How to start

a new perspective on innovation ecosystem emergence

Lysen, G.T.

Award date:
2020

How to start: a new perspective on innovation ecosystem emergence

Master thesis report

Drs. G.T. (Gijs) Lysen

Supervisors:

1st dr. ir. B. (Bob) Walrave

2nd dr. S.A.M. (Sharon) Dolmans

3rd dr. ir. E. (Elke) den Ouden

Eindhoven, October 2020

Keywords: innovation ecosystems, ecosystems-as-structures, collective action, functional, co-creation, ecosystem inception, alignment

Abstract

While innovation ecosystems have received increasing scholarly attention, the emphasis has been mainly on developing an understanding of incumbent ecosystems. In this respect, far less is known about where it all starts, that is, innovation ecosystem inception, which encompasses crucial activities such as partner selection, creation of initial alignment, and value proposition (VP) development —greatly influencing ecosystem development of both short and long term. This thesis explores what logics drive collective action in emerging innovation ecosystems. By adopting a multiple case-study, two important contributions to the field of innovation ecosystems emerge. The results of this study confirm the existence of the functional and co-creation logics, which drive collective action during the emergence of an innovation ecosystem. Furthermore, the results of this study demonstrate how innovation ecosystems emerge. Initiators adhering to the functional logic attract potential partners and select potential partners based on the VP blueprint. Whereas initiators adhering to the co-creation logic develop the VP jointly with their partners. These co-creation ecosystem initiators require highly committed and trustworthy partners and make use of their network to find such partners. This study contributes to the field of innovation ecosystem research as it confirms the existence of different logics and consequently provides insight into the creation of innovation ecosystems. Furthermore, this research provides the field of innovation ecosystem research with ample opportunity for valuable future research.

Acknowledgements

Ik wil mijn waardering uitspreken voor de begeleiding en toewijding van mijn eerste begeleider, Bob Walrave. Bob, dankjewel voor je steun, tijd, expertise en feedback. Gezamenlijk zijn we in dit onderbelichte onderwerp gedoken waar veel ruimte voor mijn initiatief lag. Door jouw regelmatige feedback heb ik mijn onderzoekskwaliteiten kunnen verbeteren en heb ik me kunnen ontwikkelen op het gebied van academisch schrijven. Daarnaast, wil ik mijn tweede begeleider Sharon Dolmans bedanken voor haar zeer waardevolle input richting het einde van deze thesis. De laatste meetings hebben ervoor gezorgd dat dit werk een duidelijke focus heeft gekregen en dat ik trots kan zijn op het resultaat. Tot slot, wil ik Elke den Ouden bedanken voor haar inzet als derde begeleider.

Ik wil alle respondenten bedanken voor hun waardevolle verhalen over hun ervaringen en hun flexibiliteit. Dankzij hen ben ik in staat geweest om een onderbelicht aspect van innovatie ecosystemen te onderzoeken. Ik hoop dat dit onderzoek een vervolg krijgt en dat jullie verhalen een waardevolle initiële stap zijn.

Ik wil mijn ouders bedanken voor hun onvoorwaardelijke steun de afgelopen negen jaar. Hoewel ik veel geleerd heb in Delft was het niet de verwachte start, maar jullie steun en suggesties hebben mij vier zeer waardevolle jaren in Wageningen gebracht. Ik ben jullie ook dankbaar voor jullie steun om een tweede master te volgen, twee jaar waarin ik wederom veel heb geleerd. Twee jaar aan theorie waarvan ik hoop dat ik deze in de praktijk mag brengen. Daarnaast wil ik Manon bedanken voor haar steun en nabijheid de afgelopen jaren. Tot slot wil ik mijn broers en vrienden bedanken voor hun steun gedurende mijn studententijd.

Met dit werk sluit ik mijn studententijd definitief af en begint een nieuwe periode. Ik ben benieuwd welke opgedane kennis en ervaring van de afgelopen jaren terug gaat komen in mijn werkende leven en hoe deze periode mijn toekomst beïnvloed. Op naar nieuwe uitdagingen en een volgende stap!

Gijs Lysen,

Amstelveen, 2020

Table of Content

1. Introduction

While innovation ecosystems have received increasing scholarly attention (Autio & Thomas, 2014; Bogers, Sims, & West, 2019; de Vasconcelos Gomes, Facin, Salerno, & Ikenami, 2018), the emphasis has been mainly on developing an understanding of incumbent ecosystems (e.g. Adner, 2006; Adner & Kapoor, 2010; Dhanaraj & Parkhe, 2006). In this respect, the emergence or inception of innovation ecosystems has received far less attention (Dattée, Alexy, & Autio, 2018; Dedehayir, Mäkinen, & Ortt, 2018; Gawer, 2014; Suominen, Seppänen, & Dedehayir, 2019; Thomas & Autio, 2015). This is surprising, given that innovation ecosystem inception encompasses crucial activities such as partner selection (de Vasconcelos Gomes et al., 2018), creation of initial alignment (Adner, 2017), and value proposition (VP) development (de Vasconcelos Gomes et al., 2018). These activities and the corresponding decisions play a key role in shaping an ecosystem and its envisioned innovation.

Furthermore, the activities and the corresponding decisions made during inception strongly affect the viability of the innovation ecosystem in several ways. The capabilities and resources possessed by the ecosystem's actors affect the development of the VP (Dedehayir et al., 2018; Dedehayir & Seppänen, 2015). Subsequently, the quality and viability of the VP will have a strong influence on the viability of the ecosystem (Thomas & Autio, 2015). Furthermore, as innovation ecosystem actors collaborate closely, alignment is required (Adner, 2017) and creation of initial alignment, in turn, is strongly influenced by the involved partners.

In essence, all innovation ecosystems aimed at materializing an innovation can be viewed as a collective of actors undertaking collective action. Consequently, establishing an innovation ecosystem requires the creation of a set of actors willing to undertake joined action. Collective action is required, as, only together, actors can deliver a solution valued by customers (Adner, 2017; Dattée et al., 2018; Dedehayir & Seppänen, 2015).

A common way of conceptualizing collective action, in the context of innovation ecosystems, is by following the functional logic of ecosystem development. This conceptualization resonates closely with Adner's work, where an ecosystem is characterized by its 'known' VP (Adner, 2017). So, when investigating innovation ecosystems this perspective assumes the VP is known. The VP has to be known, and subsequent ecosystem inception encompasses a form of collaborative action involving finding and selecting potential partners which possess the right capabilities (Adner, 2017).

Envisioning a compelling ecosystem blueprint, though, is not always possible (Dougherty & Dunne, 2011; Dunne & Dougherty, 2016) and different logics may exist (Dattée et al., 2018). Actors may choose to jointly develop a VP. Selection or search for potential partners in such cases, however, can be difficult as the initiator is unable to present a compelling blueprint (Dattée et al., 2018).

To date, there is no structured overview of such different logics, their components and what the implications are for the development and viability of emerging innovation ecosystems. Taking the complete spectrum into account ranging from VPs completely known ex-ante to VPs completely unknown ex-ante the remaining question is: *what logics drive collective action in emerging innovation ecosystems*?

This research serves to explore what logics drive collective action in emerging ecosystems. In response, and given the nature of the research question, a multiple case study was conducted, and several innovation ecosystem experts were interviewed. The results show innovation ecosystem initiators can either adopt a functional or a co-creation logic. The functional logic comprises a focal actor which presents a VP blueprint and select potential partners based on this blueprint. Initiators adopting a co-creation logic jointly develop a VP with their partners and consequently experience a high level of interdependency. These initiators require highly committed and trustworthy partners and make use of their network to find such partners.

These results contribute to innovation ecosystem literature by confirming the existence of the functional and co-creation logic. The co-creation and functional resonate strongly with the concepts of effectuation and causation, well-known concepts in entrepreneurship research (Sarasvathy, 2001). The results of this thesis demonstrate how innovation ecosystems emerge, both with and without an envisioned VP. Lastly, this research indicates that ecosystems-as-affiliations and innovation intermediaries can enable the formation of innovation ecosystems following the co-creation logic.

This research provides the field of innovation ecosystem research with ample opportunity for valuable future research. Future research could further address the apparent link with effectuation and causation (Sarasvathy, 2001). Moreover, this study encourages to maintain a wider perspective on innovation ecosystems and encourages the inclusion of additional logics.

2. Theoretical background

2.1 Innovation ecosystems

Since Moore's (1993) seminal paper on business ecosystems, the ecosystem concept received an increasing amount of attention (Adner, 2017; Bogers et al., 2019; de Vasconcelos Gomes et al., 2018). Multiple ecosystem concepts currently exist; for example, business, knowledge, and innovation ecosystems (Autio & Thomas, 2014; Jacobides, Cennamo, & Gawer, 2018; Valkokari, 2015). As the number of concepts increased some scholars started to call for a unified theory on ecosystems in business research (Bogers et al., 2019). However, business ecosystems focus more on exploitation, whereas innovation ecosystems typically describe elements such as value co-creation and exploration (Adner & Kapoor, 2010; Bogers et al., 2019). A unified theory on ecosystems would limit the ability to explore and research co-creation and exploration in depth (de Vasconcelos Gomes et al., 2018; Valkokari, 2015).

Innovation ecosystem research can be divided into work that takes an actor-centric or activity-centric perspective to ecosystems (Adner, 2017). Actor-centric ecosystems, known as ecosystems-as-affiliations, can be considered a community of related actors which interact loosely but by doing so, mutually increase their effectiveness and survival chance (Adner, 2017; Iansiti & Levien, 2004). Contrasting, an activity-centric ecosystem, known as ecosystem-as-structure, differs from this view as actors aim to materialize a specific ecosystem VP, which requires close interaction (Adner, 2017; Walrave, Talmar, Podoynitsyna, Romme, & Verbong, 2018). The remainder of this work discusses ecosystems-as-structures and makes use of the definition proposed by Walrave et al. (2018, p. 104): "an innovation ecosystem [is] a network of interdependent actors who combine specialized yet complementary resources and/or capabilities in seeking to (a) co-create and deliver an overarching VP to end-users, and (b) appropriate the gains received in the process".

Concerning innovation ecosystems, a multitude of topics and challenges has been researched. Think of topics such as absorptive capacity (K. Miller, McAdam, Moffett, Alexander, & Puthusserry, 2016), decision making (Adner & Feiler, 2019), knowledge boundaries (Kapoor & Adner, 2012) and strategy (Adner, 2006, 2017) and challenges such as external competition (Iansiti & Levien, 2004; Moore, 1993), internal collaboration (Adner, 2017), alignment (Adner, 2017) and value creation (Adner, 2012; Adner & Kapoor, 2010). Little emphasis, however, has been given to innovation ecosystem development. Perhaps given the lack of such temporal perspective on innovation ecosystems, differences that are likely to exist between phases, including the intricalities of ecosystem inception, have been neglected at large (Dattée et al., 2018; Dedehayir et al., 2018; Gawer, 2014; Suominen et al., 2019; Thomas & Autio, 2015). Partner selection as part of ecosystem inception has received little

attention too and the perspective taken in research on partners roles is often of functional nature (Adner, 2017; Adner & Kapoor, 2010; Dedehayir et al., 2018; Dedehayir & Seppänen, 2015).

Partner selection, as part of ecosystem inception, is important for all actors in the ecosystem as it influences the ability to succeed (Adner, 2017). Via partner selection, one can influence the degree of alignment between partners, as one can select based on industrial context, cultural backgrounds, and the goals and intentions of partners (Emden, Calantone, & Droge, 2006; Lin & Chen, 2004). Besides alignment, the capabilities of actors in the ecosystem influences the development of the VP and consequently influences the course of the innovation ecosystem (Thomas & Autio, 2015). Additional actors bring additional capabilities and resources. Therefore, new directions of development become available and the VP, especially during inception, can be altered (Dattée et al., 2018). The importance of partner selection is illustrated by the case study on innovation ecosystems performed by Dedehayir and Seppänen (2015), illustrates how the inclusion of a 'wrong' partner can significantly delay the development process and threaten successful materialization of a VP.

Innovation ecosystems are often defined as to revolve around a central 'known' VP, which is used to appeal to partners (Adner, 2006, 2017; Adner & Kapoor, 2010; Thomas & Autio, 2015). In line with this perspective, an ecosystem initiator presents a compelling VP blueprint as potential actors are only willing to commit resources in case a satisfactory outlook on possible returns exists (Dattée et al., 2018). This perspective, however, relies on the assumption that it is possible to envision a compelling ecosystem blueprint ex-ante (Dattée et al., 2018).

Envisioning a compelling ecosystem blueprint, though, is not always possible (Dougherty & Dunne, 2011; Dunne & Dougherty, 2016). A blueprint should relate to multiple elements such as the product, its production process, and the distribution and marketing (Dedehayir et al., 2018). When the underlying assumptions on even one of these elements' changes it will induce other changes too (Dedehayir et al., 2018; Frishammar, Lichtenthaler, & Richtnér, 2013), as the multiple elements must form a consistent whole. Thereby hindering the ability of the initiator to envision a compelling blueprint.

To study all possible origins of innovation ecosystems we define ecosystem inception as; action commenced by actors to achieve a set of partners undertaking collective action to materialize an innovation. Current literature does not explicitly differentiate between different logics therefore, a distinction is made between two types of ecosystem initiators: (1) initiators having a compelling blueprint, utilizing a functional logic and (2), initiators lacking a compelling VP blueprint utilizing a co-creation logic.

2.2 Confidence in potential partners

A central theme in ecosystem emergence is partner selection. Partner selection, in essence, is about whether you have confidence in a potential partner, as without confidence partners will not collaborate (Das & Teng, 1998, 2001). Therefore, before discussing the different logics initiators may utilize, a short review of trust and control literature on confidence in partner collaboration is given.

Confidence in partner selection can be defined as the "perceived certainty about satisfactory partner cooperation" (Das & Teng, 1998, p. 492). Confidence is needed as innovation ecosystem inception is accompanied by risk. Risk, in innovation ecosystems, is induced by the investments actors have to make vis-a-vis the uncertainty associated with the underdeveloped or lacking VP (Dedehayir et al., 2018). Another source of risk is agency, that is, the possibility that actors act opportunistically (Das & Teng, 1998).

Confidence is needed to overcome the risks a partnership brings and can originate from both trust in a partner and, possibly, control over a partner (Das & Teng, 1998, 2001). Trust can be defined as "positive expectations about another's motives with respect to oneself in situations entailing risk" (Boon & Holmes, 1991, p. 194). Trust increases the perceived certainty about satisfactory partner cooperation and thus confidence.

Trust is induced by both trusting the motives (or goodwill) of a potential partner, as well as, trusting the capabilities (or competencies) of a potential partner (Sako, 1992). Goodwill trust refers to the intentions of a trustee (Das & Teng, 2004). Goodwill trust regards the trustee intentions to be true. Furthermore, the trustor expects the trustee to refrain from opportunistic behaviour (Das & Teng, 2004; Nooteboom, 1996). Whereas competence trust is the belief of a trustor that the trustee has the necessary skills (Das & Teng, 2004).

Control is a "process by which the elements of a system are made more predictable through the establishment of standards in the pursuit of some desired objective or state" (Das & Teng, 1998, p. 493). Control can be divided into formal and informal control (Carson, Madhok, & Wu, 2006). Formal control (i.e. legal contracts) is less expected during ecosystem inception, as actors are formally independent of each other (Adner, 2017). Furthermore, the high number of contingencies stemming from the high levels of uncertainty associated with VP development make the realisation of formal control time-consuming and costly (Carson et al., 2006; Dedehayir et al., 2018; Grandori, 2006; Poppo & Zenger, 2002).

In contrast to formal control mechanisms (i.e. legal contracts), informal control mechanisms aim to induce "desirable behaviour through soft measures" (Das & Teng, 1998, p. 502). The underlying belief of informal control is that actors determine their own behaviour (Das & Teng, 1998). Informal

control influences partner behaviour via mutual goals, values, and norms (Das & Teng, 1998; Dekker & Van den Abbeele, 2010). In case, goals, values, and/or norms are shared between actors the amount of confidence in the judgement and competences of the other actor increases (Larson, 1992).

2.3 Functional logic and innovation ecosystem inception

An initiator who utilizes a functional logic aims to select and attract possible innovation ecosystem actors based on a compelling VP blueprint (Adner, 2017). As the initiator envisions the VP and the subsequent development process, the initiator leads (Adner, 2017; Adner & Kapoor, 2010). Therefore, at least initially, the initiator acts as the focal actor (Adner, 2017). Who, as the leader of the ecosystem, is expected to create and manage alignment between actors (Adner, 2017).

Alignment is the extent to which there is agreement among the members regarding the activities and the goal(s) of the ecosystem (Adner, 2012, 2017; Walrave et al., 2018). Achieving alignment can be a challenge due to "differences in industrial contexts (Autio & Thomas, 2014; Moore, 1993), conflicting cultural backgrounds of the parties involved (Lavie, Haunschild, & Khanna, 2012), and initial misalignment in terms of the goals and intentions of key actors (Casadesus-Masanell & Yoffie, 2007; Kapoor & Lee, 2013; Sharapov, Thomas, & Autio, 2013)" (Walrave et al., 2018, p. 104).

The necessity of alignment generally affects the focal actors' partner search, as via this process the focal actor can influence the establishment of initial alignment (Adner, 2017). Possible partners, with similar beliefs regarding the prospect and the value of the presented VP, will yield higher levels of initial alignment (Casadesus-Masanell & Yoffie, 2007; Kapoor & Lee, 2013; Sharapov et al., 2013). Besides establishing initial alignment based on similar beliefs, the focal actor may establish initial alignment based on the capabilities of additional actors (Dedehayir & Seppänen, 2015). The focal actor spots discrepancies between the capabilities the ecosystem actors possess and the required capabilities to realize the VP (Adner, 2017). By selecting additional actors these discrepancies can be filled.

In addition to the need for alignment, the focal actor must be confident of the value of a potential partner (Das & Teng, 2001). Confidence which stems from either the use of informal control over a potential partner or trust in a potential partner (Das & Teng, 2001). The focal actor may establish informal control by setting norms which guide the subsequent development process of the VP (Adner, 2017; Das & Teng, 2001). Thereby, the focal actor feels confident about the ecosystems' direction of development.

Furthermore, as the focal actor knows which capabilities are required to develop the VP, it may rely on competence trust to gain confidence (Das & Teng, 1998). Competence trust can be induced by a

demonstration of capabilities (Sako, 1992), for instance by showing previously achieved results (Bunduchi, 2013).

Ecosystem actors are interdependent, as they jointly provide the required capabilities to materialize the VP (Adner, 2017). However, actors which 'only' provide 'services and capabilities' are easier to replace compared to actors who are strongly involved in the development process and possess intangible knowledge. Therefore, the level of interdependency in ecosystems which follow the functional logic is lower compared to a logic where actors co-create a VP.

2.4 Co-creation logic to innovation ecosystem inception

The functional logic requires a VP blueprint which is not always available (Dattée et al., 2018), the co-creation logic departs from the assumption that it is possible to jointly create a VP. The co-creation logic has never been studied explicitly, however, by carefully reading existing literature one is able to envision what a co-creation logic could comprise. An initiator who follows the co-creation logic aims to find and attract possible innovation ecosystem actors based on their long-term goals, to jointly develop a VP (Dattée et al., 2018). Compared to the functional logic, the co-creation logic does not imply the initiator taking up the role of focal actor, even more so, leadership can be dispersed within the ecosystem (Dattée et al., 2018). The co-creation logic implies that the VP requires substantial development (or might even be non-existent), and therefore, the initiator focuses on bringing actors with similar goals together (Dedehayir et al., 2018).

Under the co-creation logic, the search for potential partners differs strongly from partner selection under the functional logic. Firstly, partners cannot be selected based on functional requirements given the undefined VP (Dattée et al., 2018). Secondly, following the co-creation logic, actors are highly interdependent, as the creation of a VP relies on all actors' capabilities and investments (Das & Teng, 1998). The stronger interdependence between partners necessitates a higher level of bilateral confidence. Therefore, following the co-creation logic, the search of partners will be more of a joined undertaking rather than a solo act.

The need for, and establishment of, confidence also differs strongly from the functional logic. Gaining confidence in partners has a different focus for actors following the co-creation logic compared to the functional logic. Whereas competence trust generally plays a crucial role in the functional logic, competence trust may not yield much confidence in potential partners as clear functional requirements lack for actors following the co-creation logic. Unquestionably, a potential actors' capabilities should lie in line with the general direction of development, i.e. when aiming for an IT-based VP, actors should not be objecting IT technology. On the other hand, goodwill trust is of great importance for actors following the co-creation logic, as actors are highly reliant on each other's

willingness to commit to the development of the VP and refrain from opportunistic behaviour (Bunduchi, 2013; Sako, 1992). Elements known to promote goodwill trust, which are expected to play a role during the inception of an innovation ecosystem following the co-creation logic are: an existing relationship (Ring & Van de Ven, 1994), third party references (Das & Teng, 2001), timely and accurate communication (Bstieler, 2006), and the ability to have rich forms of communication (e.g. face-to-face communication) (Schiele, 2006).

Like the functional logic, alignment, is crucial in innovation ecosystems following the co-creation logic, as actors mutually aim to achieve the realization of a VP (Adner, 2017). To achieve initial alignment, the functional capabilities do not play a role, as with the functional logic. Beliefs and values of actors are of great importance (Bunduchi, 2013), as their beliefs and values will influence their perspective and stance towards the development of the VP. Actors focussed on sustainable energy, for example, probably develop a different VP compared to actors active in the oil industry.

Retaining alignment as the VP develops may prove to be difficult under the co-creation logic, as actors may be disappointed with the direction of VP development (Adner, 2017). Furthermore, as the interdependency between actors is high due to the build-up of intangible knowledge during development, replacement of partners becomes difficult (Dedehayir & Seppänen, 2015). As the role of the focal actor is absent in the co-creation logic it remains unclear who should be addressing alignment issues. Thus, the co-creation logic induces several challenges which differ strongly from the challenges under the functional logic.

2.5 Overview of functional and co-creation logics in innovation ecosystems

The discussed functional and co-creation logics differ in several aspects. Table 1 provides an overview of the different logics. While it is possible to combine existing research and envision these two logics, never have these logics been studied explicitly. By defining an innovation ecosystem as a collective of actors undertaking collective action aimed at materializing an innovation, we can explore both logics (and possibly others) more explicitly. This research specifically focusses on ecosystem inception as this influential period has not yet been studied, despite multiple calls (Dattée et al., 2018; Dedehayir et al., 2018; Gawer, 2014; Suominen et al., 2019; Thomas & Autio, 2015). Furthermore, the implications of the functional and co-creation logics on the development and viability of emerging innovation ecosystems remains unclear. In this thesis, we, therefore, investigate the question: what logics drive collective action in emerging innovation ecosystems?

Table 1 Overview of functional and co-creation logic in innovation ecosystems

	Functional logic	**Co-creation logic**
Development of the VP	VP proposed by the focal actor	Co-created by all ecosystem actors
Leadership	Focal actor	Shared
Nature of confidence in partners	Informal control and competence trust	Mostly goodwill trust and little competence trust
Level of interdependence	Low(er)	High(er)
Origin of alignment	A coherent set of capabilities	Equivalent beliefs and values

3. Research design

This research aims to understand what logics drive collective action in emerging innovation ecosystems. Therefore, this research makes use of a qualitative case-study research strategy. This research focusses on logics which cannot be separated from their context. A multiple case-study research strategy is chosen as it allows us to study a phenomenon in its real-life context (Yin, 1981b). Multiple cases allow for the identification of additional logics and allow for between case analysis (Eisenhardt, 1989). By comparing and contrasting cases different components and possible implications can be explored (Khan & VanWynsberghe, 2008). Furthermore, case-study research allows studying processes with multiple decisions and concurrent development over time without a clear endpoint (Yin, 1981a). Also, as the complicated development process does not allow for simple cause and effect analysis, case-study research is appropriate (Yin, 1981a). Lastly, as this research aims to build theory, case study research is an appropriate research strategy (Eisenhardt & Graebner, 2007).

3.1 Case selection and setting

Cases were selected based on theoretical sampling until saturation was achieved, as it fits the aim of this research (Eisenhardt, 1989). By making use of theoretical sampling it was possible to select those cases which were most promising with regard to understanding how innovation ecosystems come about (Eisenhardt & Graebner, 2007). Selected ecosystem initiators are (1) part of an innovation ecosystem which is set up recently (ideally less than 3 years). As ecosystem initiation can be complicated and sometimes chaotic, interviewees must be able to recall the order of events and the feelings they had during this period (C. C. Miller, Cardinal, & Glick, 1997). Furthermore, (2) suitable cases aim to materialize an innovation which requires other actors to deliver complementary innovations. Eight innovation ecosystems are included in this research. Last, (3) as this research aims to explore different logics, innovation ecosystems with seemingly different approaches to collaboration are most relevant (Eisenhardt, 1989). As data gathering progressed different logics were found and inclusion of cases continued until saturation was achieved (Fusch & Ness, 2015).

The selected innovation ecosystem initiators are a mixture of start-ups (6), a medium-sized enterprise (1), and a multinational enterprise (1). Of the selected initiators seven are based in the Netherlands and predominantly include Dutch companies in the Netherlands. The innovation ecosystem initiated by the multinational enterprises predominantly includes European based enterprises.

The multiple cases allow the identification of (possible) alternative paths thereby strengthening theory building (Khan & VanWynsberghe, 2008). These cases can be compared since all selected

cases jointly innovate with partners to materialize an innovation. Some cases have progressed more compared to others but all aim to materialize an innovation.

To provide an even broader perspective on innovation ecosystem inception, three innovation ecosystem experts were interviewed. Expert 1 (EXP1) is active in multiple large ecosystems and is experienced in ecosystem inception. Expert 2 (EXP2) is a consultant and project manager and has been involved in several ecosystems. As a consultant, he advises several companies on their ecosystem strategy. Lastly, expert 3 (EXP3) is both a consultant as well as a researcher focussed on innovation ecosystems. As these experts are involved in multiple innovation ecosystems, they are able to discuss which phenomenon recure. Furthermore, their experience allows them to highlight the role and influence of trust and control in multiple innovation ecosystems. This research does not rely on experts alone as these experts are mostly facilitators to innovation ecosystems and therefore have not undergone the process of inception themselves. Furthermore, as these experts are often involved in large scale innovation ecosystems with multiple MNE studying the process at SME would be difficult.

The start-ups are associated with the innovation space community of Eindhoven University of Technology (TU/e). These organisations consist of students and recent graduates, who work together to materialize an innovation. While some organisations are currently focussing on the development of potential concepts and mostly work together with partners to expand their knowledge and capabilities, others are a little further and currently test their solutions at launch customers. These latter organisations often have stronger partnerships which show stronger co-innovation practices.

One of the two remaining cases is based on a technology intermediary which initiates innovation ecosystems when customers have demands which cannot easily be met. The technology intermediary operates in the field of photonic integrated circuits. The remaining case was introduced by an expert on innovation ecosystems. The expert supported this innovation ecosystem, especially project management. The case revolves around two multinational oil and gas enterprises who aim to develop a novel 3D-printing technology to produce spare parts and to repair broken parts.

An overview of all cases is presented in Table 2. The table includes the abbreviations which will be used to refer to innovation ecosystems. Furthermore, it includes the ecosystems' VP, initiation emerging VP and the VP state of development. More detailed descriptions of the innovation ecosystems can be found in Appendix A.

Table 2 Overview of studied innovation ecosystems

Innovation ecosystem	Ecosystem VP	Informants	Initiation Emerging VP	(Emerging) VP state of development	Years in development
MetalCo	Developing metal fuel as an energy carrier for heavy industry and other energy-intensive processes such as powerplants.	General manager (MC1), technical manager (MC2)	Technology used in spacecrafts and fireworks. Potentially interesting as circular/sustainable fuel. Initial development at university.	First large-scale commercial application realized	3
RecycleCo	Developing installations which allow retrieving metals and obsidian from e-waste.	General manager (RC1), technical engineer (RC2)	Converting the already used process of elementary retraction such that it allows e-waste to be recycled.	First production facility realized and development of consecutive plants	3
Electric-VehicleCo (EV-Co)	Develop a high-performance EV able to perform at Le Mans, thereby displaying their superfast charging technology	General manager (EVC1)	Aiming to build the most innovative racing car, but strongly focussing on bringing down recharge duration	Development and concept testing	2
HousingCo	Design and build a highly innovative house powered by renewable energy demonstrated in the Solar Decathlon Europe 2021	External relations manager (HC1), external relations (HC2)	Starting from scratch while relying on novel innovations gathered in and around the university	Design finished and about to start the search for construction partners	2
Energy-InsightCo (InsightCo)	An interactive touch-sensitive system providing insight in possibilities to increase the amount of sustainable energy on a campus	General manager (EIC1)	Started as an honours team of students from the energy transition and smart cities track.	Development and 2nd concept test searching for partners	2
Affordable-HousingCo (AfH-Co)	Development and realization of affordable sustainable housing	External relations manager (AHC1), general manager (AHC2)	Started as an honours team of students from multiple technical studies	Design finished and about to start construction	3
PhotonicsCo	Deliver photonics integrated circuits to clients and act as an intermediate between demand and research	Senior photonics engineer (PC1)	If the client demands require an innovation ecosystem, an ecosystem is set up	Multiple innovation ecosystems	1-2
EnergyCo	Develop novel 3D-printing techniques to repair broken parts and to produce spare parts	Expert 2 involved as a consultant	Started by two large oil and gas companies	Development completed and goals achieved	2

3.2 Data collection

The retrieved data consists of qualitative data in the form of 13 semi-structured interviews. Initial interviews held with ecosystem managers had a duration of 45-90 minutes while additional follow-up interviews with respondents from the same innovation ecosystem took about 30 minutes. The role of the interviewee, the associated innovation ecosystem and abbreviation of the interviewee is presented in Table 2 under informants.

In preparation of all interviewees with informants of innovation ecosystems the ecosystems' website was examined, to increase the effectivity of the interviews. All interviewees have been recorded, anonymized and transcribed verbatim. Anonymization of both the interviewee as well as their ecosystems and the partners they talked about to stimulate openness and honesty. During the interviews, interviewees were asked to elaborate on topics such as; (a) origin of the VP; (b) initial partner search; (c) partner selection criteria; (d) initial activities undertaken by the ecosystem (i.e. development of the EVP); (e) usage of control in the ecosystem; (f) experience and attitude about actors in the ecosystem. The original interview guide can be found in Appendix B. The semi-structured interviews allow interviewees to freely share their experiences while ensuring several topics to be addressed. The questions were framed neutrally to increase the accuracy of responses (Huber & Power, 1985)

3.3 Data analysis

The data analysis consists of multiple steps. First, to be able to analyse the multiple case studies and the experiences of the experts, in-vivo codes were created (Gioia, Corley, & Hamilton, 2013). The in-vivo codes are all elements relating to the research question and are fragments of the respondent's narratives (Gioia et al., 2013). Second, the in-vivo codes were used to create higher-order codes of similar phenomenon (Gioia et al., 2013). The complete coding scheme with first-order concepts, second-order themes, and the aggregate dimensions can be found in Figure 1 and Figure 2. This process ensures that similar evidence is integrated to generate findings shared between cases (Yin, 1981b).

As this research focusses on the process of how innovation ecosystems are formed, a strategy is needed to make sense of the descriptive codes while allowing for causal links between events. Therefore, this research makes use of a narrative strategy as it can reveal causal linkages between events (Langley, 1999). This strategy, furthermore, allows presenting a complete narrative while including the multiple cases (Langley, 1999). Even more so, the narrative strategy allows for the inclusion of the multiple observations shared by the experts, thereby enriching the overall narrative.

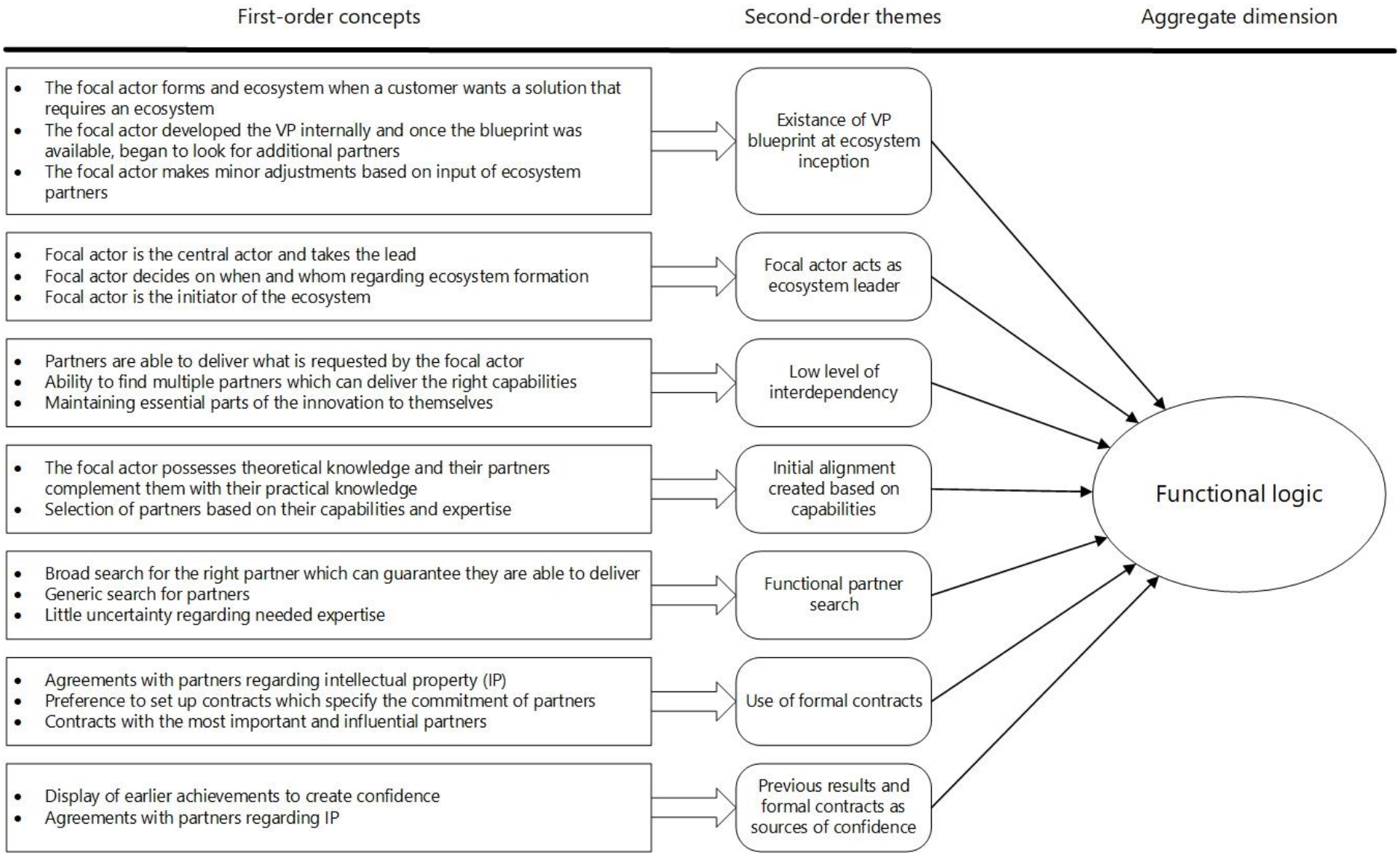

Figure 1 Coding scheme functional logic (Gioia et al., 2013)

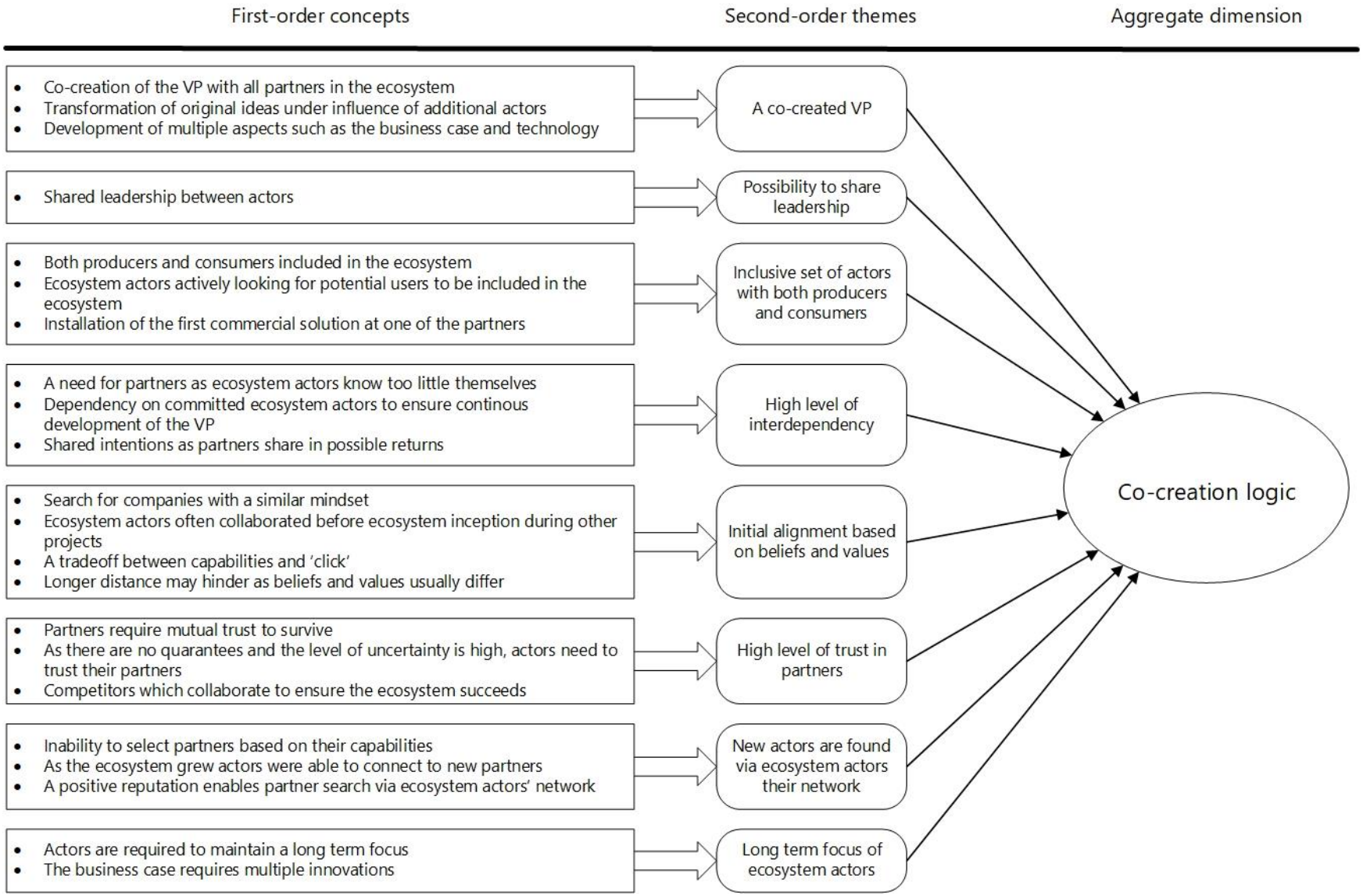

Figure 2 Coding scheme co-creation logic (Gioia et al., 2013)

4. Findings

First, the ecosystem initiators and their tendency towards either the functional or the co-creation logic are discussed. Second, the two narratives of initiators applying a functional or a co-creation logic are presented. Thereafter the key findings of both logics are presented.

4.1 Ecosystem initiators

As the interviewed initiators and their innovation ecosystem tend to different logics, they can be placed on a scale ranging from functional to co-creation. The functional logic is strongly characterised by the existence of a VP blueprint and a functional partner search. Whereas the co-creation logic is strongly characterized by a co-created VP and high levels of mutual trust between partners. Figure 3 shows the initiators (and their ecosystem) and their tendency towards either the functional or the co-creation logic.

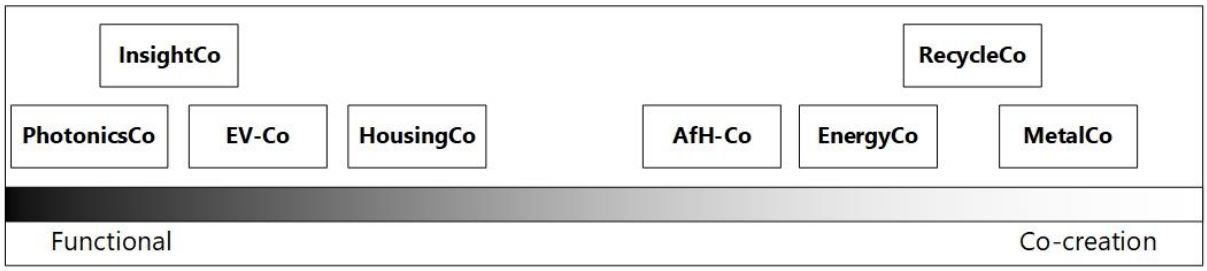

Figure 3 Overview of ecosystem initiators based on their tendency towards a functional or co-creation logic

The actors who display predominantly behaviour which can be linked to the functional logic are the initiators of EV-co, HousingCo, InsightCo, and PhotonicsCO. PhotonicsCo delivers customized integrated chip solutions to its clients and initiates the formation of an innovation ecosystem once a customer places an order. The placement of an order is preceded by a risk assessment to ensure that potential partners can develop the new product. So, PhotonicsCo always starts with a VP blueprint. Furthermore, the risk assessment is a functional approach to the selection of potential partners.

> "*Typically, a customer comes to us and says we would like to translate this product into photonics, they have a certain idea, but they don't know how to do it in photonics… sometimes we might even propose a better solution than they have in mind*" – PC1

InsightCo aims to provide a service to energy managers and is currently exploring how to start and continue collaborations with partners. Currently, InsightCo has only limited collaborations with partners, as the team has developed the main elements of its software and algorithm themselves. As there already exists a blueprint, the role of additional partners would be to provide elements which enhance the VP blueprint, therefore InsightCo tends to the functional logic.

> "*We really try to focus on two things, what we want to keep for ourselves, the data model, and the interface…those are the most important elements which we keep to ourselves*" - EIC1

EV-Co's goal is "*to solve the single problem that still keeps people from using an electric vehicle: charging times*" (EVC1). The team works with partners and suppliers to develop their electric race car. EV-Co's partners mostly develop conventional parts such as the chassis. While these parts are important, the number of partners able to deliver these conventional parts is higher, thereby allowing EV-Co to select potential partners.

> "*I think you could say that our partnerships are often very specifically searched, we know exactly what we want*" - EVC1

HousingCo designs and constructs a building which is aimed to inspire people to adopt a sustainable lifestyle. HousingCo aims to incorporate and adopt several new technologies and innovations into their design. While the innovations which partners offer are often unique, HousingCo can select any innovation they like. Therefore, they are not dependent on single innovations as they aim to develop a concept full of separate innovations.

> "*There is a company which we already contacted because we need to assess if we can use [their technology], as it has a large influence on the design"* – HC1
> *"We are currently finalizing the design… sometime after the holidays… we are going to completely finish the design and then we will be investigating which materials we need"* – HC1

The ecosystem initiators tending towards the co-creation logic are those of RecycleCo, MetalCo, AfH-Co and EnergyCo. The innovations of RecycleCo, MetalCo, and EnergyCo require multiple largescale developments and initiators had only slight ideas of what they wanted to achieve. Initiators heavily rely on partners to jointly develop a VP and therefore apply the co-creation logic. Once the VP progresses partners provide essential components which are combined in a new customer-facing solution.

AfH-Co develops affordable and sustainable housing, like the business of HousingCo. AfH-Co, however, took a different approach as they choose to jointly innovate with their partners. Their design incorporates several elements which must be altered by partners and AfH-Co pushes these partners to innovate.

> "*It is certainly true that we then talk to partners and then look...can we push that a little further, can we get that a little further*" – AHC1

EnergyCo introduced 3D-printing processes into the oil industry to quickly repair damages at oilrigs. EnergyCo asked their suppliers and experienced 3D-printing firms to join the innovation ecosystem

and jointly develop the VP. EnergyCo aimed for industry-wide acceptance which required proof of feasibility, safety, and reliability as these processes would otherwise not be certified for use.

> "*If you want to create a new industry standard, it cannot be enforced by one actor alone" – EXP2 on EnergyCo*

RecyclCo recycles waste streams which other recycling facilities are not able to recycle. Together with its oven supplier and recycling partners, RecycleCo develops new technology and new installations. The ecosystem strongly focusses on their capabilities and how they use their capabilities to advance their VP.

Metal fuels are originally used in aerospace. MetalCo uses metal fuels to generate heat for industrial processes, replacing electricity and natural gas. The burned and oxidized metal fuels can be regenerated into new usable metal fuel, thereby offering a carbon dioxide neutral energy carrier. MetalCo co-creates several new installations to generate heat and to regenerate metal fuels.

> *"…more projects have to be set up, the whole value chain development you know, we are very busy with that"* – MC1

4.2 A narrative of functional ecosystem inception

As the interviewed actors of EV-co, HousingCo, InsightCo, and PhotonicsCO could rely on their VP blueprint, they were able to identify what requirements potential partners should fulfil. These initiators are less dependent on specific potential partners as there are often multiple potential partners which meet the requirements. Therefore, the initiators could initiate the formation of an innovation ecosystem which revolves around their VP blueprint and adopt the role of focal actor. Furthermore, as the focal actors are aware of the required skills, capabilities and components potential actors should provide, they can adopt a functional partner search.

> "*For example, the architects within the team search a partner which focusses on a specific kind of panels, or windows frames…than we initiate a search regarding what kinds [of frames] are there, should it be durable, materials, size, and we mostly end up with a list of three to four companies who make these frames*" – HC1
>
> "*Lately we have got ourselves processers from China, indeed almost unbelievable. That was just, you search something with the right specifications*" – EVC1
>
> "*If we would need something then we would search very specifically both within our network and <at the start-up facilitator>*" – EIC1
>
> "*We try to find, on a broad scale who can do the job the best for certain items… what we will compare is the functionality they can deliver on the quality, the timeline and the cost*" – PC1

As potential partners are set to become ecosystem partners a sufficient level of confidence between partners must be created. Often both focal actors, as well as potential partners, aim to increase the

level of confidence by demonstrating their abilities based on earlier work. Furthermore, focal actors may use the reputation of other ecosystem actors to convince potential partners. The overall level of confidence is however lower compared to ecosystems adopting a co-creational logic as the amount of risk related to these innovations is lower. Furthermore, as the development time of the VP is often shorter actors are under the perception that less trust is needed as payoffs are achievable soon.

> "*If you visit another partner and you say we already work with one of the biggest engineering firms in the Netherlands, that induces trust as they are well known… the fact that they [the big firm] participate… they [the visited partner] known for sure that it will be alright*" - HC1

> "*We do all we can to meet our targets if you look at my work week, I think they will believe it"* – EVC1

> "*I don't like the trust word somehow, you prove that with your background and experience, you can deliver on specifications. It should not be about the trust*" – PC1

> "*if it is in the early stages of technology, then we will focus on feasibility we will assess if we can do it or what will be the investments required to do it. Then it is not about trust, but it is more about assessing the future, the risks, and the options*" – PC1

As it is clearer which actor performs which task, it becomes easier to set up control. The role of control is most prominent in the innovation ecosystems of PhotonicsCo. PhotonicsCo initiates an innovation ecosystem once a customer has been found and directly formalizes several elements. Once ecosystem partners are found, their responsibilities (deliverables) are formalized. Furthermore, the distribution of revenues and the ownership of created IP is established and put into contracts. Also, other interviewed ecosystems state that they make use of formal control concerning investments and deliverables.

> "*The battle is just to discuss who owns what, how you will transfer the IP-rights, whose experience is worth what, whose background is worth what… so there is no confusion at the end of the project*" – PC1

The focal actor aims to achieve initial alignment via alignment of the set of capabilities the ecosystem holds. First, the focal actor identifies which capabilities are needed to successfully transform the VP blueprint into an ecosystem VP. If capabilities lack, the focal actor can achieve alignment by including partners which specifically hold these capabilities.

Lastly, it is observed that as these ecosystems revolve around innovations which can are envisioned by the focal actors and build upon existing solutions are of incremental nature. As the VP blueprint is central to these ecosystems and potential actors are selected based on and attracted by the VP, a comprehensive VP blueprint is needed. Incremental innovations, as they build upon existing technology, may make it easier to envision possible novel applications whereas radical innovations may require a departure from current affairs.

4.3 A narrative of co-creation ecosystem inception

The initiators of ecosystems adhering to the co-creation logic to jointly establish a VP are heavily dependent on potential actors to join as without additional actors the VP cannot progress. The need for additional partners was clear from the beginning, as the initiators realized they needed additional knowledge and experience.

> *"Partners are, I think, the most important aspect of innovation. Because A) you know nothing yourself, B) even less and C) you do not know the rest either. Therefore, it is good to surround yourself with people from specific niches who know very much and work together with them…you need many partners*" – RC1

> "*If we have questions we can call them, for say half an hour, and we can make use of their combined experience of 213 years, which we lack…I think we [within the start-up] maybe have 20 years of experience" – RC1*

> "*We mostly have the theoretical knowledge, but they have the experience" – RC2*

> "*I think we very quickly decided to say: alright, we are not going to do this alone" – AHC1*

> *"If you want to make an industry-standard, one company cannot enforce that. So, the competitors need each other there for a while, otherwise, it will not happen, impossible" – EXP2 on OI*

Potential partners should, one, be strongly committed to the goals of the innovation ecosystem, as the VP has yet to be formed. Which means that before revenue streams could be expected the complete development of the VP has to take place. Thus, partners need to be committed and maintain a long term focus regarding the development of the VP.

> "*It means that everyone who participates needs to wait for the second plant [regarding revenues] and needs to play long game*" – RC1
>
> "*But they need to have patience…it is innovation so it may sometimes take longer because we have to test things"* – AHC1
>
> "*It is quite a long road to the market…if you try to achieve that, that partner has to work for it incredibly hard and if you do not have that relationship, if you begrudge each other it becomes very difficult*" - MC1
>
> "Active involvement and investing, and not just in-kind investments, at some point it must be possible to buy something" – *EXP2 on OI*
>
> "*our attitude is very much like what are we going to do together now? Action! Tangible! You can make hundreds of pamphlets, but if there is nothing that makes companies say; yes here you have two guys of mine and just get to work and I understand that it costs something and we pay for it. If nothing comes off, then you might as well stop*" – EXP 2

And, two, should possess certain general capabilities and skills, but the initiator's search process is hindered by the inability to pin down the exact needed functional capabilities needed to develop the VP.

"*From every conversation you have, you learn more about the market than you knew before and you get a better understanding of who to talk to, your understanding increased exponentially*" – RC1

"*I think the most important thing is, we did a lot of technical [partner] search in a generic way in the beginning, very little of that stuck, of which we still think we really needed that*" – RE1

"We are honest from the beginning regarding the fact that we do not exactly know what we want or need, so we tell companies sometimes, we think we need this" – AHC2

Furthermore, the inclusion of an end-user is said to be of great importance according to Expert 2 on innovation ecosystems. All ecosystems adopting the co-creation logic currently have end-users included in their ecosystem. While the timing of inclusion varies between the ecosystems', inclusion strengthens the connection between the market and the VP.

"*A lot of those ecosystems… it is mainly the developers, the people who have something to offer that are included. But not the ones who ask for something. If you have an ecosystem without an end-user, and you have to find one in the end, I would almost say a disastrous path. There must be someone in an ecosystem who has a manifest need for the output that that system will deliver*" – EXP2

With, at least, these requirements regarding potential actors clear, the focus shifts to the process of attracting potential partners. Attracting partners by showing the potential and feasibility of the VP however remains very difficult, if not impossible.

"*I can tell you all about the innovation, but in the end, you still know little. The risk you take remains high, so there must be quite some trust between us*" – MC1

So, potential partners cannot be convinced based on the VP concept, therefore a need for trust arises as trust is a positive expectation in situations entailing risk. Not only mutual belief and trust in the potential to establish a VP. But also, mutual trust regarding the capabilities and, sometimes experienced as even more important, the motives of both partners is needed.

"*in fact, this is done almost entirely based on trust. Now it is different, but in the beginning, we have not concluded a contract or anything with parties*" – AHC2

"*that people do have trust in the story you are selling, which makes them willing to contribute, they will link you to other people*" – MC2

"*that actually ensures, before you start working together at a certain point, that that initial bonding occurs and I also think, the greater the technological complexities and the risk, the more important it is ... ... at the moment that the complexity and the risk increases it also means that the bonding is becoming increasingly important*" – MC1

"*That you can deal with trust, because it is an industry where profit margins are often not super high, so yes, competition is dangerous, but on the other hand, without the competitors or actually other people in the niche, you are not going to survive*" – RC1

"*I think more and more, I am convinced, in the beginning, relationships are more important than what they can do*" – MC1

Initiators, thus, seek a method which allows them to search for general capabilities while being able to create mutual trust and assess the commitment of potential actors. The ambiguity regarding the needed capabilities of potential partners limits the possibilities of digital generic search as initiators lack the specific search criteria. Setting out a question in their network, however, allows initiators to elaborate on the general requirements they look for. Therefore, all initiators stated they made use of their network and only if their network would not yield satisfactory suggestions made use of partner search via the internet.

> "*In such a conversation you come up with what you want to achieve. And you notice that those people start thinking along. Most of them think it is great and they say, I may know someone*" – AHC1
>
> "*Knowing people with a large network helps. That is how it often goes, or even your own network, people you just meet*" – MC2
>
> "*Yes, but then I still have to say, it [continued partner search] still goes via an intermediary*" – MC1
>
> "*So, then the question is, yes who do you think would believe in <the concept>. Who do you wish success if [the innovation] is indeed successful? That way …you are linked with partners who are really open to [join]"* – RC1

The network the initiators make use consists of their own connections, the connections of the university start-up accelerator and the connections that follow from these two. The importance of having access to an initial network to find potential partners is stressed by multiple interviewees. While gaining access to networks of third parties or connectors is often experiences as easy. Access to connectors, however, is said to be influenced by both trust and the potential and quality of the VP.

> "*So hence people with a lot of experience are very important in that regard. Then you immediately have people who always left a good experience with others. [Team members which have] good contacts and a good strong network, these are extremely important at the start of partnering*" – MC1
>
> "*I [a connector] will show you a part of my network and that goes well. Okay, then I want to show you another part of my network, and if that goes well, then I am proud of you. So, I want to show you everything and, yes that way, it grows, so yes, it is a very natural process actually. You have almost no influence on it*" – RC1

The first benefit of using their network is the efficiency, their network will redirect them to other potential partners if they are not able to deliver themselves. The importance of the network is further stressed by one of the experts and, according to his experiences, it could even be the most important element of the ecosystem-as-affiliation he is part of. The ability to quickly get into contact with relevant people at various companies via the ecosystem-as-affiliation enables actors to maintain a high development speed.

"*We first try to do it [partner search] via an intermediate, because you talk to the relevant people way faster*" – AHC1

"Rapidly you *are going to look in your network, like physics laws, you try to find the route of the least resistance. So, you look into your network, who is close by and if-else, you ask them because they will know somebody* "– RC1

"*How it works in this [ecosystem-as-affiliation], you have a number of those clusters with a concentration of smart people ... all of a sudden all kinds of connections arise automatically ... it seems like a coincidence, but of course it is not*" EXP1

"*Trust is the secret ingredient… of [ecosystem-as-affiliation]… trust is the default here. This means that you can connect more easily and quickly with each other at the beginning, when things are still very uncertain and that you do not have all kinds of conversations to make agreements with each other*" – EXP1

Second, by making use of their network the possibility to create initial trust arises. By transferring previous experiences and reputations of actors in the network, initial trust is built. Also, after an initial meeting, the focal actor can verify their experiences with network partners.

"*those[ecosystems-as-affiliations] if you do something wrong there or you are not reliable, it will spread (others will know)… so such a cluster will help to create that mutual trust"* – EXP1

"*In this way, such a network, of course, hangs together on the basis of trust. That is why if you break trust once, the whole network will break open and it will fall apart*" – RC1

Even more so, it appears that in some cases the reputation of the referring party, the intermediate actor, influences the experienced trustworthiness of those being linked to each other. Having a strong trustworthy network thereby increases the chance to quickly create initial trust with potential partners in the network.

"*We have spoken with [the CEO of an environmental organisation] and she introduced us to [the CEO of a large metal producer]…they [the ceo] immediately had a feeling of, alright, this is good, because she introduced us…how you are introduced is very important*" – MC1

Third, actors within a network or ecosystem-as-affiliation may already share a vision or goals. Shared goals and visions (i.e. alignment) between actors increase commitment as they experience similar motives to develop the VP. Moreover, as actors are convinced of the benefits of the VP, actors are more willing to commit resources. With these resources, the development process can be kept up to speed. The shared vision and goals, known sources of informal control, are in this context responsible for higher levels of commitment and alignment.

"*in [ecosystem-as-affiliation]… you see each other often, you are in the same waters, in the same current... you not only have a shared ambition but you also have the feeling that you will need each other in the future*" – EXP2

> *"... that it is about something close to their strategic goals. It is important that such ecosystem partners are there because they need [the VP] to achieve their goals. If there are only parties who say well if it does not work it is no problem, the whole concept will not fly*" – EXP2
>
> "are you prepared to work based on principles over commercial value…as we have a smaller budget, we need partners who have principle values" – AHC1

Making use of their network allows initiators to efficiently search for actors while providing them with several trust inducing methods, it even allows the creation of initial alignment. This search method increases the chances to create an innovation ecosystem of committed and aligned partners. While other methods could perform similarly, initiators heavily stressed the importance of this method.

Independent of the search method, interviewees mentioned multiple aspects related to communication to establish trust between partners. First, face-to-face communication is valued by interviewees as it is a rich form of communication, similar a different language can be problematic as connotations can be lost. Second, interviewees experience the impression they leave behind to be important and therefore stress some element related to decency to be influential. Third, communication with network partners, apart from the content of the conversation, could be the only additional source of trust.

> "*That is why it is so crucial because the moment they call someone and you have not sent an email, they say: yes, we have had this experience, see what you do with it*" – MC1
>
> "*If you have language barriers, making those partnerships are much more difficult to set up, compared to the Netherlands where you can simply speak your own language. You know what you can expect from each other*" – RC1
>
> "*The partner is just as good as the person you talk to, because the moment another person comes to the table, you have to start all over again*" – MC1

Partner selection does not necessarily end as further development of the VP may generate a new need for skills and capabilities, the reputation of the actors in the ecosystem will then influence the partner search. The level of trust a potential partner has in a known ecosystem actor can convert into trust into the whole ecosystem. Put differently, by having high trust in an actor, the partners of the actor are deemed trustworthy as well. Some start-ups carefully dealt with potential partners as the reputation of large influential partners would significantly affect the reputation of the whole ecosystem. Which could have both beneficial and detrimental effects on future partner searches.

> "*ASH1: Because people, someone they trust, trust you too. Interviewer: Yes, so the trust is passed on. ASH1: Yes, I think so*" – AHC1
>
> "*They (a former ecosystem he was part of) quickly partnered with [a multinational oil company], not really known for its sustainability, they lost reputation and latter had to make up for that by working with [a brewery]*" – RC1

Initial alignment is established based on mutual goals but as the VP and the ecosystem progress maintaining aligned can be challenging. The VP may develop in ways not expected or valued by some ecosystem partners and therefore their level of commitment may decline. Or these 'disconnected' partners may try to steer the development of the VP into a different direction. This may prove the be challenging especially as a 'disconnected' partner may provide the ecosystem essential capabilities and the joined development process causes an accumulation of tacit knowledge. This situation also highlights the interdependency between actors, as they all need each other not only to develop the VP but also to produce the VP once finished.

> "*Innovation is always a difficult thing; you innovate because you want to achieve something. In such an ecosystem, getting the parties aligned and keeping them bound for a longer period is quite difficult. Because, within each of those companies, the idea of where they want to go also develops. In a year, 10 to 20% of companies will no longer see it as a priority*" – EXP2
> "*So, what we're trying to do is actually look at the whole ecosystem. What is involved? Which elements do we need to fill in now? Which activities should we implement that involves partners*" – MC1
> "*I think that is a bit different per actor. Some actors will also be very open about it, we have had some people who said we would like to work with you because we would like to be in the network with [company X]. They just said that straight to our face, that is fine for us, it does not matter to us and we will get you to sit down with [company X]*" – ACH1

Compared to trust, control only plays a limited role during the inception of these innovation ecosystems. The need for control often arises from external financers such as subsidy providers and financial institutions. In the case of subsidies, it is a requirement to formalize the distribution of money. While financial institutions may require contracts to assure the knowledge created within the ecosystem remains in the ecosystem and intentions to make use of the solution under development are warranted.

> "*We have an NDA with X such that what we discuss, they cannot just pass it on. We can show that NDA to investors so that they know that our knowledge will not just spread. The Letter of Intent is able to offer larger investors some certainty that things [purchase of our solution] will continue*" – RC2
> "*I also see with parties that NDAs are always important, and that is mainly a push from finance, by the way, the person responsible for finance wants that*" – EXP3

Some interviewees experienced that particularly multinationals required formal control, in the form of contracts. Control, however, can be difficult to realise due to the variability of the concept and control can hurt potential partnerships. The expert involved in the EnergyCo ecosystem experienced how, initially, the large multinationals wanted to protect all knowledge created within the ecosystem but slowly became more confident about the knowledge they had gained and started to open up. As

the developments progressed, actors realized their knowledge was mostly intangible and felt their position in the ecosystem was difficult to replace.

> "*We waited a long time before formalizing it because of course, we did not know exactly what we would need from people*" – AHC1
> "*Yes, they wanted to have that completely boarded up ... something that makes you say, well, yes, then we are not going to work with you ... for us is just too much hassle to make it attractive*" – MC1
> "*You notice in the beginning it was a lot of oh yes keeping it in, just for us and that actually halfway through something comes of just bringing everything out. Because we are together, we have such an advantage over the rest*" – EXP 2 on EnergyCo

Turning to the latest developments in the researched innovation ecosystems, some are currently at the stage of initial commercialization. The level of commitment and mutual trust remains high and therefore interviewees do not foresee troubles regarding appropriation.

> "*I think that trust is also getting stronger, it is also precisely because we all have an academic background that we can respond to their questions, talk about the theoretical situation. As a result, they also know that we know what they are talking about*" – AHC1
> "*We have done research for the TU and it appeared that you could use <our product> in concrete and then you have CO_2 neutral concrete. Then [two large constructors] called and showed their interest. We said, sorry but we already have a letter of intent with [company x] and we will honour it*" – RC1
> "*That they build a relationship with us. They also trust it, like, you know where to find us and then you automatically call us because we are not more expensive than the competitor and you already have a relationship with us*" – MC1

Furthermore, as actors jointly develop the VP, they all possess high levels of intangible and tacit knowledge which ensures they have a certain level of negotiation power. Actors are confident they will remain ecosystem actors, which explains why they would join the innovation ecosystem in the first place. As without any perspective on the ability to recoup their investments, a partner would not join. During development, strong bonds are formed and ecosystem actors expect to remain partners and provide the ecosystem with their co-developed solution.

> "*That is why it is so interesting to participate for those companies because you do not just have confidence with everyone. The 3D-print suppliers ... have thus acquired a position among those operators, which can hardly be taken by anyone else, because they have made that journey together for 2 years*" – EXP2 on EnergyCo
> "[*ecosystem actors] are called immediately if there is a problem, they are #1 on the shortlist, that is not formal, but that just arose in that project*" – EXP2 on EnergyCo

A final observation regarding innovation ecosystems adhering to the co-creation logic is that these ecosystems tend to more radical innovations. While this logic could work for incremental innovations

as it simply allows actors to make use of their current abilities, actors aim to achieve revolutionary changes. This could be due to the nature of university linked start-ups, however, EnergyCo is quite the opposite.

4.5 Key findings

The two narratives present new elements of both the functional and the co-creation logic, therefore Table 3 presents a supplemented overview of the functional and co-creation logic in innovation ecosystems.

Table 3 Supplemented overview of functional and co-creation logic in innovation ecosystems

	Functional logic	**Co-creation logic**
Development of the VP	VP proposed by the focal actor	Co-created by all ecosystem actors
Leadership	Focal actor	Shared
Nature of confidence in partners	Informal control and competence trust	Mostly goodwill trust and little competence trust
Level of interdependence	Low(er)	High(er)
Origin of alignment	A coherent set of capabilities	Equivalent beliefs and values
Set of partners	Focussed on production	Inclusive (producers and consumers)
Potential partners found	Via conventional search	Via network

Under the functional logic, a focal actor envisions a VP ex-ante. Subsequent, the focal actor searches for additional partners to realize that vision. Notably, the focal actor selects partners on their functional capabilities (Dedehayir & Seppänen, 2015). Potential partners are found via a regular search process, search via the internet and any contacts the focal actor has. Once a potential partner is found actor aim to establish confidence by making use of competence trust (Sako, 1992). To prove their capabilities, potential partners, as well as the focal actor, build confidence by presenting results from the past. The ecosystem as a whole is focussed on production and, therefore, potential end users are not included. In line with earlier work of Adner (2017) the interviewed focal actors, which tend to the functional logic, established initial alignment by creating a set of actors jointly possessing the required capabilities to develop the VP blueprint.

Under the co-creation logic, an initiator searches for actors to jointly develop a VP. Whereas the functional logic follows a clear selection process, the co-creation logic is more reliant on self-selection of actors (Dew & Sarasvathy, 2007). Actors both share their beliefs and visions regarding the direction of development of their industry. Equivalent beliefs and values enable the establishment of initial trust (Das & Teng, 2001). Known trust antecedents, such as an existing

relationship (Ring & Van de Ven, 1994), third party references (Das & Teng, 2001), and timely and accurate communication (Bstieler, 2006), are used by initiators which follow a co-creation logic. As the development of the VP requires committed partners which show high levels of goodwill trust, actors make use of their network (Dew, Read, Sarasvathy, & Wiltbank, 2009). At a certain point, the co-created VP seems to benefit from the inclusion of potential consumers. These potential consumers specify their needs and thereby provide the ecosystem with valuable input.

5. Discussion

While innovation ecosystems have received increasing scholarly attention (Autio & Thomas, 2014; Bogers et al., 2019; de Vasconcelos Gomes et al., 2018), the emphasis has been mainly on developing an understanding of incumbent ecosystems (e.g. Adner, 2006; Adner & Kapoor, 2010; Dhanaraj & Parkhe, 2006). In this respect, far less is known about where it all starts, that is, innovation ecosystem inception, which encompasses crucial activities such as partner selection (de Vasconcelos Gomes et al., 2018), creation of initial alignment (Adner, 2017), and value proposition (VP) development (de Vasconcelos Gomes et al., 2018)—greatly influencing ecosystem development of both short and long term.

In essence, all innovation ecosystems, directed to materialize an innovation, can be considered a group of actors that undertake collective action by following some sort of logic. A common way to guide such collective action, in this context, is the so-called *functional logic* (Adner, 2017). Facets of the functional logic are the existence of a focal actor which presents a VP blueprint ex-ante to innovation ecosystem inception, and forms an innovation ecosystem by selecting potential partners on their functional capabilities (Adner, 2017; Dedehayir et al., 2018). A different, more recent collective action logic departs from an unknown VP, the so-called *co-creation logic*. Facets of the co-creation logic are the presence of an initiator which searches for partners willing to co-create a VP, here selection of potential actors is more of a joined undertaking (Dattée et al., 2018). An initiator following the co-creation logic is unable to select partners based on their capabilities.

To date, there is no structured overview of such different logics, their components and what the implications are for the development and viability of emerging innovation ecosystems. As such, this thesis set out to study: *what logics drive collective action in emerging innovation ecosystems*? By adopting a multiple case-study, two important contributions to the field of innovation ecosystems emerge.

5.1 Functional and co-creation logics in innovation ecosystems

The results of this study confirm the existence of the functional (Adner, 2017; Adner & Kapoor, 2010; Dedehayir & Seppänen, 2015) and co-creation (Dattée et al., 2018) logics, which drive collective action in the emergence of innovation ecosystems. The functional logic can be linked to several notable papers in innovation ecosystem research (Adner, 2006, 2017; Adner & Kapoor, 2010; Autio & Thomas, 2014; Dedehayir & Seppänen, 2015). Whereas little research exists which can, in hindsight, be linked to the co-creation logic (Dattée et al., 2018). This illustrates the current existing tendency towards the functional logic. This study encourages to maintain a wider perspective on innovation ecosystems and the inclusion of additional logics, such as the co-creation logic.

Furthermore, the results of this study demonstrate how innovation ecosystems emerge. Either an initiator presents a VP blueprint and selects potential actors based on the blueprint (functional logic) (Dedehayir & Seppänen, 2015). Or an initiator searches for likeminded partners to jointly develop the VP based on their capabilities (co-creation logic). This solves the "chicken and egg" problem as presented by Dattée et al. (2018) which states that without a VP blueprint an initiator is unable to persuade potential actors to commit and to jointly develop the VP. An initiator can convince potential actors to commit to the innovation ecosystem, as by relying on their capabilities they can jointly develop a VP.

The functional and co-creation logic with their distinct components resonate strongly with the concepts of causation and effectuation described in entrepreneurship literature (Sarasvathy, 2001). As initiators of innovation ecosystems undertake entrepreneurial activities this observation is explicable. Entrepreneurs can either follow a premeditated strategy to achieve their goal (causation) or can choose to rely on their capabilities to create the most impact (effectuation) (Sarasvathy, 2001). Causation, like the functional logic, works best in environments where actors are able to predict the future, set achievable goals and select the route which leads to the goal (Sarasvathy, 2001). Whereas effectuation, like the co-creation logic, enables actors which only have a vague idea of what they would like to achieve (Sarasvathy, 2001). Effectuation allows actors to make best use of their capabilities and select between possible outcomes that can be achieved based on their capabilities (Sarasvathy, 2001).

Innovation ecosystem research can benefit from this established research stream as it is able to progress our understanding of how innovation ecosystems are formed and how ecosystems may develop under these different logics. For example, Dew et al. (2009) already discuss how entrepreneurs adopting an effectuation logic rely on their network and build partnerships with self-selecting stakeholders, a finding this research confirms (Dew et al., 2009; Ring & Van de Ven, 1994; Sarasvathy, 2001). This implicates that innovation ecosystem scholars should be open to new and additional logics which depart from often applied causation logics. Future research could explore to which extend causation and effectuation logics apply to innovation ecosystems.

The coexistence of at least these two logics also raises new possibilities for future research. The first question that comes to mind is: how do conflicts in logics between potential (or existing) ecosystem partners affect the development of the innovation ecosystem? As these logics come with different expectations, levels of commitment, and expected outcomes conflicting logics could severely harm the progression of the central innovation. Whereas the functional logic assumes the focal actor to

resolve these misalignment issues (Adner, 2017) it remains unclear how and whom in an innovation ecosystem following a co-creation logic would resolve such issues.

An additional question would be: how does the moment of 'entrance' into an innovation ecosystem affect one's business performance? Innovation ecosystems following a co-creation logic jointly develop the VP, consequently late entrance decrease one's ability to create control points for value capture. While on the other hand late entrance and a developed VP come with lower development costs for the joining actor.

5.2 The influence of networks and ecosystems-as-affiliations

Furthermore, this work shows the extensive role of trust during ecosystem inception, especially in innovation ecosystems following a co-creation logic (Bunduchi, 2013). Initiators pursuing a co-creation innovation ecosystem, make extensive use of their network as their network stimulates trust-building. Ecosystems-as-affiliations are a specific form of network and may influence and stimulate ecosystem-as-structure formation.

Ecosystems-as-affiliations allow partners' visions, goals, and motives to casually converge. As actors are already loosely connected and interact regularly. Moreover, actors in an affiliation are often co-located which is a known trust antecedent as it stimulates face-to-face communication (Bunduchi, 2013; Schiele, 2006). With regard to some aspects, actors of ecosystems-as-affiliations perform activities similar to innovation intermediaries (Kivimaa, 2014) such as facilitating knowledge dissemination and learning and stimulating communication (Kivimaa, 2014). Moreover, innovation intermediaries are known to enable the formation of innovation systems (Suurs & Hekkert, 2009). Therefore, ecosystems-as-affiliations may contribute to the co-creation logic and aid innovation ecosystem emergence. Future research could further investigate the role ecosystems-as-affiliations and innovation intermediaries play in the formation of ecosystems-as-structures.

Lastly, this research also adds to the discussion on whether to pursue a single theory on ecosystems as proposed by Bogers et al. (2019). This research specifically addressed innovation ecosystems and by focussing on this type of ecosystem alone is able to explore new logics which previously have been neglected. While a unified theory would certainly progress ecosystem research as a whole, it may be too early to pursue a unified theory. A unified theory requires a thorough understanding of all the different elements of ecosystems and their intricacies. An example of a relatively untouched area in innovation ecosystem research is actor level research. Topics such establishment of mutual trust and the role of technology intermediaries, which would improve our understanding of how innovation ecosystems come into existence, could benefit from actor level research.

5.3 Practical implications

Several practical implications follow from this study. First, the realisation that different logics exist underlying innovation ecosystem emergence. Initiators should realize that whether they are able to present a VP blueprint has a large influence on ecosystem inception. If the initiator can present a VP blueprint, following the functional logic, the initiator can take the role of focal actor. Subsequently, the initiator can select potential partners based on the VP blueprint. Whereas initiators who lack a VP blueprint, following the co-creation logic, require strongly committed partners to jointly develop a VP. Initiators aiming for a co-creation innovation ecosystem can take advantage of the effectuation process, to make best use of their means and provide possible partners with clarity regarding the process as it is substantially different from conventional causation logic (Sarasvathy, 2001). Furthermore, initiators of a co-creation innovation ecosystem should be aware of the need for mutual trust among partners and realize they can often find trustworthy partners in their network.

Second, actors potentially joining an innovation ecosystem should consider at which moment they join an innovation ecosystem, especially ecosystems with a co-creation logic. An innovation ecosystem with a functional logic provides clarity to potential actors, as the VP blueprint better allows for the prediction of the required development activities. The co-creation logic, however, is associated with high levels of uncertainty as the VP must be developed. Joining early, may enable an actor to influence the direction of development but requires large investments. Whereas, potentially, in a later stadium the VP may require additional actors (transitioning to the functional logic) allowing actors to join late. The decision to enter an ecosystem aimed to co-create a VP thus should be dependent on whether the actor wants to be able to influence the course of the ecosystem.

5.4 Limitations

A potential limitation of the interviewed SMEs is their ability to only supply a few people, thereby inducing the risk of singular respondent bias. Often, however, it is noted that the most knowledgeable person will provide the response and that this may, in fact, reflect the view of the organisation (Lyon, Lumpkin, & Dess, 2000). Furthermore, this allows for increased participation of organisations as they only have to provide one or two people (Lyon et al., 2000). Lastly, it allows for the analyses of more organisations instead of only a few organisations (Lyon et al., 2000) thereby allowing for a broader perspective on innovation ecosystem initiation. Furthermore, to limit the potential influence of singular respondent bias, most relevant cases were asked to provide additional interviewees to verify findings. These interviews showed that in these organisations, in fact, the initial interviewee was able to elaborate significantly more on the subject.

Another possible limitation is the retrospective bias of respondents regarding past events (Golden, 1992). Multiple guidelines to improve the accuracy of retrospective reports as suggested by Huber

and Power (1985) are followed. First, the most knowledgeable persons regarding ecosystem inception and partner selection were asked to participate (Huber & Power, 1985), all organisations responded willingly. Second, the amount of time between inception and the collection of data is minimized (Huber & Power, 1985). Last, respondents were encouraged to respond with candour, questions were framed neutrally and follow up probes were used to ensure that questions were understood (Huber & Power, 1985).

Last, all researched cases are still progressing towards commercialization, potentially leading to survivor bias. By including the experiences of experts who also encountered innovation ecosystems not leading to successful commercialization, the effects of survivor bias are mitigated (Gudmundsson & Lechner, 2013).

6. Conclusion

This qualitative research explores what logics drive collective action in emerging innovation ecosystems. This research shows innovation ecosystem initiators can either adhere to the functional or co-creation logic. The functional logic revolves around a VP blueprint presented by the focal actor. The focal actor can select potential partners based on the functional requirements that follow from the VP blueprint. Initiators, adhering to the co-creation logic, jointly with their partners develop a VP and consequently experience a high level of interdependency. These initiators require highly committed and trustworthy partners and by making use of their network they can find such partners. This study contributes to the field of innovation ecosystem research as it confirms the existence of different logics and consequently provides insight into the creation of innovation ecosystems.

References

Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard Business Review, 84*(4), 98.

Adner, R. (2012). *The wide lens: A new strategy for innovation*: Penguin Uk.

Adner, R. (2017). Ecosystem as structure: an actionable construct for strategy. *Journal of management, 43*(1), 39-58.

Adner, R., & Feiler, D. (2019). Interdependence, Perception, and Investment Choices: An Experimental Approach to Decision Making in Innovation Ecosystems. *Organization science, 30*(1), 109-125.

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic management journal, 31*(3), 306-333.

Autio, E., & Thomas, L. (2014). Innovation ecosystems. *The Oxford handbook of innovation management*, 204-288.

Bogers, M., Sims, J., & West, J. (2019). What Is an Ecosystem? Incorporating 25 Years of Ecosystem Research. *Academy of Management Proceedings, Vol. 2019*(1).

Boon, S., & Holmes, J. (1991). The dynamics of interpersonal trust: resolving uncertainty in the ace of risk. *In R. A. Hinde & J. Goebel (Eds.), Cooperation and prosocial behaviour: 190-211. Cambridge, England: Cambridge University Press*.

Bstieler, L. (2006). Trust formation in collaborative new product development. *Journal of Product Innovation Management, 23*(1), 56-72.

Bunduchi, R. (2013). Trust, partner selection and innovation outcome in collaborative new product development. *Production planning & control, 24*(2-3), 145-157.

Carson, S. J., Madhok, A., & Wu, T. (2006). Uncertainty, opportunism, and governance: The effects of volatility and ambiguity on formal and relational contracting. *Academy of management Journal, 49*(5), 1058-1077.

Casadesus-Masanell, R., & Yoffie, D. B. (2007). Wintel: Cooperation and conflict. *Management science, 53*(4), 584-598.

Das, T. K., & Teng, B.-S. (1998). Between trust and control: Developing confidence in partner cooperation in alliances. *Academy of management Review, 23*(3), 491-512.

Das, T. K., & Teng, B.-S. (2001). Trust, control, and risk in strategic alliances: An integrated framework. *Organization studies, 22*(2), 251-283.

Das, T. K., & Teng, B.-S. (2004). The risk-based view of trust: A conceptual framework. *journal of Business and Psychology, 19*(1), 85-116.

Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. *Academy of management Journal, 61*(2), 466-498.

de Vasconcelos Gomes, L. A., Facin, A. L. F., Salerno, M. S., & Ikenami, R. K. (2018). Unpacking the innovation ecosystem construct: Evolution, gaps and trends. *Technological Forecasting and Social Change, 136*, 30-48.

Dedehayir, O., Mäkinen, S. J., & Ortt, J. R. (2018). Roles during innovation ecosystem genesis: A literature review. *Technological Forecasting and Social Change, 136*, 18-29.

Dedehayir, O., & Seppänen, M. (2015). Birth and expansion of innovation ecosystems: A case study of copper production. *Journal of technology management & innovation, 10*(2), 145-154.

Dekker, H. C., & Van den Abbeele, A. (2010). Organizational learning and interfirm control: The effects of partner search and prior exchange experiences. *Organization science, 21*(6), 1233-1250.

Dew, N., Read, S., Sarasvathy, S. D., & Wiltbank, R. (2009). Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices. *Journal of business venturing, 24*(4), 287-309.

Dew, N., & Sarasvathy, S. D. (2007). Innovations, stakeholders & entrepreneurship. *Journal of Business Ethics, 74*(3), 267-283.

Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. *Academy of management Review, 31*(3), 659-669.
Dougherty, D., & Dunne, D. D. (2011). Organizing ecologies of complex innovation. *Organization science, 22*(5), 1214-1223.
Dunne, D. D., & Dougherty, D. (2016). Abductive reasoning: How innovators navigate in the labyrinth of complex product innovation. *Organization studies, 37*(2), 131-159.
Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management Review, 14*(4), 532-550.
Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of management Journal, 50*(1), 25-32.
Emden, Z., Calantone, R. J., & Droge, C. (2006). Collaborating for new product development: selecting the partner with maximum potential to create value. *Journal of Product Innovation Management, 23*(4), 330-341.
Frishammar, J., Lichtenthaler, U., & Richtnér, A. (2013). Managing process development: key issues and dimensions in the front end. *R&d Management, 43*(3), 213-226.
Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The qualitative report, 20*(9), 1408.
Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research policy, 43*(7), 1239-1249.
Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational research methods, 16*(1), 15-31.
Golden, B. R. (1992). The past is the past—or is it? The use of retrospective accounts as indicators of past strategy. *Academy of management Journal, 35*(4), 848-860.
Grandori, A. (2006). Innovation, uncertainty and relational governance. *Industry and Innovation, 13*(2), 127-133.
Gudmundsson, S. V., & Lechner, C. (2013). Cognitive biases, organization, and entrepreneurial firm survival. *European Management Journal, 31*(3), 278-294.
Huber, G. P., & Power, D. J. (1985). Retrospective reports of strategic-level managers: Guidelines for increasing their accuracy. *Strategic management journal, 6*(2), 171-180.
Iansiti, M., & Levien, R. (2004). *The keystone advantage: what the new dynamics of business ecosystems mean for strategy, innovation, and sustainability*: Harvard Business Press.
Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic management journal, 39*(8), 2255-2276.
Kapoor, R., & Adner, R. (2012). What firms make vs. what they know: how firms' production and knowledge boundaries affect competitive advantage in the face of technological change. *Organization science, 23*(5), 1227-1248.
Kapoor, R., & Lee, J. M. (2013). Coordinating and competing in ecosystems: How organizational forms shape new technology investments. *Strategic management journal, 34*(3), 274-296.
Khan, S., & VanWynsberghe, R. (2008). *Cultivating the under-mined: Cross-case analysis as knowledge mobilization.* Paper presented at the Forum qualitative Sozialforschung/forum: Qualitative social research.
Kivimaa, P. (2014). Government-affiliated intermediary organisations as actors in system-level transitions. *Research policy, 43*(8), 1370-1380.
Langley, A. (1999). Strategies for theorizing from process data. *Academy of management Review, 24*(4), 691-710.
Larson, A. (1992). Network dyads in entrepreneurial settings: A study of the governance of exchange relationships. *Administrative science quarterly*, 76-104.
Lavie, D., Haunschild, P. R., & Khanna, P. (2012). Organizational differences, relational mechanisms, and alliance performance. *Strategic management journal, 33*(13), 1453-1479.
Lin, C.-W. R., & Chen, H.-Y. S. (2004). A fuzzy strategic alliance selection framework for supply chain partnering under limited evaluation resources. *Computers in industry, 55*(2), 159-179.

Lyon, D. W., Lumpkin, G. T., & Dess, G. G. (2000). Enhancing entrepreneurial orientation research: Operationalizing and measuring a key strategic decision making process. *Journal of management, 26*(5), 1055-1085.
Miller, C. C., Cardinal, L. B., & Glick, W. H. (1997). Retrospective reports in organizational research: A reexamination of recent evidence. *Academy of management Journal, 40*(1), 189-204.
Miller, K., McAdam, R., Moffett, S., Alexander, A., & Puthusserry, P. (2016). Knowledge transfer in university quadruple helix ecosystems: an absorptive capacity perspective. *R&d Management, 46*(2), 383-399.
Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review, 71*(3), 75-86.
Nooteboom, B. (1996). Trust, opportunism and governance: A process and control model. *Organization studies, 17*(6), 985-1010.
Poppo, L., & Zenger, T. (2002). Do formal contracts and relational governance function as substitutes or complements? *Strategic management journal, 23*(8), 707-725.
Ring, P. S., & Van de Ven, A. H. (1994). Developmental processes of cooperative interorganizational relationships. *Academy of management Review, 19*(1), 90-118.
Sako, M. (1992). *Price, quality and trust: Inter-firm relations in Britain and Japan*: Cambridge University Press.
Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of management Review, 26*(2), 243-263.
Schiele, H. (2006). How to distinguish innovative suppliers? Identifying innovative suppliers as new task for purchasing. *Industrial Marketing Management, 35*(8), 925-935.
Sharapov, D., Thomas, L. D., & Autio, E. (2013). *Building ecosystem momentum: The case of AppCampus.* Paper presented at the 35th DRUID Celebration Conference.
Suominen, A., Seppänen, M., & Dedehayir, O. (2019). A bibliometric review on innovation systems and ecosystems: a research agenda. *European Journal of Innovation Management*.
Suurs, R. A., & Hekkert, M. P. (2009). Cumulative causation in the formation of a technological innovation system: The case of biofuels in the Netherlands. *Technological Forecasting and Social Change, 76*(8), 1003-1020.
Thomas, L. D., & Autio, E. (2015). *The processes of ecosystem emergence.* Paper presented at the Academy of Management Proceedings.
Valkokari, K. (2015). Business, innovation, and knowledge ecosystems: How they differ and how to survive and thrive within them. *Technology Innovation Management Review, 5*(8).
Walrave, B., Talmar, M., Podoynitsyna, K. S., Romme, A. G. L., & Verbong, G. P. (2018). A multi-level perspective on innovation ecosystems for path-breaking innovation. *Technological Forecasting and Social Change, 136*, 103-113.
Yin, R. K. (1981a). The case study as a serious research strategy. *Knowledge, 3*(1), 97-114.
Yin, R. K. (1981b). The case study crisis: Some answers. *Administrative science quarterly, 26*(1), 58-65.

Appendix A

Background information on included innovation ecosystems

Affordable HousingCo (AfH-Co)

AfH-Co designs and supervises the build of a sustainable residential building. The concept uses a holistic approach to sustainable living and integrates various sustainable and innovative solutions. The holistic concept aims to create synergy by wisely combining various solutions. The building does not make use of concrete to increase the amount of durable materials. The roof houses solar panels and rainwater is collected. Furthermore, the house makes use of a novel heat pump with even greater efficiency. The building requires customization; however, this building requires some partners not only to customize but also te design new solutions.

AfH-Co started as a team of honours students interested in innovations for the built environment. Initially, the team aimed to only design a building, as to show it could technically be done. The team nowadays consists of 15 team members. During the process partners joined and it was proposed to not only design but also to build the concept.

AfH-Co has various partners ranging from constructors, architectural firms, technical partners, and investors. The team is heavily reliant on partners as it is not able to fully design, verify and build a concept themselves. The constructor takes up most of the legal work such as obtaining a building permit. Co-innovation mostly takes place between AfH-Co and technical partners.

Currently, AfH-Co has received a go decision by one of the partners to build the concept and the public housing partner has agreed to let the building to lower-income households. The team is finishing the concept and aims to start realization in the next year. If the project turns out to be successful, the team will focus on scaling up.

MetalCo

MetalCo aims to develop a sustainable source of heat used in the industry. As many industrial processes are heat-intensive a sustainable fuel or heating method is welcome. Key to this innovation is, on the one hand, the ability to burn metal fuels and to generate heat and on the other hand to regenerate the burned fuel. Without regeneration, the fuel would not be sustainable.

Metal fuels are used in aerospace but could be used to create a flame in lab environments. MetalCo aims to continue the development of this technology and to use MetalCo as a sustainable alternative. MetalCo was started by students and currently consist of about 30 people.

The partners of MetalCo are knowledge institutes, engineering firms and customers. Combined these actors can further develop all relevant elements of metal fuels.

Currently, MetalCo has its first industrial plant placed at a brewery and has contact with multiple actors interested in the technology. The ecosystem continues to develop new applications of their technology and a maritime project is started. Metal fuels could potentially replace conventional propulsion technologies.

RecycleCo

RecycleCo continues a thought earlier pursued by an acquainted inventor, however, this time by including ecosystem partners. The aim is to recycle materials by heating them to very high temperatures (about 1500 degrees Celsius), metals will melt or even evaporate and can be separated. As the mixture is heated elements will burn which creates energy, therefore, it is important to have the right mixture of 'waste'. The mixture will allow the process to continue once it has been started.

The preamble to the innovation ecosystem was difficult as the initial concept required further development. By teaming up with other university students the team allows the creation of a viable VP. Currently, the focal company consists of about 10 people.

RecycleCo has partners regarding the development of ovens where waste is heated and partners for testing locations. Furthermore, interested customers are part of the ecosystem. Thereby, the ecosystem has secured itself of customers allowing for smooth upscaling of the technology once the test facility is proven to be successful.

Currently, RecycleCo is finishing their first large scale test plant and thereafter a much larger commercial installation will be built.

EnergyCo

Two large competing oil and gas companies have set up an innovation ecosystem as the benefits of the proposed innovation would be so big and the ability to share costs and increase leverage within the oil industry made them cooperate. The innovation ecosystem consists of all companies involved in the value chain, ranging from owners of oilrigs, contractors, operators, designers, service providers, metal suppliers, IT-specialist, and a certification body. The innovation ecosystem aimed to develop a new method to produce spare parts, repair broken parts and to get this method certified. The certification is needed to warrant the quality of the produced parts.

Tools used in the oil and gas industry on rigs are often very large and very expensive. These parts are often not stockpiled and repairing broken parts is often impossible. This means that if parts break there is a considerable downtime, and the cost of new parts are high. This ecosystem aimed to research if parts could be 3D printed to allow shorter downtimes and to research whether it was possible to repair broken parts with 3D printers. Repairing broken parts requires the bonding of the newly printed metal with the original part to be of sufficient strength. All related processes, protocol and quality requirements did not exist and therefore had to be developed.

The central innovation appealed to multiple actors because of various reasons. A certification body was interested to cooperate as the guidelines for the new certified method would be put into a booklet which they could sell. The participating 3D-printing companies were interested as they could demonstrate their technology to the oil and gas industry which would open a new market for them. While large operators of oil and gas rigs were interested as this innovation would allow them to stock fewer spare parts and reduce downtime as parts could be made on the spot.

EV-Co

EV-Co has developed multiple electric racing cars and nowadays focusses on decreasing charging duration for electric vehicles. To showcase the performance of their car they aim to participate in Le Mans in 2023. Le Mans offers innovative cars the possibility to participate via a special application process. To succeed the car needs to be both fast, efficient, and able to recharge quickly. The team makes use of both standardized components as well as custom-designed and build components.

Initially when the team started the focus laid on building a biofuel racer. Once the team succeeded the focus changed to building an all-electric car. The team size strongly fluctuates over time and is dependent on the phase the team is in. During built and design the size of the team increases and once a project has finished the team size shrinks. Currently, the team consists of 6 full times students.

The team works with different kinds of partners. Technical partners either codevelop parts or deliver parts to the team. The amount of co-innovation of this team is lower compared to MetalCo, RecycleCo, and AfH-Co. This is mostly due to the need for unique high-performance parts, which at this time are not used in a broad environment.

Currently, the team is developing a prototype endurance car which will charge in about 7.5 minutes. Developments will continue to bring down charging times to about 2 minutes in 2022.

InsightCo

InsightCo builds a campus-wide energy simulation model which enables laymen to understand how potential new renewable energy sources would affect campus energy management. The simulation model works with actual numbers and considers available resources such as the current network and the limitations that come with it. The model can, real-time, show how, for example, solar panels on building x will influence the energy management of the campus. The model presents the cost, payback time, saved CO_2, and possible limitations in the physical network.

InsightCo started as a team of honours students but is open to all students at TU/e. Currently, the team exists of 15 students with eight different study backgrounds. Their first simulation model was based on the TU/e campus.

InsightCo is part of a network and via this network met a new partner in the form of a local business park. EI works with partners to develop the data model but is looking for additional partners currently. Partners in the field of data cleaning are especially welcome.

Currently, InsightCo is focussing on finalizing the TU/e model before upscaling their activities and business. InsightCo aims to build additional simulation models for large business parks and other campuses which have an energy manager. The current model is most suitable for creating awareness and understanding. Therefore, InsightCo is considering to further expand their simulation such that professionals can make use of the simulation rather than laymen only.

HousingCo

HousingCo designs and supervises the build of a highly innovative building which makes use of renewable energy. The team first participated in a global design competition which challenges teams to design and build highly efficient and innovative houses powered by renewable energy. The aim of the competition is to showcase energy-efficient houses which integrate with their surroundings. Teams are among others evaluated on their architecture, connection with the surroundings, efficiency, and affordability. The house HousingCo designs make use of several novel technologies.

HousingCo started as a team of honours students but is now open to all students of TU/e. The team nowadays consists of 36 members with backgrounds in mechanical engineering, sustainable innovation, industrial design and the built environment.

Currently, HousingCo is about to finish their design which will be build and be their entry for a new global design competition. During the design process, HousingCo collaborated with several architectural and engineering firms, in contrast in preparation of the previous design competition they did make far less use of collaborations during the design phase. During the design phase, architectural and engineering firms provide feedback to the team and help improve the overall

design. As the design is almost finished the team is preparing the transition from design to realization. HousingCo has a contractor which will survey the realization of the building, but HousingCo searches, contacts, and selects possible partners.

PhotonicsCo

PhotonicsCo is active in the photonics integrated circuits market and acts as a technology intermediary. Whenever clients request solutions which are difficult to realize with existing chip designs an innovation ecosystem is established. Clients can have varying request and some clients do not exactly know which solution they need. PhotonicsCo advises clients on possible solutions and performs an initial feasibility study. Part of the feasibility study is which actors would be included in the design process, how IP, in general, would be distributed and what the associated costs are.

As ecosystems are only initiated when actors agree to the upfront investment based on the feasibility study, innovations are incremental. Without the possibility to assess risks chances of ecosystem inception are slim.

PhotonicsCo has experience with multiple innovation ecosystems as well as with regular design solutions which are based on off the shelf solutions. Some innovation ecosystems are formed as part of subsidized research projects which require the inclusion of multiple actors.

Appendix B

Interview guide

This research investigates the cooperation between companies which aim to develop a product or services together.

- Could you provide me with some general information about your organisation (area, number of partners, years in business)
- Could you tell me something about the aim of your organisation, which innovation are you trying to materialize? (kind of innovation, product or service, time frame)
- What is your role in this process?

Establishment and initial phase of the network/ecosystem

- If you think back to the moment the project started, how did that go?
    - Who came up with the idea (lead actor)? What was the initial response? At what point the idea of incorporating others came about? Was there consensus?
- How did the process of searching for partners unfold?
    - Where did you look for? Certain skills or more of a mindset fit? Furthermore, what did a good partner needed to bring both regarding skills but also commitment wise?
    - Where there many interested partners?
    - How did you attract or persuade other actors?
    - Where did the actor search start? Who was incorporated?
- Why did you select these partners?
    - Where did you look for? previous experience, right skillset or knowledge, reference, smooth communication (rich form of communication and timely and open), beliefs, values, norms?
    - Did partner selection also had to do with a feeling of trust?
    - A partner possesses certain skills/capabilities but also brings vulnerability for example regarding their motives, do you recognize this?
- After a partner was selected, how did it go? How do you react on the change in control, from controlling everything yourself to sharing control with a partner?
    - Was there a need for control? Is there any control relation between both actors?
        - Why do you want/not want control? Could it be that you expect the partner to act in accordance with your interests?
    - Was there anything discussed or decided?
    - If contract, why, what was concluded, how did it work out

    - If no contract, why not, was there no need or was it too difficult?
- How did the level of trust develop over time?
- How did control develop over time?
- How is appropriation arranged?
    - Was it clear from the beginning who would earn what or what the distribution would be?
- How did the project progress? What is the current status of the project?
- Are there aspects or elements which we did not address and which you think are valuable to share?