledge sharing to enable the delivery of the ecosystem value proposition. Thus, the governance strategy also requires a negotiation and decision on the degree of openness, for example by creating the terms for data sharing and standardizes protocols that are needed to deliver the ecosystem outcome (Almirall et al. 2014; Konietzko et al. 2020b).

In the case of the Circular Footwear Alliance, the tension between standards and variety showed itself in the variety of safety footwear that was sent back and the challenges in ensuring an effective sorting and separation process for recycling. To ensure standards, the Alliance asked its partners to incorporate more circular product design principles in the shoes they manufacture to facilitate recovery. Similarly, the collaboration with the recycling companies required experimentation to find an effective and efficient processing of the old shoes into new raw materials, which led to new intellectual property on the recovery of shoes, which is shared with new entrants to ensure the scalability of the ecosystem.

In the case of Clean Water, a governance model was essential to steer and coordinate the collaborative efforts of all the partners involved. The governance model was initially sketched in the grant agreement between consortium partners and the funder, namely the European Commission. In this document, roles and responsibilities of the partners were clearly defined, specifying that the leading European University would orchestrate the collaboration. To this end, the university appointed an executive project coordinator, who was eventually flanked by a technical and scientific project committee meeting on a monthly basis. Furthermore, an external board of advisors was also established. This was essential to keep track of progress, ensure coherence across intra-firm activities performed by the partners and solve related challenges.

4.4.5 Develop Fair Value Capture Mechanisms

Another set of activities relates to developing fair value capture mechanisms to incentivize actors to engage and to stay engaged (Brown et al. 2021b; Den Ouden 2012; Williamson and De Meyer 2012). This is important for a healthy and a sustainable ecosystem. How much value is captured by whom depends on the negotiation and on the power and influence of the ecosystem leader, as well as the abilities of different actors to differentiate their value capture opportunities (Lavie 2006; Ritala and Hurmelinna-Laukkanen 2009). A benevolent leader will ensure fair value capture, a dominating one will try and vertically and horizontally integrate to capture most of the created value, which may compromise the longer-term health and sustainability of the ecosystem (Dedehayir et al. 2018).

An effective governance model ensures that actors have clear incentives to join, and can answer the question of "*what is in it for me?*" for each participating actor (see also Ritala and Hurmelinna-Laukkanen 2009). Ideally, this includes short-term gains that keep actors engaged and long-term benefits, for example in terms of recurring revenue streams enabled by the participation in the ecosystem (Ritala et al. 2013). Depending on the needs of the actors, this can be made explicit through formal contracts and intellectual property models, or it can be negotiated more informally and based on mutual trust (Holgersson et al. 2018; Leten et al. 2013).

The participating recycling companies in the Circular Footwear Alliance capture value through the viable recovery of materials that can then be sold on to other suppliers. Other participating stakeholders who send in old safety footwear capture value by showcasing the carbon emission reductions on their website through a dashboard that the Circular Footwear Alliance provides. They also benefit from the developed knowledge around the recovery of the shoes, which can be used to improve the circular product design and technology of their shoes. Overall, in this case, the whole ecosystem can increase its value capture opportunities via the increased legitimacy in the eyes of the external participants (Thomas and Ritala 2022), providing more transparency in terms of circularity, and resulting benefits in consumer trust, brand recognition, and stakeholder perceptions.

Value capture, in the case of Clean Water, represented a challenging aspect, considering the large number of partners involved, their different typology, size, and core business, naturally resulting in disparate innovation goals and approaches. In principle, the idea was to allow the supplier of demineralized water to capture value through a more energy-efficient solution for its wastewater treatment process, which would also provide additional value by recovering some minerals to be reused within the process itself. Those minerals that could not be reused internally would allow another firm to capture value through their sale on the market. Finally, technology suppliers would capture value by being able to sell their solutions through Clean Water, while research institutions would benefit through the production of scientific knowledge. To test whether all of this would be technically feasible and financially viable, a large-scale demonstration was conducted in the European Port. Results evidenced the need for further development, strengthening the business case, before being able to capture monetary value while operating commercially at full scale.

4.4.6 Keep Track of Environmental and Social Impacts

To track progress toward the circular economy vision of the ecosystem, it is important to keep track of both environmental and social impacts (Baldassarre et al. 2019; Manninen et al. 2018). The circular economy has often been criticized for ignoring the social side of sustainability (Schröder et al. 2020). Impacts on workers, human rights, and product responsibility, for example, should be considered in the context of a circular economy, to prevent negative social externalities (Padilla-Rivera et al. 2021).

In the case of the Circular Footwear Alliance, a dashboard was created that shows the number of collected pairs of shoes, the weight of the total material, the carbon emission reductions, and the number of participating actors.

In the case of Clean Water, for example, the environmental impact was analyzed using life cycle assessment (LCA). As part of this method, several environmental indicators (e.g., CO_2 emissions, freshwater eutrophication) were selected and used to quantitatively measure the impact of implementing the wastewater and resource recovery technologies, in comparison to a baseline scenario in which the technologies would not be implemented.

To prevent rebound effects – when good intentions for environmental impact reductions lead to a net increase in impact – the value proposition might have to be reconsidered and adjusted along the way to ensure optimal environmental outcomes (Bocken et al. 2019). The cases in our chapter exemplify that circular economy innovation also tends to exclude social impacts in practice.

In general, newly emerging innovation ecosystems for circularity should aim for positive value and impact across the social, environmental, and economic dimensions. Recent developments on company pledges for net positive outcomes on sustainability — like storing more carbon than is emitted or replenishing more water than is consumed — go in the right direction, to aim high and motivate an emerging ecosystem to join ambitious efforts. It is imperative that newly founded ecosystems aim at net positive impact, rather than just aiming at creating something that is less bad. Making such aims concrete is essential, which highlights the importance of assessing, measuring, and reporting impacts.

4.5 Discussion and Conclusion

Ecosystem-level innovation is perhaps the most complex of the different types of circular economy innovations (material, product, business model, etc.), involving different actors, high circular economy ambitions, and potentially complex governance models as a result (Konietzko et al. 2020b; Aarikka-Stenroos et al. 2021). It is therefore unsurprising that, despite many successful industrial symbiosis networks that we have witnessed in practice, our understanding of circular ecosystems and their innovation potential is still in its infancy.

This paper has contributed to nascent research on circular ecosystem innovation by conceptualizing – based on Ron Adner's work on innovation ecosystems (Adner 2012) – a framework for a Minimum Viable Ecosystem for Circularity (MVEC). This framework is based on literature and three emerging circular ecosystem cases. The framework boasts 6 core steps with a typical sequence: (1) Put forward a circular economy vision, (2) Design an ecosystem value proposition and outcome, (3) Develop an actor engagement strategy, (4) Develop a governance model, (5) Develop fair value capture mechanisms, and (6) Keep track of environmental and social impact. We expect these steps to capture the essential aspects required in setting up an ecosystem that aims at circularity as the ecosystem-level outcome, and at a viable business case for all involved actors.

Given the contextual heterogeneity of our cases and the inherent organizational complexity of ecosystems (Phillips and Ritala 2019), the steps in our framework should be treated as iterative and interconnected dimensions, rather than linear roadmap that is suited to all context as is. Therefore, several limitations and further research directions should be highlighted. First, by nature, the Minimum Viable Ecosystem for Circularity provides only high-level steps and guidance. More research is needed to understand the precise intricacies of each step. Second, the study is limited by three cases, which were all about the closing of resource flows. More research is needed to understand the types of ecosystems emerging that use and combine different circular strategies like narrowing, slowing, and regenerating resource flows. We suspect that organizations will often engage in several circular ecosystems that cater to different aspects of the business and that cover different life-cycle trajectories for products, components, and materials.

More research is also needed to investigate the growth and successful scaling of circular ecosystems, similar to former research on industrial symbiosis networks (Boons et al. 2017). Third and finally, there is ample opportunity for inter and transdisciplinary research, to learn from adjacent fields like “circular cities”, circular economy policy, but also engaged research with circular economy innovators. Another interesting avenue is to further investigate the relationship between the literature on ecosystems from strategic management and the literature on transitions (Quist et al. 2011). This chapter purposely did not include this stream of literature, because transition theory is mostly directed at policy and civil society, and therefore provides limited guidance for business. Nonetheless, the multi-level perspective, which forms part of transition theory, is crucial to understand the external viability of emerging circular ecosystems (Walrave et al. 2018).

With this chapter, we contribute guidance for innovators that want to tackle systemic problems like waste, greenhouse gas emissions, and pollution. Next to material, product, and business model innovation, the Minimum Viable Ecosystem for Circularity provides guidance for the broader, inter-organizational dynamics that need to be addressed to move toward successful systemic change.

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