MASTER

How to make the innovation ecosystem of Eindhoven future proof?
insights from an innovation system foresight study

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Master Thesis

How to make the innovation ecosystem of Eindhoven future proof? Insights from an innovation system foresight study

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Executive Summary

In a world of exponential technologies, where every human will be connected within a decade, and a global population of 10 billion people by 2050, the urge to innovate has never been stronger. However, with decreasing product life cycles and increasing costs to innovate, it is no longer an option for companies to innovate inside the four walls of their R&D departments (Chesbrough, 2003). Therefore, highly competitive companies in R&D-driven industries want to locate themselves close to the action to seek out new ideas from start-ups, incubated projects or other channels that might disrupt their business. This resulted in conglomerations of loosely interconnected high tech businesses in a relatively small geographic area like a city or business campus. Researchers describe these conglomerations as business ecosystems (Moore, 1993), innovation ecosystems (Iansiti, 2004), regional innovation systems (Andersen and Andersen, 2012) and others. This study defined an innovation ecosystem as "a network where people, culture, and technology meet and interact to catalyze creativity, trigger invention and accelerate innovation across scientific and technological disciplines in public and private sectors and in a top-down, policy-driven as well as bottom-up, entrepreneurship-empowered fashion" (Carayannis and Campbell, 2009, p. 202-203).

Aim of this study

The study aims to investigate how the innovation ecosystem of Eindhoven can be further developed in the future. I conducted my research for Campus Site Management (CSM) of the High Tech Campus Eindhoven (HTCE). As a subsystem of the innovation ecosystem of Eindhoven, the HTCE is known for providing its residents access to shared resources and facilities to facilitate research and product development, as well as creating an innovation community that enhances knowledge sharing between knowledge workers on campus (Romme, 2017). This approach appears to be highly successful. In fourteen years, the HTCE has grown to a population of 11,000 researchers, developers, and entrepreneurs. Together they are working at over 160 companies, 40 startups and various institutes on developing future technologies and products. Collectively they apply to four patents per day which is nearly 40 percent of the Dutch patent applications, making it the smartest square kilometer in Europe.

To stay on top of their game, CSM asked me to give direction how it can become future-proof together with its surrounding partners. This led to the following research question:

"How can CSM 'strengthen' the innovation ecosystem to become future proof?"

Methodology

I used two units of analysis: Firstly, I studied the broader innovation ecosystem of Eindhoven and secondly developed actions for specifically CSM to 'strengthen' the HTCE and Eindhoven. Due to the limited knowledge available on the topic of future trends for innovation ecosystems, we agreed upon an exploratory study without the imposition of any theoretical framework beforehand. Therefore, I chose to take a longitudinal view by using the innovation system foresight methodology (Andersen and Andersen, 2012). This methodology brings structure to the process by splitting the project up into four parts; mapping of the current situation, foresighting in future trends, creating future scenarios, and developing actions for CSM in the innovation ecosystem of Eindhoven. To execute this study effectively, the project draws on qualitative data from industry experts in three different innovation ecosystems; Eindhoven, Munich, and Cambridge. Besides, archival data and observations were also addressed to perform triangulation.

Insights & Implications for Eindhoven and CSM

The main barriers for the functioning of the innovation ecosystem of Eindhoven are a non-entrepreneurial mindset, risk-averse (corporate) venture capital, the lack of talent, and the local competition which affects the feeling of a shared identity and message to the outside world. In the future, the central forces that will have an impact on the innovation ecosystem are exponential technologies, demographics, and individual empowerment. Exponential technologies are going to transform the *nature* of work, demographic changes will transform the *workforce*, and individual empowerment will shift the *relationship* between employer and employee.

Two different models describe work in innovation ecosystems but only of them gains potential while the other one loses its potential. Therefore, to become future proof, the innovation ecosystem of Eindhoven must use the forces as a catalyst to change the old definition of work called 'scalable efficiency' to 'scalable learning.' They must use the forces to change the *definition of work* from 'a set of routine, predictable, standardized and highly integrated tasks' to 'solving business problems, finding and providing new services, and establishing new relationships.' To do so, the innovation ecosystem needs institutional innovation to transform the actors in the innovation ecosystem at a fundamental level. Fundamental to institutional innovation is that it should not be done top-down. Instead, the innovation ecosystem should identify an 'edge' that embraces scalable learning and scale it via third-party resources till it becomes the new core of the innovation ecosystem. I identified two different these edges in the innovation ecosystem of Eindhoven.

The first edge consists of two initiatives from the TU/e; 'Innovation Space' and 'The Engine.' In both cases, students work on real-life problems in multidisciplinary teams. I argue that other actors in the innovation ecosystem should become a third party in scaling these edges. Therefore, CSM should also become a third party that scales the initiatives of the TU/e. To do that, CSM can use its network on the HTCE to nurture the pipeline of problems needed at Innovation Space and The Engine. A first step is to start showing The Engine and Innovation Space on all screens on the HTCE, endorsing all campus residents to send their unused IP or current problems to these initiatives. Besides, CSM should also promote HTCE residents to become a mentor for these student teams. These bottom-up approaches should be used to create an open community of people that like to discuss ideas with each other. CSM should foster this informal approach for a sustained period. When the bottom-up approach does not work anymore because of the 'chaos' it created, CSM has an excellent foundation to formalize these collaborations with the TU/e.

Second, CSM should create a setting for scalable learning on the HTCE. I advise CSM to do this via setting up a startup accelerator on a theme that all large companies on the HTCE have an affiliation with. This theme is *light* with optic and photonic technology included. CSM can organize hackathons, startup weekends, and workshops all based on *light* in the three application areas of the HTCE. This way, startups and investors from all over the world can come to Eindhoven to help the globals and research institutes speeding up their technology transfer in the scope of light. Over time, this creates a solid base of startups on the HTCE and will make the High Tech Campus future proof. The first step would be to establish a strategic startup team with "pragmatic bridge builders" and build the startup accelerator in a short period. When CSM has successfully established the startup accelerator based on light, it can further scale the edge by creating a connected marketing platform with partners on the edge of light. Next, it can build Light-Space, a shared office building with all high tech infrastructure needed by the startups (or make Philips Innovation Services a partner in the concept). Then, CSM can attract 'Entrepreneur First' (EF) to open their next location on the HTCE (or initiate an own accelerator based on the EF model). Next, it can create a venture capital fund based on the model of Cambridge Innovation Capital specifically for startups that use light as a technology for their business. Last, CSM can attract a partner to create an online platform based on the theme light with a variety of services on it. For example, technological infrastructure, capital funds, experts, startups, crowd sourcing options in the theme of *Light*.

When CSM successfully scales these two edges, it creates a setting of scalable learning on the HTCE and strengthens the innovation ecosystem of Eindhoven to become future-proof.

Contents

Chapter 1

Introduction

In a world where every human will be connected within a decade, a global population of 10 billion people by 2050, and exponential technologies disrupting market after market, the urge to not be left behind has never been stronger. This revolutionary transformation will not only affect businesses, institutions, and governments. It will change every single human being on the planet.
To not be left behind, enterprises have to innovate faster than ever before. Therefore, they can no longer rely on a few people or a single department within their own company. Instead, businesses, governments, and universities in small geographic areas are increasingly seeking collaboration in so-called innovations ecosystems to gain economic growth, international competitiveness, and social well-being for their region.
The Brainport Eindhoven region in the Netherlands is seen a as prime example of a well functioning innovation ecosystem. Eindhoven was praised by Forbes in 2013 as the most inventive city in the world. Two years later, Business Insider and The New York Times described the region as a role model for design and technology experimentation. The success is due to the globally known companies like Philips and DAF, but also of cutting-edge technology manufacturers like ASML and NXP in the semiconductor industry, high-end research facilities, and some of the best designers in the world. The High Tech Campus Eindhoven, 'the smartest square kilometer in the world,' is also one of the main contributors to the success of Eindhoven. There are over 11,000 top researchers on the High Tech Campus that develop the products and applications of tomorrow. To stay on top of their game, Campus Site Management of the High Tech Campus Eindhoven asked the author of this master thesis what it should do to 'strengthen' the innovation ecosystem of Eindhoven to become future-proof. By doing so, they want to prolong their success in the region and become a globally known hotspot for innovation and technology.

This master thesis outlines as follows. In chapter 2, the client will be introduced. The next chapter covers the planning phase of this innovation foresight study. Here, I will focus on the context, research questions, scope, and methods that I used during my study. The main phase of this project starts in chapter 4, where I describe three innovation ecosystems based on their evolution and current functioning. Via a cross-analysis, I conclude the chapter by explaining the main barriers to a functioning innovation ecosystem. Chapter 5 investigates the future. First, I will scan the future for megatrends that will affect the whole world an then I will analyze the current trends and challenges in the three innovation ecosystems. Chapter 6 converges the findings I gained over past two chapters and explains three forces that will change the future of work. In the same chapter, I will discuss two models of work and provide an argumentation why only one of them will work in the future. Chapter 7 explains an action plan how the innovation ecosystem of Eindhoven can get to a new model of work and so becomes future proof. The last chapter contains the conclusion, the theoretical discussion about findings, and practical implications for the client. Over the course of this master thesis, I use "We" to refer to my supervisors and myself and "I" to refer to myself when a decision is made.

Chapter 2

Organizational Context

This chapter introduces the organizational setting of this master thesis. The first section explains the history and reasoning to build the High Tech Campus Eindhoven. Then the company is described together with its mission and vision.

2.1 History

In 1891 Koninklijke Philips N.V. was founded by Gerard Philips and his father. Their goal was to produce and sell carbon-filament lamps in Europe and later also globally. Subsequently, Anton Frederik Philips (14 March 1874-7 October 1951) co-founded Royal Philips Electronics N.V. in 1912 with his older brother Gerard Philips in Eindhoven, the Netherlands. By 1914 Anton and Gerard decided to create a separate department within Philips Electronics in Eindhoven where research activities of Philips Electronics would take place. This department was called Natlab and is currently known as Philips Research.
Since the establishment, Natlab became one of the largest private research centers in the world. Therefore it was not only a prominent entity in Philips, but also a key global research center as well. Well known products as DVD, compact discs, MRI, CT, X-ray were innovated and developed in Eindhoven. At the end of the 1990s, the R&D activities of Philips were spread right across the city of Eindhoven [1]. Therefore, in 1998, Royal Philips decided to co-locate their R&D facilities in a single location for all its national R&D facilities. This led to the development of "Philips High Tech Campus" in the south of Eindhoven.
For the development of the campus, Philips Research needed to invest heavily in R&D infrastructure to preserve internal research at the campus and also stay ahead of the competition. However, despite the centralized R&D facility, Philips' R&D costs were too high, and the turnover could not keep up. The year result of 2002 netted a loss of 3,2 million euros[2]. Management of Philips Research had to do something to reduce R&D costs while keeping the research output similar or higher to stay in business. Rick Harwig and Arthur van der Poel were first to raise the opportunity of opening the boundaries of the campus for other companies in a strategy meeting in 2001. After two years of discussions, the original Philips Research facility was dismantled and transformed into an open innovation ecosystem, the High Tech Campus Eindhoven (HTCE). This meant that other technology companies could reside themselves on the campus. The result is a multi-tenant open innovation ecosystem where companies, research institutes, and service providers work together to generate innovations.

[1] source: https://www.philips.com/a-w/research/100-years-research/history.html
[2] source: https://www.philips.com/cdam/corporate/aboutphilips/investors/financialresults/qresults/archiveq-results/2002/R_QR4_0212882.pdf

2.2 High Tech Campus Eindhoven

Since 2003, the HTCE has been open for other technological companies from all over the world. During the development of the open innovation ecosystem, several top technology companies and institutes settled themselves to the high tech campus. A good example is research institute "Holst Centre," where wireless sensor technologies and flexible electronics are being developed. The uniqueness comes from the open innovation model present between the partners of the research institute. At the Holst Centre, partners complement their exclusive R&D with shared R&D, leveraging each other's talents and knowledge in a well-structured setting [3]. ASML is another progressive company on the HTCE who adopted the open innovation approach as well. Instead of doing all the innovation projects themselves, AMSL closely collaborates with their suppliers in the region and increasingly expects them to take on their share of innovation in the semiconductor equipment industry [4].

Besides Holst, ASML, and the presence of a community with an enormous amount of knowledge in high tech. The HTCE also provides technological infrastructure and facilities for its residents by engaging in a partnership Philips Innovation Services (PIS). Facilities include electromagnetic compatibility (ECM) test center, reliability test center, a lab for material analysis lab, and instruments for testing on rental. On top of the technological facilitates, the HTCE also offers a wide variety of social services. For example, a gym, child day care, shops and restaurants, a conference center, and campus sports teams. Most of the social services all present in 'The Strip,' which is a 400-meter long building in the center of the HTCE. Because of this central point on the campus, employees and visitors are more likely to spontaneously run into each other and communicate on an informal level.
Overall, the High Tech Campus Eindhoven encloses over 10,000 m^2 of social services, 45,000 m^2 of laboratories and clean rooms, 185,000 m^2 office space and 115,000 m^2 additional development space, and 10,000 m^2 reserved for start-ups (according to the current data). In total, more than 11,000 researchers, developers, and entrepreneurs are working at over 160 companies, 40 startups and various institutes on developing future technologies and products. Together they apply for four patents per day which is nearly 40 percent of the total Dutch patent applications, making it the smartest square kilometer in Europe!
In 2012 the HTCE was sold by Philips to Ramphastos Investments, a consortium of investors. Philips remained on the Campus as a tenant, but its status changed from owner/manager to resident. Since 2012, the HTCE has continued to attract new globals, SME's, start-ups and research institutes engaging in advanced R&D in the area of high tech systems, nanotechnology, smart pharma, embedded systems, life sciences, and security and encryption. Global players like Intel, IBM, ABB, ASML, and Philips have located at least part of their research activities to the campus. On January first, 2017, Shimano opened their European head office at the HTCE with the intention to stay for the next 25 years. One year later, the HTCE plans to open the 'Smart Industry Hub,' which is designed for small and medium-sized high-tech companies and is a combination of office space, workshop facilities, and research labs all under one roof [5].

When the High Tech Campus was set up to become an open innovation ecosystem, Philips introduced Campus Site Management (CSM) as a separate unit of Philips. CSM became responsible for the daily operations as well as setting a long-term strategic vision for the HTCE. Therefore, CSM had to vital task to fulfill that the HTCE became a widely known open innovation ecosystem as well as the crucial role to endorse networking under campus residents on all levels. To do so, CSM organizes a full range of events together with its partners. For example, open lectures by professors of the TU/e, business club events, and Campus Technology Seminars. Besides the task of building a community on the campus, CSM is also responsible for daily operations. These include maintenance of the campus, the brokering of new technology development programs and

[3]source: https://www.holstcentre.com/about-holst-centre/
[4]source: https://www.asml.com/leading-in-innovation/en
[5]source: source: https://www.hightechcampus.com/office-space/smart-industry-hub

technical services, and the acquisition of new tenants, To bring structure to this wide range of tasks, CSM created a management team of five persons. These are Frans Schmetz (Managing Director), Cees Admiraal (Business Development Director), Hilde de Vocht (Marketing & Communication Director), Jan Winges (Finance Manager), Harrie Arends (Operations Manager), and Ingrid Kantelberg as Managing Assistant (see figure 2.1).

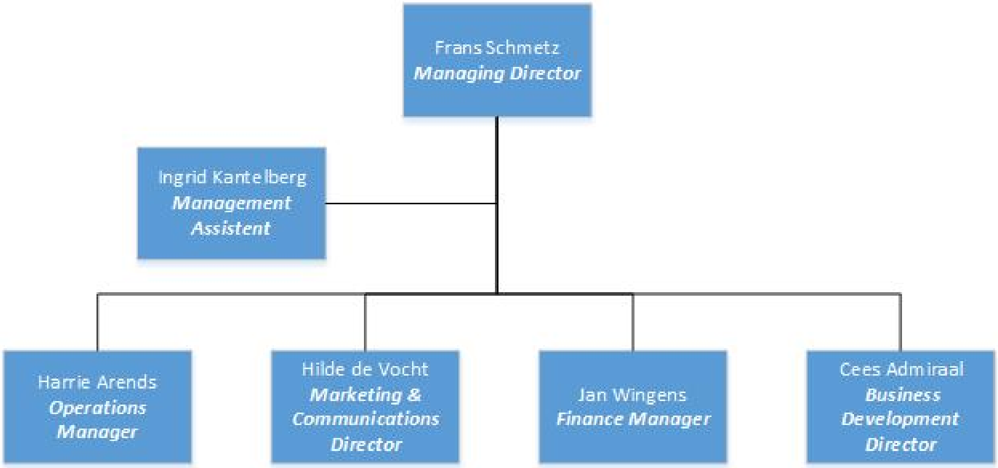


Figure 2.1: Organizational structure of Campus Site Management.

2.2.1 Mission

Since the official founding of the HTCE in 2003, the companies on the HTCE were driving research to global businesses as an international community. The mission of the HTCE was to become a global leader for research, innovation and business development in the cluster of high-tech. From 2003 to 2012, this was done by attracting new companies to the campus and by creating and sustaining an innovation community and providing access to innovation services. According to the marketing plan of 2013, their new mission is:

"High Tech Campus Eindhoven is the best location to turn technology into successful business."

2.2.2 Vision

The success of High Tech Campus Eindhoven and its resident companies are best served by a dynamic mix of global companies, SMEs, tech starters, knowledge institutes and partner competence centers. Active and creative cooperation within the important stakeholders' network of owners, investors, resident companies and public organizations will make a significant contribution to Open Innovation and crossfertilization at the Campus. The HTCE will grow their business profitably by further developing the Open Innovation ecosystem, their state of the art technical facilities and their business services. The number of high tech companies in the areas of Health, Energy and Smart Environments will continue to increase.

The goal of this research is directly linked to the mission and vision of the HTCE. To be or become the best location in the world to turn technology into business, the CSM should further develop the innovation system. However, how should they further develop the innovation system? What actions can CSM take to stay or become the best location for technology transfer? The next chapter focuses on thehapter focuses on the research design to investigate this.

Chapter 3

Planning Phase: Research Design

3.1 Context

As mentioned in chapter 2, CSM's mission statement is: 'HTCE is the best location to turn technology into a successful business.' Moreover, the primary objective is to grow the campus in a healthy way by further developing the innovation ecosystem. Over the past years, attractors for companies to settle on the HTCE were the shared clean rooms and laboratories, but also the wide variety of specialized tools, machines, and supporting research processes (van der Borgh et al., 2012). Besides, CSM has created and sustained an innovation community on the HTCE that increases the likeliness of knowledge sharing and informal networking between knowledge workers. Like any other company, CSM needs to keep reinventing its business model to stay competitive in a fast-changing global environment (van der Borgh et al., 2012). Moreover, because CSM is the orchestrator of the innovation ecosystem (Hutama Reksa Putra, 2015), they also have to keep in mind that every ecosystem goes through the phases of birth, expansion, leadership, and self-renewal or, and if not self-renewal, death (Moore, 1993). Therefore, it is essential for CSM to know if they are heading in the right direction for the future, and if not, what they can change for the future.

This gave Cees Admiraal, the CSM supervisor of this master thesis, the incentive to let somebody investigate their situation and analyze what they could do differently in the future (if needed). Besides, the client is also interested how the innovation ecosystems of Munich and Cambridge (UK) are currently functioning. Cees Admiraal explains: "Both places are very innovative, but are probably completely different as well. Therefore, it would be interesting to understand how these innovation ecosystems operate and what we can learn from them to develop our innovation ecosystem". These two questions gave shape to this master thesis. On the one hand, investigate if the HTCE and Eindhoven are well positioned for the future, and if not, what can be changed to become future proof. On the other hand, how the innovation ecosystems of Munich and Cambridge function and what CSM can learn from them.

From a theoretical perspective, there was a need to open the black box of innovations ecosystems further (van der Borgh et al., 2012). Moreover, there was a need to look at innovation ecosystems without imposing any theoretical framework beforehand. By doing this exercise, we hope to gain new insights into the relatively vague concept of innovation ecosystems.

3.2 Problem Statement

As mentioned in section 3.1, there is no direct problem related to the development or commercial activities of the HTCE. However, the campus is in a growing trend and wants to keep evolving to become a significant technology hub with a global reputation. To do so, CSM has to overcome two ‘problems’. Firstly, CSM has to gain insights in the main problems the innovation ecosystem of Eindhoven faces today. Secondly, CSM needs to gain an understanding of future trends and challenges that will occur. When both problems and future trends are visible, CSM can take actions in their power to develop the innovation ecosystem of Eindhoven. This means that development to become future-proof is likely to start on the HTCE. Subsequently, it can be expanded to the rest of the innovation ecosystem of Eindhoven.

3.3 Goals

Based on context and problem statement, we made five goals for this master thesis:

- Find new ways to ’strengthen’ the innovation ecosystem of Eindhoven to make it future proof.
- To develop actions that CSM can take to develop the innovation ecosystem further and become future proof.
- To gain insights in the innovation ecosystems of Munich and Cambridge and see if their best practices can be applied in the innovation ecosystem of Eindhoven.
- To further open up the black box of innovation ecosystem by providing insights obtained via industry experts (van der Borgh et al., 2012).
- To move towards a shared vision, among stakeholders, of what success in the innovation ecosystem would look like in the future and begin the process of developing a roadmap to get there.

3.4 Research Questions

A main research question, with some sub-questions, are formulated to come to an appropriate answer for the problem stated in section 3.2 and help achieve the goals stated in section 3.3. The main research question to be answered is:

”How can CSM ‘strengthen’ the innovation ecosystem to become future proof?”

When this question is answered accordingly, it will provide CSM with actions to ‘strengthen’ the innovation ecosystem inside and outside the HTCE. By doing so, the HTCE and innovation ecosystem of Eindhoven remain a place where companies like to position itself.

This thesis adopts a *longitudinal* view to provide recommendations for ’strengthening’ the innovation ecosystem of Eindhoven. This means that the history, current situation, and future of the innovation ecosystem should be investigated to provide insightful recommendations. To understand the history and current situation, we came up the following sub-questions:

- *How does the evolution of the innovation ecosystem look like?*
- *What are the strengths and weaknesses of the innovation ecosystem?*
- *What are the main barriers/enablers to develop well-functioning innovation ecosystems?*

These questions are asked for each of the innovation ecosystems of Eindhoven, Munich, and Cambridge. When this project answers these questions, it gives a clear understanding of the evolution and current situation. The current situation is important to understand in order to make any suggestions for the future. To gain insights into the future, we answer the following two subquestions for every innovation ecosystem. Here, the goal is to gain a sufficient amount of information that can be used in later stages in this research:

- *What are the external trends in the global environment?*
- *What are the internal trends & challenges for the innovation ecosystems?*

When both of these questions are answered, we gained sufficient amount of information about the future. The last set of sub-questions need to connect the current situation with the future. The project tackles this by answering the following set of sub-questions:

- *Which trends are the most significant forces of change for the future of innovation ecosystems?*
- *What competencies are needed in the innovation ecosystem to become future-proof against these trends?*
- *What approach should be used to strengthen the innovation ecosystem?*
- *What actions can CSM take to strengthen the innovation ecosystem of Eindhoven?*

When we clarified on this last set of sub-questions, we can answer the main research question. Chapter 4 aims to answer the sub-questions of the current situation. Chapter 5, addresses the questions about the trends and challenges. Chapter 6 and 7 target to answer the last set of questions by connecting the current situation to the future.

3.5 Scope

I used *innovation system foresight* as the methodology to investigate innovation *eco*systems. However, the levels of analysis are not exactly the same, therefore, the scope is explained according to the innovation ecosystem literature and innovation system foresight literature. Appendix A provides an overview of research background on the open innovation literature.

Innovation Ecosystem
Here, I describe which definition of an innovation ecosystem we used. The concept of innovation ecosystems has gained ground over the past years. In multiple streams of literature, like strategy, innovation, and entrepreneurship, researchers have come up with different definitions in a variety of contexts. As a result, many concepts have somewhat similar meaning. Therefore it is important to understand the definition of innovation ecosystem we used in this thesis. We do not want to focus on one single value chain. Instead, we want to focus how different actors in and around the city of Eindhoven collaborate to gain economic growth, international competitiveness, and social well-being. Therefore, in the open innovation literature, I use the definition of an innovation ecosystem presented by Carayannis and Campbell (2009):

"An innovation ecosystem is a network where people, culture, and technology meet and interact to catalyze creativity, trigger invention and accelerate innovation across scientific and technological disciplines in public and private sectors and a top-down, policy-driven as well as bottom-up, entrepreneurship-empowered fashion"(Carayannis and Campbell, 2009, p.202-203).

This definition of an innovation ecosystem leaves us enough room to identify critical players (government, university, and industry) that should strengthen collaboration by engaging in new partnerships. With regards to the literature stream of foresight, the definition of an innovation system is:

"The elements and relationships which interact in the production, diffusion, and use of new, and economically useful knowledge." (Lundvall, 1992)

Innovation ecosystem boundary
Given the open nature of an innovation ecosystem, drawing precise boundaries of an ecosystem is practically impossible (Iansiti and Levien, 2004). Also, given the exploratory nature of this study about future opportunities to strengthen the innovation ecosystem, it would be limiting if the scope is set too strict. However, some form of scope is needed to clarify what we will investigate. With regards to the open innovation literature, we studied the innovation ecosystem in and around

the cities of Eindhoven, Munich, and Cambridge.
Since we used the innovation system foresight as the methodology (section 3.6.2) a scope also needs to be set for this literature stream. According to Andersen and Andersen (2012), in foresight, there is no agreed-upon method for setting system boundaries and thus deciding which factors are external and internal. However, they do mention that it is useful to set boundaries according to the different innovation system types. Given the fact that we focus on innovation ecosystems which are in and around the cities of Eindhoven, Munich, and Cambridge, it makes sense to set the boundary as a regional innovation system (instead of technological, sectoral, or national innovation system) (Andersen and Andersen, 2012).

Unit of analysis

With regards to the open innovation and foresight literature, a unit of analysis has to be set. This study investigates the interactions between various development and commercialization actors, as well as the governance of such interactions. According to the theoretical framework presented by Bogers et al. (2017) in appendix A, this is the inter-organizational level. Also, this study aims to explore the role of one the innovation ecosystems actors (CSM) and its future actions for strengthening the innovation ecosystem. As such, the second unit of analysis are the actions of CSM. So first I will investigate how the innovation ecosystem of Eindhoven can be strengthened and then I focus on the actions that CSM can take to execute this.
With regards to foresight literature, the emphasis lies on the innovation system- and organizational layer, this will be further explained in the next section.

Time horizon

We set three time zones. Firstly, the external megatrends have a long-term vision for the future. Secondly, the internal trends and challenges have a medium-term vision. Lastly a short-term time horizon is set for present-day decisions and mobilizing joint actions to improve innovation-system performance. This will be further explained in section 3.6.2.
Table 3.1 shows the scope in table form to provide a clear comparison between open innovation literature and innovation system foresight literature.

Table 3.1: Overview of the scope setting.

	Open Innovation Literature	**Innovation System Foresight literature**
Definition of innovation (eco)system	An innovation ecosystem is a network where people, culture, and technology meet and interact to catalyze creativity, trigger invention and accelerate innovation across scientific and technological disciplines in public and private sectors and a top-down, policy-driven as well as bottom-up, entrepreneurship-empowered fashion (Carayannis and Campbell, 2009).	The elements and relationships which interact in the production, diffusion, and use of new, and economically useful knowledge (Lundvall, 1992)
Level of analysis	Innovation ecosystem level, organizational level	Innovation system layer, organizational layer
Boundary	Innovation Ecosystem present in and around the City	Regional Innovation System
Time zone	Short, medium, and long term	Short, medium, and long term

3.6 Methodology

This section describes the general methodology. Firstly, I justify the approaches used in this research. Secondly, I will explain the methodology step by step. Thirdly, data sources and cases are selected. Fourth, I present a strategy for data analysis and a plan to ensure the quality of research. Lastly, appendix B provides an overview of the planning.

3.6.1 Considerations

The goal of this master thesis is to discover opportunities to 'strengthen' the innovation ecosystem. Due to the limited knowledge available on the topic of future trends for innovation ecosystems, a qualitative exploratory research approach is most suitable for this study. Exploratory research is described as a loosely structured study that discovers future research tasks and is "particularly useful when researchers lack a clear idea of the problems they will meet during the study" (Blumberg et al., 2011, p.150).

There are multiple methods to carry out exploratory research. For example, document analysis, case studies, participant observation, interviewing and foresight (Blumberg et al., 2011). Because the project focuses on the future of innovation ecosystems, and in particular, the exploration of opportunities for creating, expanding and maintaining network links. Foresight looks like the most suitable methodology, because foresight is oriented to support the functioning and development of innovation systems, and involves mutual learning processes, by involving stakeholders and experts of many kinds (Eerola and Miles, 2011). This aligns well with the goals of this master thesis, which is to 'strengthen' the innovation ecosystem of Eindhoven. Therefore, I choose foresight as the methodology for this master thesis.

In the section 3.5, I described two *levels* of analysis according to the open innovation literature; the innovation ecosystem level and the organizational level (Bogers et al., 2017). However, foresight uses *layers* to set a scope; therefore, the levels of analysis should be aligned with the layers of foresight. According to (Dufva et al., 2015), there are multiple layers within foresight. These are the landscape, innovation system, organization, and individual layer. Table 3.3 provides an overview of the different layers in foresight. The different layers of foresight are partly overlapping, which means that there are no strict boundaries between the layers (Dufva et al., 2015).

Table 3.3: Layers in foresight. Adopted from Dufva et al. (2015)

Layer	Description	Foresight effects
Landscape	The external developments that affect the innovation systems but are hardly affected by any single measure	Anticipating global developments, trends and/or wild cards, and enhancing future-orientation of the society
Innovation system	The structure and dynamics of intertwined innovation sub-systems consisting of organisations	Increasing the capacity to reconfigure the innovation system to respond to future developments by exploring alternative futures and supporting networking between stakeholders
Organisation	The organisational culture and allocation of resources	Creating organisational future-orientation and triggering the creation of organisational responses to the anticipated changes in the operational environment
Individual	Individual capacities and capabilities	Enhancing future-oriented thinking and increasing capacities and capabilities related to anticipating possible futures

Therefore multi-layered is mostly used in foresight and so in this master thesis as well. However, it is essential to identify the layers that the foresight puts the primary emphasis on. Looking at the levels of analysis in the scope, it makes sense that the emphasis of this master thesis is in the innovation system layer in foresight. Innovation system layer focuses on the activities between actors in the innovation system while the landscape layer emphasizes external events and trends. I *do* investigate the landscape level but *focus* on the development of interactions between actors to respond to these global changes. Also, the focus of this study is not on which individual competencies are needed for the future. The emphasis on which network links should be developed to create these individual competencies.

Moreover, section 3.5 mentioned the second unit of analysis, which are the actions that can be taken by CSM. This is in line with the organizational layer of foresight because the organizational layer emphasizes on how the organization should react to changes in the operational environment and how the organization can create capabilities for renewal and survival (Dufva et al., 2015). Therefore the project also emphasizes the organizational layer. *To conclude*, most emphasis is put on the innovation system layer of foresight. Based on the results of the innovation system layer, recommendations on an organizational layer are made to CSM.
The innovation system layer contains several methodologies to perform research. I choose the methodology of innovation system foresight (Andersen and Andersen, 2012) as the leading methodology for my research. The reason for this is that the primary goal of this study (see section 3.3) aligns well with the primary objective of innovation system foresight. The primary objective of innovation-system foresight "is to strengthen the innovation system which involves building, transforming or reorienting the system by removing barriers to and promote learning and innovation activities"(Andersen and Andersen, 2012, p.22). This is precisely what I want to do for the innovation ecosystem of Eindhoven, which CSM is part of.
The last consideration is with regards to the scope of the innovation system foresight methodology. Andersen and Andersen (2012) let the researcher choose between a national innovation system, regional innovation system, technology innovation system, and sectoral system of innovation. In section 3.5, the boundary of the innovation ecosystem was set to the geographical location of a city. Therefore, the regional innovation system will be the scope of the innovation system foresight study. The next section explains the innovation system foresight methodology.

3.6.2 Innovation System Foresight

Innovation system foresight can be described as "systemic, systematic, participatory, future-intelligence-gathering and medium-to-long- term vision-building process aimed at present-day decisions and mobilizing joint actions to improve innovation-system performance" (Andersen and Andersen, 2012, p.13). To make innovation foresight a systematic process, Andersen and Andersen (2012) created a framework with three phases. The planning phase, the main phase, and the follow-up phase. Each phase consists of some processes and the processes of some steps. In the following paragraphs, I will explain the phases and the corresponding processes, as well as the steps per process. Figure 3.1 gives a graphic overview of the methodology.

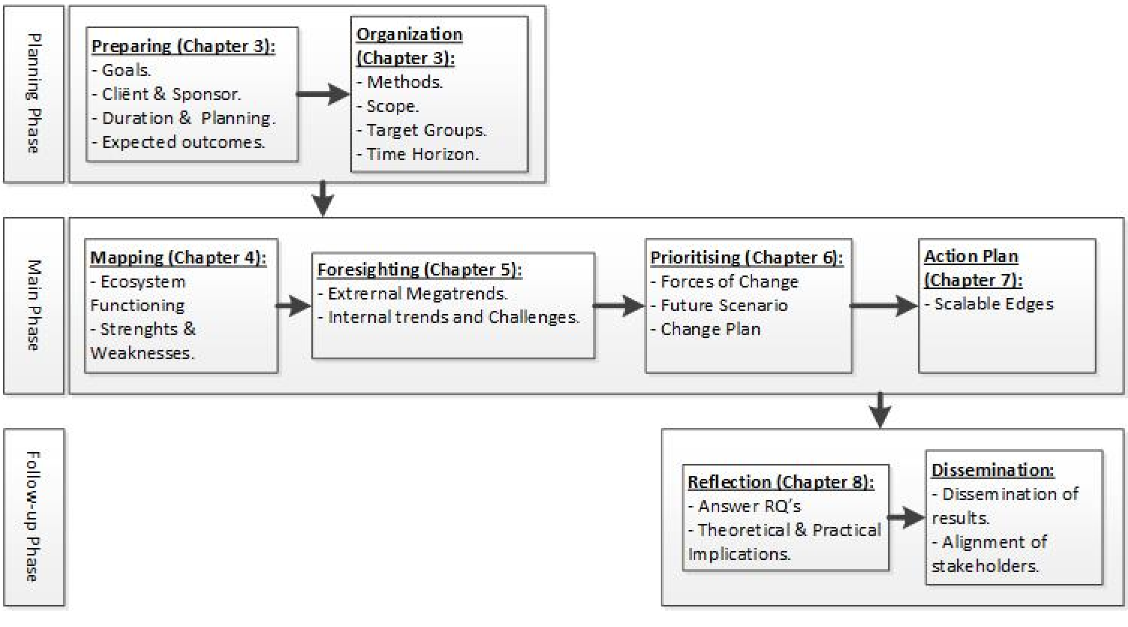


Figure 3.1: Innovation system foresight methodology.

Planning

The planning phase consists of two processes. First, the preparation process, here researcher should focus on the goal of the foresight, the sponsor of the study, which groups to target, planning, and outcomes. The second process is the organization of the foresight, here methods, scope and time horizon of the study are described. Chapter 3, 'Research Design,' functioned as the planning and organization processes of the planning phase.

Main Phase

The main phase consists of four processes; mapping, foresighting, prioritizing, and the action plan. In the first two processes, I diverged as much as possible to create as many choices that can be used in later stages of my research. This starts with chapter 4, mapping, here, the project described the evolution of three innovation ecosystems, the current functioning of them, and their strengths and weaknesses. In chapter 5, foresighting, I investigated external megatrends and focused on internal trends and challenges from the three innovation ecosystems. The goal of these chapters is to gain as many insights and information as possible about innovation ecosystem evolutions, current functioning and future (external) trends and challenges. Figure 3.2 illustrates these *diverging* processes.

In chapter 6, I *converged* all information gained over chapters 4 and 5 into two scenarios for the future. In chapter 7, I converged even further to the actions for CSM. Here, an action plan for CSM is presented how the innovation ecosystem of Eindhoven can be 'strengthened' to become future proof. Figure 3.2 also shows the converging of information.

Follow-up Phase

Chapter 8 contains the follow up phase. Here, I reflected on the entire foresight study by answering the research question and presenting the theoretical and practical implications. Last, the project was disseminated and aligned with stakeholders.

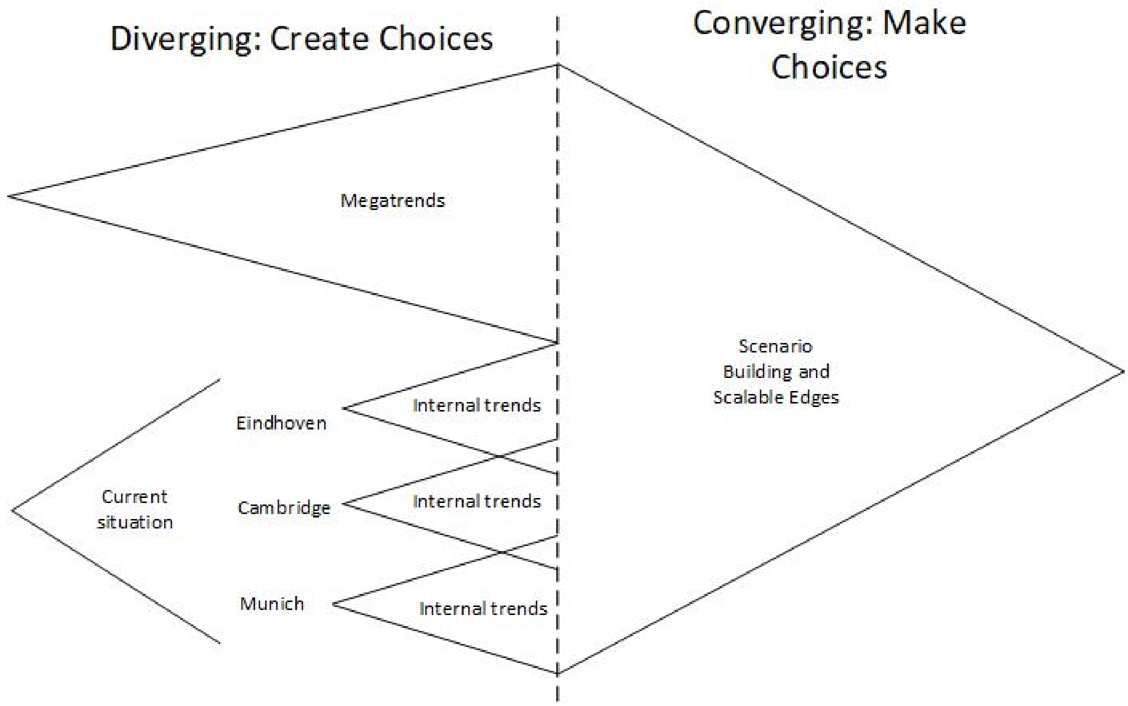


Figure 3.2: Diverging and converging processes throughout this master thesis.

3.6.3 Methods

As mentioned in the previous section, innovation system foresight is the main methodology of this master thesis. However, innovation system foresight uses multiple methods per process. In this section, I will explain the methods used per process. Appendix C provides background information on the nature and capabilities of the methods.

Method 1: Mapping
First, I used 'interviews' with experts to gain insights on how innovation ecosystems function in its current situation (choice for interviews is described in section 3.6.4). To analyze the data gathered from the interviews, I used 'the general inductive approach' (explained in detail in 3.6.5) in combination with the 'functional approach' (Bergek et al., 2008). This mapping phase had three steps: First, the 'general inductive approach' was used to find consistent patterns in the data to map the current situation. Second, I used the 'functional approach' to categorize the patterns systematically. Third, the *current situation* of the innovation ecosystems of Eindhoven, Munich, and Cambridge were cross-analyzed.
The 'functional approach' (Bergek et al., 2008) is used for the categorization because it contains a relatively well-specified guide map while keeping an open mind to the boundaries of it (Andersen and Andersen, 2012). The 'open-mindedness' of the *functional approach* provides me room to identify the important aspects of an innovation ecosystem via the *general inductive approach* and report them in a categorized way without imposing theoretical frameworks. Bergek et al. (2008) found that the performance of an innovation system is dependent on seven different functions (left column of table 3.4). However, the content of these functions comes forward out the general inductive analysis. So in the right column of table 3.4, one can find the essential aspects of an innovation ecosystem highlighted by experts. Chapter 4 explains the most important aspects per function of each innovation ecosystem.

Table 3.4: Seven key functions of an innovation ecosystem as a result of the general inductive analysis.

Function	**Important aspects**
F1 Entrepreneurial activities	(1) The entrepreneurial culture of people. (2) Which actors pursue the entrepreneurial activity? (3) Non-financial support activities present in an innovation ecosystem.
F2 Knowledge Development	To what extent is knowledge being developed in a closed or open setting within the innovation ecosystem.
F3 - Knowledge diffusion through networks	(1) The condition of the physical network links in the innovation ecosystem. (2) The level of formality of intangible networks.
F4 - Guidance of the search	To what extent and in which forms the government is active in the innovation ecosystem with regards to R&D funding.
F5 -Market formation	(1) The level of competition present an innovation ecosystem and the effects of it. (2) The dominant players and to what extent are they dominating the innovation ecosystem.
F6 - Resources mobilization	(1) The mobilization of (corporate) venture capital. (2) What kind of human capital is present in the innovation ecosystem.
F7 - Creation of legitimacy	The barriers to innovation with regards to regulations of different actors.

Method 2: External mega trends
In the foresight process, the first step was to gain a long-term future vision of megatrends that will happen with a high certainty (section 3.5). Therefore, I used a method based on evidence which is called 'Trend Extrapolation' (Popper, 2008). Trend Extrapolation uses statistical methods, such as exponential smoothing or moving averages to project the future pattern of a time series data [1]. However, the quantitative data is not gathered and analyzed by myself. Instead, I merged statistical data and megatrends of several 'mega trend' reports made by consultancies and institutions (see section 5.1). This gathering of information on emerging issues and trends on topics like politics, economics, social, technology, and environment is called 'scanning' [2]. Therefore, the second method I used is a mix of 'Trend Extrapolation' and 'Scanning.'

Method 3: Internal trends and challenges
To gather data about the internal trends and challenges of each of the innovation ecosystems in the medium term, I used the method 'interviews' again (Popper, 2008). In the second part of the interview, the interviewer (myself) asked the experts what kind of network links should be developed in the future. As well as what kind of competencies there will be needed in their innovation ecosystem. Then, I used the 'general inductive approach' (Thomas, 2003) to find consistent patterns in the data to develop common trends and challenges for the innovation ecosystems (see section 3.6.5).

Method 4: Scenarios & Scalable edges
Here, I applied a combination of two methods. First, I used normative scenarios to develop a desired future scenario. Then, I employed the exploratory method of 'scalable edges' to get to that desired scenario. This combination is also known as the zoom-out zoom-in approach; the researcher develops a long-term desired future scenario and based on that scenario it identifies two 'edges' that can be scaled over time to reach the desired scenario. These are 'edges' are identified in the present situation of the innovation ecosystem.

3.6.4 Data Sources & Case Selection

We chose three different innovation ecosystems to investigate, which are the geographical locations of Eindhoven, Munich, and Cambridge (UK). These innovation ecosystems were chosen based on the goals of this master thesis.
As mentioned in section 3.7, this master thesis is a qualitative exploratory foresight study. For this particular study, there are several options for data collection. The next parts describe the data sources that I chose. Also, Yin (2003) suggests that multiple data collection methods should be used for triangulation. Therefore, I collected data from multiple sources, which are interviews, observations, and archival data.

Interviews
One the goals of this research are to get insights into the current situation of different innovation ecosystems. Also, the client is interested in how these innovations ecosystems should be further developed in the future. According to Blumberg et al. (2011), semi-structured interviews have two main objectives: on the one hand, the researcher wants to know the informants perspective on the issue, but on the other, he also wants to know whether the informant can confirm insights and information the researcher already holds. The goals of this research and the semi-structured interviews are aligned very well because they both want to get new insights about a particular topic as well as confirming other information. Also, I found that most of the online and archival data is primarily meant to promote the innovation ecosystems. Therefore, it does not give an honest perspective of the actual current functioning and future development of the innovation ecosystem. Because of those reasons, I used a *set of semi-structured interviews as the main data*

[1] Source: http://www.businessdictionary.com/definition/trend-extrapolation.html
[2] source: https://ec.europa.eu/jrc/en/research/crosscutting-activities/foresight

source of this study.
Popper (2008) described semi-structured interviews as 'structured conversations, intended to gather knowledge that is distributed across the range of interviewees. As reported in section 3.6.6, semi-structured interviews do have some reliability issues. I countered those issues by triangulating findings of one expert at another one. Before the interviews, we developed an interview protocol for Eindhoven, Munich, and Cambridge. On top, a pilot interview for Munich and Cambridge was performed to make sure the interview protocol worked accordingly. The interview protocols can be found in appendix D. The interview protocols mainly severed as a tool to keep the conversation going as well as to steer the conversation in a particular direction. Per interview, questions were added and deleted to confirm and gain new insights.
In total, I interviewed 29 experts from May to August 2017. Of the 29 experts, nine were interviewed in Eindhoven, eleven in Munich, and nine in Cambridge. We selected the experts using the following criteria: (1) The expert has been active in the innovation ecosystem for a substantial amount of time; (2) They have a unique role in the innovation ecosystem; and (3) Others experts gave me the advice to interview the expert. These criteria created a list of experts ranging from CEOs, business development managers, angel investors, corporate investors, founders, professors, civil servants, and consultants. I anonymized the experts for confidentiality reasons. Therefore, each expert is given a code, so the reader knows which expert opinion is addressed. Appendix H provides a list of the summarized profiles of the experts. Appendix G shows the names of all experts. Most interviews were conducted in person, except for two of Munich and one of Cambridge, they were held and recorded via Skype. Also, I lost one audio file of an interview of Cambridge before transcribing it. Therefore, I could not use that interview as data anymore. The other interviews were transcribed within 24 hours after the recordings (if I was able to do so).
Approximately 36 hours of interview data were collected. The average interview time was around 1 hour and 15 minutes. According to the interview protocol, each interview was set up with 5 minutes of introduction. The following 30 minutes were characterized by a semi-structured discussion about the current situation. Then the interview proceeded into a 25-minute open discussion about future of the innovation ecosystem. Before the start of each interview, the interviewer asked for how long the interviewee was available. If this was more than 60 minutes, the interviewer extended the time proportionally over the second and third part.

Observations

Direct observations also served as a tool to collect data. For this study, I was physically located at the HTCE for a period of 28 weeks, from May 2017 to October 2017. I also went to Munich and Cambridge UK for one week each. During my period at the HTCE, I joined several meetings, some seminars, and conferences. Most importantly, I had several informal discussions with the marketing, communication, and business development manager of CSM.

Archival data

This thesis also used a variety of documents and other archival data. In particular, I consulted 'mega trend' reports of several consultancies to gather information about the landscape level (see section 3.6.2). Also, brochures, presentations, websites (blog & social media), and newsletters provide a good overview of the different innovation ecosystems.

3.6.5 Data Analysis

I used the 'general inductive approach for qualitative data analysis' to analyze the interviews (Thomas, 2003) because the purpose of this approach aligns well with the goals of my study. The main objective of this approach "is to allow research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by structured methodologies" (Thomas, 2003, p.2). Given the exploratory nature of this research and its goal of finding patterns in the data for future visions, makes this approach very suitable to use. Therefore, the following steps were executed (Thomas, 2003):

1. First, I read all interview transcripts intensively because close reading leads to an appreciation of the data and identification of themes and the definition of important parts (Corbin and Strauss, 2015).

2. Second, I executed a highly iterative process of coding the transcripts to emerging themes. In line with the general inductive approach, I let themes evolve from the data(Thomas, 2003). This iterative process involved moving between transcripts, themes, and codes. I used NVIVO 11 to structure the coding process because NVIVO 11 is developed for qualitative researchers working with very rich-based information.

3. The next step during data analysis was to map the current situation. To do so, I clustered and categorized the evolved themes to the seven different functions of the 'functional approach' (see appendix E for coding schemes). Afterwards, a cross-analysis was conducted to understand the similarities and differences of the innovation ecosystems.

4. After mapping the current situation, I performed the same iterative coding process for the internal trends and challenges of the three innovation ecosystems. These coding schemes can be found in appendix F.

3.6.6 Quality of Research

For my study, I adopted the tactics used by (Yin, 2003) to assure the quality of research. According to Yin (2003), construct validity, external validity and reliability are used to make sure that exploratory research has a certain level of quality. When testing construct validity, the researcher needs to evaluate if the models used to describe observations are appropriate to describe the phenomena (Yin, 2003).

This study assures construct validity by addressing multiple sources of evidence such as documents, observations, interviews. With the multiple data sources, a chain of evidence can be created, this is done by using a coding scheme in Nvivo during the data analysis. Moreover, the key interviewees were asked to crosscheck the interview transcript to avoid misinterpretation. Also, we reviewed the interview protocols of Munich and Cambridge.

External validity defines the domains to which the findings of an exploratory study can be generalized. The first tactic used to enhance generalizability is the choice of multiple cases. Eindhoven, Munich, and Cambridge serve as the main cases. Per main case, I interviewed several experts. These will be used as subcases to develop a view of the main case (innovation ecosystem). The second tactic that is addressed is replication logic. That means that each case serves as a distinct experiment that stands on its own as an analytic unit. The multiple cases serve as replications, contrasts, and extensions to an emerging theory (Yin, 2003)

Reliability shows that the operations of the study can be repeated with the same results. This is difficult for my study in particular since it is an exploratory study about the future. There will be threats like a respondent error, where the respondent may judge activities differently in a different situation. Next, respondent bias is also problematic, here the respondent gives desired answers to present his company in a better light. Tactics being used to counter this threat are: (1) using several highly up-to-date information sources, (2) perform triangulation between interviewees and (3) ask for examples during the interviews. A database will also be created to store all of the research data, interview data, and additional notes.

However, it is impossible to avoid errors and biases entirely. However, working with a semi-structured interview and documenting the results in a database, increases the reliability of this study and quality can be assured.

3.7 Deliverable

The deliverables of this master thesis are twofold. For the theoretical contribution, this master thesis can provide researchers with new insights about innovation ecosystems. With regards to the practical contribution, this thesis delivers two great edges that can be scaled over time to let it become the new core of the innovation ecosystem of Eindhoven. By explaining these edges, I hope to create an idea that there is a higher goal for the entire innovation ecosystem of Eindhoven and by sharing it, actors start meaningful collaborations with each other.

The deliverable marks the end of the planning phase of this study. On the next page, I will start with the main phase of the innovation foresight methodology. The first process is to map the current situation in the three innovation ecosystems.

Chapter 4

Main Phase: Mapping The Current Situation

Mapping the current situation is the first process in the main phase of the foresight methodology, and this chapter shows the results of it. As figure 4.1 illustrates, I analyzed the innovation ecosystems separately before conducting a cross analysis to find out what the main barriers/enablers are for a functioning innovation ecosystem. The separate results are stated in section 4.1, 4.2, and 4.3. Then, section 4.4 states the results of the cross analysis and conclusion of this chapter. This chapter addresses the following sub-questions:

- *What does the evolution of the innovation ecosystem look like?*
- *What are the strengths and weaknesses of the innovation ecosystem?*
- *What are the main barriers/enablers to develop well-functioning innovation ecosystems?*

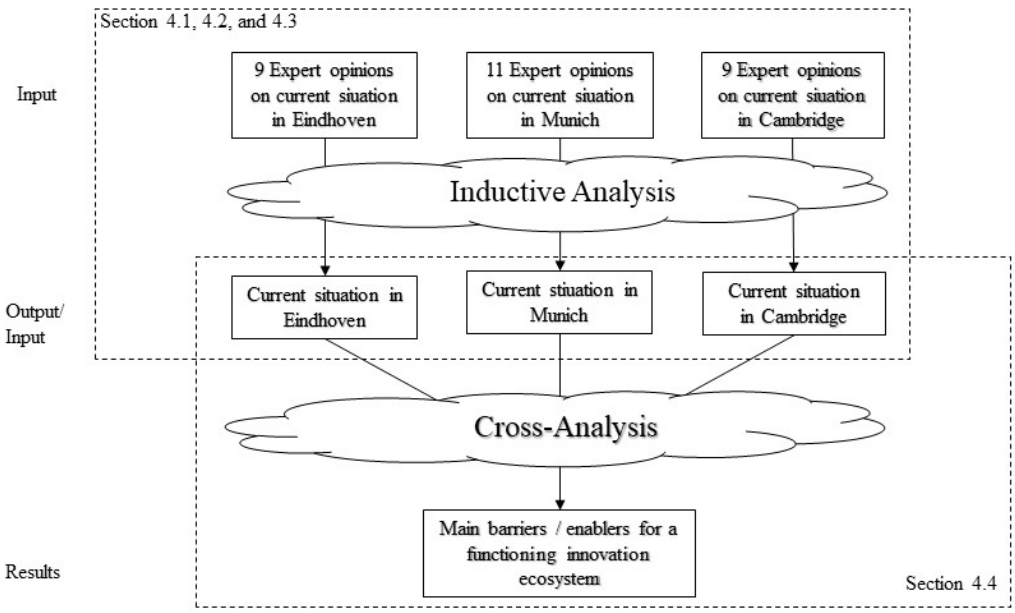


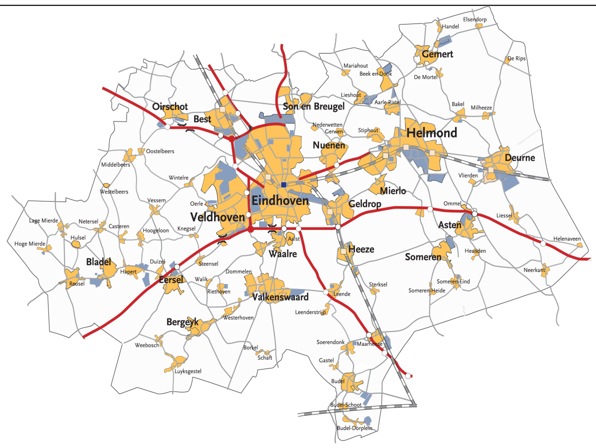
Figure 4.1: Structure and processes of chapter four.

4.1 Innovation Ecosystem Eindhoven

4.1.1 Introduction

Chapter 2 introduced the High Tech Campus Eindhoven (HTCE) as an open high-tech innovation ecosystem. The HTCE is situated in the innovation ecosystem of Eindhoven which is known for its high concentration of high-tech and knowledge-intensive industries. The innovation ecosystem of Eindhoven is mostly known as 'Brainport.' Brainport is the conglomoration of 21 municipalities around the city of Eindhoven. Table 4.1 shows the overall information of the innovation Brainport.

Table 4.1: Overview of Brain port. **source:** https://www.brainport.nl/en/about-brainport/facts-figures

	**Work force**	Approximately 401000.
	Geographic Area	25 kilometer radius centered on Eindhoven.
	High Tech Firms	6800 firms, employing over 62.000 people, with combined industry export of € 14 bn.
	Universities	Tu/e (Unversity of Technology Eindhoven, Fontys (university of applied sciences), Design Academy Eindhoven.
	Key technology sectors	Health, Energy, Mobility, Agrifood and Design (all with a focus on mechatronics, robotics and advanced materials).

Evolution

Before 1900 the Eindhoven area can be described as poor farmland with scarce resources and the local population had to work together to produce an income. But at the start of the 20th century, Philips and DAF (truck manufacturing) came to Eindhoven and started manufacturing and so Eindhoven gradually transformed into a 'company town'. In 1920 the municipality of Eindhoven was created when the original municipality of Eindhoven (the current city center) merged with the surrounding villages Strijp, Woensel, Gestel, Tongelre and Stratum. From there on, Eindhoven and the region rapidly grew into a powerful industrial area with a center role of technology development. In 1956, the The Eindhoven University of Technology (TU/e) was founded as the Technische Hogeschool Eindhoven (THE). In the early ages the University was known for its research in Automobile sector. Throughout the second part of the 20th century, several companies were established as spin offs of Philips and DAF. NXP was founded as a spin off (from Philips) which was previously called Philips Electronics, and AMSL was founded as a joint venture of Philips and ASMI. This bottom-up approach with globals spinning of departments resulted in a collaborative but still somewhat closed and corporate mindset.
However, in the 1990s, DAF went bankrupt and Philips decided to restructure its activities in the Netherlands. This had a huge negative impact on Eindhoven and also showed that a economy based on a few global companies can be very fragile. 36,000 jobs were lost in the region and Eindhoven was on the edge of disaster. However, this negative event did bring together local government leaders and together they initiated a new triple helix collaboration (Xu et al., 2015). This meant that the government, industry, and research and education institutions worked together to

attract investment for the region. They also brought TNO (Dutch governmental research institute) to Eindhoven. Until the early 2000s, the triple helix collaboration did not had a face yet. This changed when the parties created public-private partnership called 'Brainport' in 2005, with its own ambition and strategy.

Measures of performance
According to a report by Brainport (2016), there are 6800 high tech companies in the region companies at the moment, employing 61.200 people in the high tech industry. The companies in the region generate a gross regional product of € 33.5 billion, this is € 44.813 per job, compared to national average of € 39.440. Unemployment is 6.7% in the region, compared to a 6.9% national average. Also the economic growth is 3%, which is 1.5 times bigger than the national average.

Next to the core measures of performance, the Brainport (2016) report also highlights some the of key features of the Brainport region in comparison to the national averages:

1. In 2015, more people from the within and outside the Netherlands migrated to the the region than left it. As a result, the region has a increasing diversity and dynamic growth.
2. 30,000 students including 6,671 first year technical students.
3. A large proportion of the economic growth is driven by strong high-tech companies. Around € 2 Bln. of private funding was invested by the top R&D companies combined, that R&D spending is 21% of the national total.
4. Brainport has five of the top seven R&D companies in the Netherlands, combined they invest 61.5% of all the R&D spending of the companies on the list. Also the total R&D investment by the top twenty five companies decreased, while total spending of the total R&D spending of Brainport companies rose.
5. 40.1% of all patents of the Netherlands are coming from companies that are Brainport based. It must be said that the 2400 patent applications of Philips account for one third of the total patent applications of the region.

Experts interviewed
Nine experts were interviewed to gather a sufficient amount of information to describe the current situation of Eindhoven innovation ecosystem. As mentioned in section 3.6.4, these experts were selected based on their time in the innovation ecosystem, they have a unique role in the innovation ecosystem, and others experts gave me the advice to interview the expert. In table H.1 in appendix H, the experts are anonymously described via their current occupation, position and the profile of the company they work for. In the next section, I use codes like 'E1' or 'E2' to describe which expert's opinion he used in his argumentation. Table I.1 in appendix I provides an overview of the strengths and weaknesses of the next section.

4.1.2 Ecosystem Functioning

This part focuses on the functioning of the innovation ecosystem based on information gathered from experts.

F1 - Entrepreneurial Activities

All experts are aware that entrepreneurs are fundamental to the functioning of the innovation ecosystem (E1..., E8) but they also report that they current 'startup ecosystem' is not broadly developed (E1, E3, E4, E5, E9). There are three important reasons for the under developed startup ecosystem:

1. *Mono disciplinary technical university*, which means that there is little cross-fertilization present in the university which suppresses innovation (E8). Also, the university does not actively stimulate entrepreneurship throughout the student's time on it. This results in a lack of students that see entrepreneurship as a logical step during or after their education.
2. *Culture*, the people in the innovation ecosystem are mostly 'technological' minded, which means that they like to work with technology but are not driven to make a business out of it (E3, E5, E8, E9). E8 adds that a person from the south of the Netherlands is just less entrepreneurial minded than someone from the west.
3. *Capital*, which is further explained in function 6 (E4, E5, E6, E9).

However, multiple government organizations do support entrepreneurs to get funding and connect them to interesting partners (E1, E4, E6, E7). Interesting entrepreneurial activities also take place where it is less expected. For example, research institute Solliance wants to spinoff startups to produce solar cells (E6). Also, startup accelerator High Tech XL partners with global companies to offer them 'acceleration as a service;' they empower corporate employees to create new business opportunities by getting them out the department and into a three-month acceleration program (E4, E8).

F2 - Knowledge development

Most knowledge is still being developed within a corporate setting (E1, E2, E3, E8) because most companies are developing high-tech *hardware*. High-tech hardware is paired with high risk and enormous R&D investments (E8), this forces the companies to 'close' their R&D departments to ensure nobody steals their innovations. E2 criticizes the HTCE went from a single client to a multiple client campus, but that is not in line with the open innovation paradigm. He adds that open innovation *is about working together on a theme with shared programs* and none of the companies actively pursues that on the HTCE.

More 'open' innovation strategies are found at research institutes like Holst and Solliance (E2, E3, E6, E8). These are partnerships between universities, industry, and government-funded research institutes. However, over time these partnerships transform from 'open' to 'closed group' innovation (E2, E4, E6, E8). Which means that there is an open nature of knowledge sharing between the actors within the group, but the group is absolutely 'closed' to companies outside of it. "When a company wants to join our group, we first check if he is a direct competitor and then he must pay an entry fee to enter the group" (E2).

F3 - Knowledge diffusion through networks

With regards to physical network links, the innovation ecosystem in Eindhoven works well because of its limited distances between companies. Experts report that physical distances between businesses on the HTCE are minimal, which is very useful for unplanned meetings (E1, E2, E3, E7, E8 E9). For the Eindhoven innovation ecosystem as a whole, several experts mention that there is not enough exchange of knowledge workers between the TU/e and HTCE while the campuses are only 6 kilometers apart (E4, E6, E8, E9). E9 gave a possible explanation for the limited exchange: he argues that "it is not attractive for students to come to the HTCE because there is no activity after 5:00 P.M. here" (E9).

With regards to knowledge diffusion through networks, most experts report that the HTCE is doing very well getting the engineers to interact with each other on the HTCE (E1, E2, E4, E7, E8). When taking a broader scope, several experts report that there are many collaborations such as PhDs and part-time professor between the TU/e and HTCE (E8), but they also argue that these collaborations can be way more intensified (E1, E3, E4, E7, E8, E9). For example, there lies a huge potential in connecting students with mid-size companies or research institutes on the HTCE (E2, E3, E4, E9).

F4 - Guidance of the search

The government is involved in several ways in the innovation ecosystem of Eindhoven:

1. There is the governmental organization 'Brainport,' that is responsible for the promotion of the innovation ecosystem, acquires companies that want to join the innovation ecosystem, consults firms in the innovation ecosystem in several ways, and connects businesses to each other (E7).
2. The government provides various subsidies to the university, industry and research institutes. However, one expert believes that the innovation ecosystem should get rid of the 'subsidy thinking' attitude (E6). He believes that "the subsidies play a significant role in why the innovation ecosystem is doing something and we should get rid of that" (E6). Moreover, E9 argues that there is too much bureaucracy in the subsidy system and this makes them not well aligned with the whole innovation ecosystem. For example, research institute Solliance want to get long-term program funding of three years, but they have to settle with a vague system where they only get short-term subsidy (E6).

F5 - Market formation

There are three important factors to mention here:

1. E6 explains that the region thrives on a few massive companies: Philips, ASML, and NXP (recently bought by Qualcomm). ASML, the producer of photolithography systems for the semiconductor industry, has their 1st, 2nd, and 3rd tier suppliers in and around Eindhoven (E4, E8). At the moment ASML is doing great, so the suppliers too and in turn the innovation ecosystem as well. "However, this dependency creates vulnerability as well; you do not know what's going to happen with the jobs at NXP. Will they stay here or go?" (E4). On the other side, Philips has spun out companies like ASML and NXP which grew to market leaders themselves but stayed in the innovation ecosystem (E2, E4), which shows that they like to stay involved.
2. In an informal conversation E7 mentioned that the supervisory board of Brainport is too actively involved in the day to day business of the networking organization. Instead, the supervisory board should set long-term targets and let the operational team do the daily operations.
3. Although companies engage in collaborations in many forms, experts argue that on a campus level, there is a lack of cross-fertilization and shared vision (E1, E2, E3, E4, E8, E9). For example, every campus in the region is promoting their own focus areas.

F6 - Resources mobilization

With regards to the venture capital, some experts conclude that this is a problem in the innovation ecosystem (E4, E5, E6, E9). Concerning investment rounds, the first round up to one million euro is sufficiently serviced (E4, E7, E9). The second round of investment (between one and five million) is "an absolute disaster to get in the region" (E9). The main reason for this is the risk-averse nature of venture capital funds, but there is also a lack of communication between the investors.[1].

With regards to human capital, experts emphasize the balance between 'technological' and 'market' focused people as well as the importance to attract top talent to the innovation ecosystem (E2, E3, E4, E6, E8). Moreover, the people in the innovation ecosystem of Eindhoven focus too much technology and neglect the importance of finding a market for their new technology (E4,

[1]source: http://www.overondernemen.com/retail/startups/het-beste-startupklimaat-hoe-wl-een-succes-maar-gn-hype-te-worden

E6, E8, E9). This technology focus results in slow technology transfer to marketable products and a lack of promotion of the innovation ecosystem (E4, E6, E8). E4 argues that not enough technological students graduating from the TU/e to nurture the growing companies in the innovation ecosystem. Therefore, the innovation ecosystem needs to attract this talent from elsewhere. To attract top talent from anywhere else, the city Eindhoven needs to be attractive for top talent. E4 argues that currently Eindhoven is just a big village and there are little cultural offerings. In contrast, E5 (who works at a global company) says that they find it relatively easy to find top talent.

F7 - Creation of legitimacy

There are three important issues to mention here:

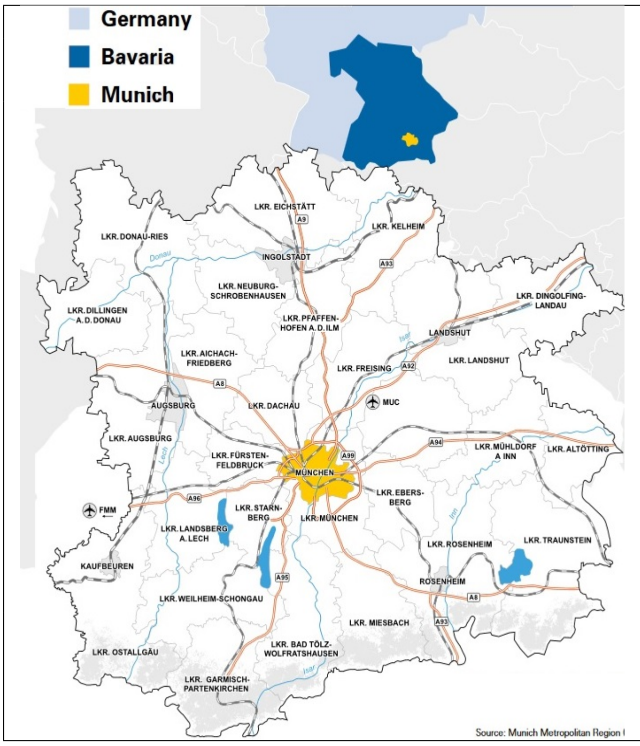
1. Although the TU/e is trying their best to create an entrepreneurial culture under students by creating shared workspaces and offer consult to young entrepreneurs, their intellectual property policy towards students and employees is still rigorous. This means that when a student or employee develops a technology, it belongs to the university (TU/e, 2015). For employees, this makes somewhat sense, but not for students because they are not employees of the university. I had several informal conversations where students were complaining about the IP rights of the university. In contrast, employees of the TU/e explained to me that the IP rights are not rigorous at all and students are allowed to keep their IP for most of the time.
2. Legislation towards investing in startups in the Netherlands is not competitive in comparison with other European countries like Belgium[1]. For example, as a founder, it is impossible to give shares to employees without having to pay taxes on them, and as an investor, it is impossible to reinvest returns without paying tax on them.
3. Innovation in high-tech hardware is paired with very high R&D investments costs, and this forces companies in the innovation ecosystem to protect their developed technology via IP (E8). At first sight, there is nothing wrong with that. However, companies like Philips have huge amounts of patents on the bookshelf while these are not being used. Technology transfer could be massively increased if Philips is not able to keep them for such a long time (E8). Instead, the patents should become available for others to use.

4.2 Innovation Ecosystem Munich

4.2.1 Introduction

Next, I went to Munich to interview experts about the innovation ecosystem to get insights of the ecosystem functioning. The innovation ecosystem of Munich does not promote itself via a single name, but the ecosystem encloses a geographic area of intense high-technology innovation activity around the City of Munich, which one of the largest contributors to the German economy. Table 4.2 shows the overall information of the innovation ecosystem of Munich.

Table 4.2: Overview of the innovation ecosystem of Munich. **source:** www.malardalsradet.se/wp-content/uploads/2016/10/6.-Block-2-Ute-Berger.pdf



Work force	Approximately 822,000.
Geographic Area	15 kilometer radius centered on Munich.
High Tech Firms	22,000 high-tech companies, with 90 of the 1,000 largest German companies headquartered in Munich, including global corporations such as Allianz, BMW, MAN, Munich Re, and Siemens.
Universities	Technische Universitat Munich (TUM), Ludwig Maximilian University (LMU), Munich University of Applied Sciences (MUAS), and Bundeswehr University Munich (UniBwM)
Key technology sectors	ICT, Automotive, life sciences, aerospace, finance, and creative industry with media.

Evolution

Munichs innovation ecosystem has been under development for the past 60 years. Just after world war two, the city benefited from large firms like Siemens who wanted to leave Berlin and needed to headquarter somewhere else, and Munich seemed like a good choice. Munich also benefited from long-term state government investments in human capital, and infrastructure development to get out of the crisis after world war two.
In the 1960s and 1970s, federal investments on military created spin-offs in microelectronic sectors around Munich and pushed the city in a manufacturing setting with a strong focus on technological innovation. Next, the state of Bavaria set a long-term R&D and innovation policy in 1970 that was meant for companies to respond to future technologies. With the use of government funding, eleven Max Planck Institutes and ten Fraunhofer institutes (including the headquarters) were established in the region as well.
After a first large investment round by the state government, they decided that a second and third round were essential for Bavaria not to fall behind economically. In 1983, the 'Bavarian Innovation Program and Bavarian Technology Introduction Program'(BayTEP) was initiated to

support technology transfer in Munich and Bavaria. This was done by investing in R&D, training, and infrastructure for Munichs key sectors.
In the 1990s, the Offensive Zukunft Bayern program was initiated to make the entirety of Bavaria fit for the future. This was done by setting up three governmental organizations: (1) Bavarian Research Foundation, which funds individual ventures and collaborative research projects. (2) Bayern Innovativ, which is responsible for the creation of networks in Bavaria. And (3) Bayern Kapital, which is a governmentally owned venture capitalist.
In 2006, the 'Cluster Initiative' program was initiated to create and manage 19 technological clusters. Cluster management was responsible to facilitate networking and collaboration among firms, venture capitalist, and research institutes. Between 2012 and 2015, it was the cluster managers job to get these clusters 'world class' and at the same time, the cluster needed to become self-sustaining. For the government, the cluster initiative streamlined the funding programs, and for the companies, it created transparency in the market.
When looking at the evolution of the innovation ecosystem of Munich (and Bavaria), one can see that there has been a lot of top-down level involvement. Meaning that the government has played a significant role in shaping the innovation ecosystem as it is today. Also, the innovation ecosystem started with many corporate companies deciding to relocate their businesses to Munich. These corporate companies grew based on individual successes with the use of government funding. In their success, they grew the German mittlestand as their first and second-tier suppliers. Overall, this resulted in a very competitive and corporate mindset over the entire Munich ecosystem.

Measures of performance

According to reports by City of Munich (2016, 2017), there are 22,000 high tech companies in the region at the moment, employing around 157,300 people in the high tech industry. The companies in the region generate a gross regional product of € 165 billion, this is € 92,876 per job, compared to national average of € 41,936. Unemployment is 4.3% in the region, compared to a 6.1% national average. Also the economic growth is 4.9%, which is twice the national average.

Next to the core measures of performance, Clark et al. (2016) also highlight some the key features of the Munich region:

1. A highly competitive manufacturing sector, including an 80 billion car industry (e.g., Audi, BMW, MAN) and an advanced aerospace cluster (e.g., Airbus, IABG, and MTU)
2. Biotechnology and life science clusters, which now employ around 30,000 people in over 400 companies, many of which are anchored by the Max Planck Institute for Biochemistry
3. Munich possesses a very diverse and mature innovation economy and is responsible for 10 to 15% of Germanys patents.
4. 119.375 students in Munich, of whom 19,748 (16.5 %) were foreign students (City of Munich, 2016).
5. New businesses registered in 2016: 17,696 (excluding freelance start-ups are excluded from these statistics) (City of Munich, 2016).

Experts interviewed

Eleven experts were interviewed to gather a sufficient amount of information to describe the current situation of Munich's innovation ecosystem. As mentioned in section 3.6.4, I selected these experts based on their experience in the innovation ecosystem, their unique role in the innovation ecosystem, or others experts gave me the advice to interview the expert. In table H.3 in appendix H, the experts are anonymously described via their current occupation, position and the profile of the company they work for. Table I.3 in appendix I provides an overview of the strengths and weaknesses of the next section.

4.2.2 Ecosystem Functioning

F1 - Entrepreneurial Activities
Most experts report that risk averseness is still very common in Germany (M1, M2, M4, M5, M6, M9, M10, M11), but there is a shift from working for a global company to starting an own business (M2, M4, M6, M10). Older generations have problems understanding why somebody wants to work for a startup (M1, M2, M3, M4 M7), so when a millennial fails a startup, he or she generally only has the startup community to fall back on (M2, M4). With regards to startup facilitation, there are lots of activities going on! Most universities have a startup accelerator/incubator, and they also host joint startup events (M2, M4,..., M8, M10). M7 notices that there is a strong competition between university accelerators, which negatively affects the ecosystem; the universities want to have startups because then they promote themselves as an entrepreneurial university. However, they are less interested what is good for the startup, therefore, limiting the potential growth of the startup. Support for entrepreneurial activity comes from most big corporates, they all have a startup accelerator and CVC fund (M2, M4, M6,..., M10). However, most corporates lack idea on how to execute this task (M4, M7, M9). Not so long ago, the Fraunhofer Institute also successfully started contributing to the startup ecosystem by sharing their IP and research facilities to startups in return for equity (M9).

F2 - Knowledge development
Experts explain that companies are still closed with regards to their innovation projects because German engineers are very proud of their capabilities and don't like other people telling them what to do (M3, M6, M9). Four experts would like to see the innovation ecosystem a bit more 'playful' and not so focused on efficiency, meaning that you make time for 30 minutes to talk with somebody about their ideas (M3, M6, M7, M8, M9). M4 adds that CTO's as well as startups are very protective towards their innovations, there is not a curiosity on how to learn from each other and benefit from each other.
Open models are present in the *active* technology clusters of the 'Bayern Cluster Initiative' (M1, M11). Here, mainly SME and corporates join forces to set up joint R&D projects to get a subsidy from the government. Companies from outside Germany can join as well, but they should have a German entity if they want to participate in funding programs. Critics mention that these clusters are being managed more as technology interest groups and that makes them slow and inefficient with regards to technology transfer (M2, M4, M7, M9, M10).

F3 - Knowledge diffusion through networks
The physical distances between actors in the Munich region are significant. Munich partly solved this by an excellent public transport system. However, because Munich's size there is a low chance of having a random exchange of information. The 'cluster initiative' has partly solved this by creating transparency of the different sectors that are present in Munich (M1, M11), this meant that companies could network more efficient within their sector (M1, M3, M6, M11). There are also many events organized by different actors of the innovation ecosystem (M4, M5, M6 M7). However, only a few events that are organized well and create value for the participants, 'Bits and Pretzels' is a good example of such an event. (M4, M5, M7, M9). Others are just more of the same and M9 makes the statement that there should be more innovative events. "We are tired of seeing startups pitch their ideas to globals again, we need something different" (M9). Another aspect that experts report is to keep people in the innovation ecosystem, meaning when if you cannot help them, make sure to send them to somebody else within the network (M2, M4, M5, M7, M9). This way you keep people engaged, and they will be more likely to give something back to the innovation ecosystem as well.

F4 - Guidance of the search
The government is involved in many ways in the innovation ecosystem of Munich. They started the 'cluster initiative' to cluster the companies based on technology to streamline funding programs (M1, M2, M3, M4). However, this might have created an effect the government did not

want because this has made companies very reactive (M2, M3). "They innovate in a particular technology because of the government subsidies that particular technology" (M3). With regards to funding to startups, M9 explains that 'BayStartUp' is a "good example of something you can do with government funding" (M9). BayStartUp professionally connects startups and business angels and possibly funds them as well. Also, "BayernInvest is a venture capitalist who is owned by the government. Their investment goes up to 2 million." (M10).

F5 - Market formation

Experts report that the Munich innovation ecosystem is part of the D-A-C-H region (South-Germany, Austria, and Switzerland), which is an economically strong region with much B2B activity (M1, M3, M6, M11). However, this region is not institutional like the 'Cluster Initiative'. Also, there are a large number of global companies headquartered in Munich. These factors are a blessing and a limiting factor for the startups and SMEs (M2, M4, M5, M7, M10). The blessing is "that you have your potential customers right in front of your door" (M4, M7). The limiting factor is that startups are not being challenged to look further this particular region and that could limit the growth potential of them (M2, M3, M6). Experts also argue that the economy is too dependent the car industry (M3, M4), if "the big mommy goes somewhere the rest follows" (M4). Large companies also have the support of the government, which in turns sets the funding programs and by doing so, they push the SMEs in a technological direction in line with the globals (M3, M4, M6).

F6 - Resources mobilization

With regards to capital for growing startups, expert highlight three factors. Firstly, there are a lot of rich people and families (of the typical mittlestand) around Munich, but they are very risk-averse to invest in startups. M8 explains that he asked this them about investing in start-ups: "They immediately think about the 2000 bubble, and they are like, yeah, I tried that. No, thanks." (M8). Secondly, venture capital is present but limited and very risk-averse as well. Managers first want a proof of concept, before they invest in a startup (M2, M7, M8, M9). The TUM has created its own VC to counter this factor. When there is a first 'believer,' it is easier to convince other VC's as well (M2, M7, M10). Thirdly, every global company has its own CVC fund to invest in startups. However, the CVC managers are risk averse and have a nonbeliever mindset (M7, M9, M10). Meaning that CVC managers' decision-making is on data rather than vision since they "won't get a promotion if the startup is not successful" (M7). M4 criticizes that there is a bubble being created in VC and CVC, startups solving problems that everybody can relate to, but their technology is not interesting at all. Also, a lot of corporates are trying to invest in startups, but they have no idea which venturing activities work and add value for both parties (M4, M8, M9). With regards to human capital, experts report that Munich has many skills in hardware and the back-end software (deep learning, AI) (M4, M8, M9, M10). However, there is a lack of disruptors, people that can dramatically change business models (M2, M3, M4, M7, M9, M10). Next47, accelerator and CVC of Siemens, tries to tackle this problem by letting startups do a proof of concept project. Here, Next47 lets them do the technology, the process process and business model for Siemens (M4).

F7 - Creation of Legitimacy

Munich is a city with very high living costs (M3, M5, M6, M9, M10). Therefore, if someone wants to start up a business, he or she has to be dead serious about it (M5). Also, there are a lot of large enterprises that offer graduates an excellent salary, so it gets even less attractive to take that chance of setting up an own business (M3, M5, M7). For example, "If I can go to BMW as an engineer and then start with a salary of € 75,000, or I get nothing when I start my own company, what will I do?" (M7). Then there are also quite strict investment regulations in Germany which make investors even more risk-averse (M2 M4, M7, M9). For example, when a corporate investor invests in a startup, it has to pay 19% tax over the investment. A consequence is that one corporate startup accelerator even forbid their startups to talk to the corporate's competitors (M9). This impacts the growth potential of a startup significantly.

4.3 Innovation Ecosystem Cambridge

4.3.1 Introduction

Last, I went to Cambridge to interview experts of the Cambridge innovation ecosystem. Like Eindhoven, Cambridge also gave the name to its innovation ecosystem. It is mostly known as the Cambridge Cluster, but Silicon Fen, and the Cambridge Phenomenon are also used. The Cambridge Cluster is a geographic area of intense high-technology innovation activity encompassing the City of Cambridge. It sits in the wider region of the East of England, one of the fastest growing and most innovative regions in the UK. In table 4.3, the key features of the Cambridge Cluster are shown.

Table 4.3: Overview of the innovation ecosystem of Cambridge. **source:** Minshall and Gill (2013) and University of Cambridge (2017)

Work force	Approximately 600,000.
Geographic Area	40 kilometer radius centered on Cambridge.
High Tech Firms	over 4700 high-tech companies, employing over 60,000 people and have a combined turnover that is over € 13 billion.
Universities	University of Cambridge, Anglia Ruskin University, The Open University.
Key technology sectors	Information technology (hardware and software), mobile telecommunications, biotechnology, electronics (inc. plastic electronics), instrumentation, nanotechnology, inkjet printing, technology consultancy.

Evolution

The origin of the Cambridge cluster can be traced back to the 13th century when the University of Cambridge was created. However, the modern innovation ecosystem of Cambridge is in development over the past 55 years. Many people believe that the University of Cambridge is central to the birth of the Cambridge Cluster. However, that is not the case. The university played an indirect role because the founders of the Cambridge Consultants went to school at the University of Cambridge (Kirk et al., 2012). The initial creation of the *modern* innovation ecosystem can be traced to 1960 when the Cambridge Consultants were formed. The Cambridge Consultants were essential to the birth of the innovation ecosystem because this is where the first founders of the high-tech startups were born. Another important factor was that Trinity College established the Cambridge Science Park in 1970 which was the first business park of its kind.
As mentioned before, the University of Cambridge was not directly involved with the creation of the innovation ecosystem but it did play a central role in the evolution of it (Segal, 1986). Because of the Mott report of 1969, the University of Cambridge changed its mind about commercializing developed technology from the university (Kirk et al., 2012). The Mott report recommended the expansion of a 'science-based industry' in Cambridge. This recommendation was based on a case

study at MIT and Stanford. The university changed two important aspects. First, the terms of employment of staff. Where other universities have terms with very little flexibility, academics at The University of Cambridge have considerable autonomy, but an informal system of checks and balances ensures close attention to teaching, research and administrative duties (Segal, 1986). Second, policy towards commercial exploitation of academics know-how and links with industry. Where other universities want some control over the relationship, the University of Cambridge had a *hands-off but positive attitude* towards university-industry links. This means that staff and students are free to interact with industry and "the Universitys financial interest is protected only to the extent that it insists that if its physical facilities and other resources are used in the course of private work, they should be commercially costed and paid for"(Segal, 1986, p.197).
In 1985, Charles Cotton and Kate Kirk wrote 'the Cambridge Phenomenon', where they highlighted the key success factors of the Cambridge innovation ecosystem. By this time, there were about 360 high-tech companies present and active in the Cambridge cluster. Between 1985 and 2000, the innovation ecosystem experienced a rapid expansion reaching over 1300 high-tech companies. Networking companies for It, biotech, wireless, cleantech, and agri-tech popped up and started to link the universities, research institutes and enterprises in these sectors to create a collaborative innovation ecosystem. During this time, the high-tech companies also received government funding. However, the development of the Cambridge Cluster has been mainly bottom-up and without top-down public financing.
Interestingly, throughout the development of the innovation ecosystem, most of the high-tech firms of Cambridge cluster did not grow to a large corporate. However, there are global success stories such as Acambis, ARM, Autonomy, CSR and Domino Printing Sciences. Their stories attract large corporates to do their R&D activities in the Cambridge Cluster. Firms like Philips, Microsoft, Apple, and Unilever either bought their way in or started an own research and development lab. The companies that bought their way in the innovation ecosystem kept their acquired companies completely intact. This shows that they do not just want to get their hands on the technology, but also be part of the innovation ecosystem.
In 2013 AstraZeneca announced that they are going to move their global headquarters to Cambridge. This would be the first multinational from outside the Cambridge Cluster who has done this. In the same year, the University of Cambridge established Cambridge Innovation Capital, which serves as a long-term venture capitalist for high-tech startups in Cambridge (this will be further explained later). 2016 marks the year of the first billion-dollar acquisition of a firm founded in the Cambridge Cluster. This is the exit of ARM, which has been acquired by Soft Bank.

Measures of performance

According to reports of University of Cambridge (2017) and Minshall and Gill (2013). There are currently 4,700 knowledge intensive firms in the Cambridge Cluster, employing over 60,000 people, with a total turnover over € 13 billion. Unemployment is 2.1%, compared to UK average of 7.8% and the there an value added per job of € 49,455, compared to national average of € 43,300.

Next, to the core measures of performance, Minshall and Gill (2013) also highlights some the key features of the Cambridge cluster in comparison to the national averages:
international high-tech clusters. These include:

1. People and technology of the University of Cambridge have been in the center of 300 new high-tech ventures in the past 20 years.

2. Startup in which the University holds an equity stake have the highest amount of venture capital invested in it across all the UK.

3. Significant scientific discoveries and inventions have been made at the University of Cambridge. This is reflected in the fact that the University has more Nobel prizes than any other university in the world and is consistently ranked as one of the top four universities worldwide.

4. The European Commission ranked the Cambridge Cluster as an excellent innovation ecosystem for its support to innovative startups.
5. 12 Companies have been valued at over 1 billion dollars in the past 15 years: Abcam, ARM, Autonomy, AVEVA, CAT, Chiroscience, CSR, Domino, Ionica, Marshall, Solexa, Virata.

Experts interviewed
Nine experts were interviewed to gather a sufficient amount of information to describe the current situation of Munich's innovation ecosystem. As mentioned in section 3.6.4, I selected these experts based on their experience in the innovation ecosystem, their unique role in the innovation ecosystem, or others experts gave me the advice to interview the expert. In table H.5 in appendix H, the experts are anonymously described via their current occupation, position and the profile of the company they work for. Table I.5 in appendix I provides an overview of the strengths and weaknesses of the next section.

4.3.2 Ecosystem Functioning

F1 - Entrepreneurial Activities
When I asked the experts about the entrepreneurial activities, most of them reported that there is a culture in Cambridge about doing something 'good' (C1,..., C4, C9). In contrast with Silicon Valley, where the mentality is that the winner takes it all (C1, C3, C9). According to C1, Cambridge graduates are the most employable graduates in the world. He also mentions that Cambridge a safe place to do risky things and being entrepreneur is a risky thing to do. "However, that doesn't mean that Cambridge makes your idea successful, but you will have a greater chance in Cambridge" (C1). A lot of mentoring done by serial entrepreneurs because they are a very generous society which creates a supportive community. This results in much entrepreneurial activity coming out of the university, but also people who work at a technology consultancy or larger firm are eager to start their own business (C1, C2, C6, C8). Moreover, many people recycle themselves in the innovation ecosystem, creating a healthy mix of experienced and inexperienced entrepreneurs (C1,..., C9). Also, experts report that the current focus is on scale-ups rather than startups because that is where the potential lies (C1, C2, C5, C6). C2 elaborates that a startup is just and idea and a scale up is growing an actual business.
The innovation ecosystem is helping the scale ups by providing multiple services like incubators and make-spaces. At the moment, the Bradfield Centre is being built on the Cambridge Science Park and will become home to 500 entrepreneurs (C4, C7). "Theres much work going on that makes sure the Bradfield Centre is not just a pure property play, it is about growing the ecosystem" (C4). Although most technology developed in Cambridge is software related, there are four 'make spaces' for the biotech industry in Cambridge (C2, C4). These make spaces are for example shared laboratories with technical infrastructure (C4). The university is also reasonably open to let startups use their labs. This is mostly done when the startup is licensing some IP from the university. Then, the University is eager to help to speed up the commercialization process (C2, C3, C4).

F2 - Knowledge development
Experts report that one of the strengths of Cambridge is that there is research and development of *fundamentally* new ideas going on across multiple sectors (C1, ..., C9). Until the technology becomes commercially sensitive, people are very open to discuss it (C1, C2, C7). Open models are found in collaborations between the University of Cambridge and Bioscience research institutes. Here, the researchers "have one foot in the university and the other foot in the research institute" (C1). Closed models are found between the technology consultants and their customers. However, the technology consultants do contribute heavily to the knowledge development of the Cambridge innovation ecosystem, because they "attract tech talent from all over the world and train them to deliver on time and so on.[...]. So you have to get competent in the tech and business side to survive in that world" (C1). The skills that engineers learn at the consultants can be used later they want to set up a company (C1, C2, C3, C4, C6, C8, C9).
C1 and C2 report that many international organizations either buy their way in or set up own

R&D activities in Cambridge to get insights into the innovation that is being done in the Cambridge cluster. C2 adds that when global companies "come in and act badly so to say (only buy for the technology and not the company), then quite often the Cambridge people just turn around and go do something else. So a big company that comes in has to behave very well to keep the talent of the acquired company." (C2).

F3 - Knowledge diffusion through networks

With regards to the physical network links, experts report that Cambridge is suffering badly (C1,..., C9). The infrastructure does not keep up with the speed of expansion of the Cambridge Cluster (C1). The underlying reason for this problem is that the Cambridge Cluster was hardly planned at all (C3) therefore, no governmental institution feels responsible for it. However, because nobody planned the Cambridge Cluster, it meant that an informal network was purely created because people were interested in each other's activities. Moreover, experts report that the main strength of Cambridge is that many people recycle themselves in the informal network and stay engaged with the next generation (C1, C2, C3, C4, C8, C). On top, all of this is happening in a tiny town with only 125.000 people. As C2 explains: "So when I walk into town, I always meet somebody and can say hello. That makes it very different from London or Eindhoven even. We all know each other and are very business focused, that is very interesting." (C2). However, because there are many things happening in Cambridge, people are less interested to look outside of it. Therefore, outsiders find it difficult to connect to the Cambridge innovation ecosystem and this can become more problematic when the Brexit becomes a reality (C3, C4, C5). C4 explains that when he moved to Cambridge and wanted to get involved with the local community, he had to prove himself before he was allowed in. He did this by doing pro bono activities for more than two years (C4). This example shows that the informal network is mainly build on thrust and social connections between people.

Apart from the informal networks, there are also several cluster network membership organizations like 'One Nucleus' for life sciences, and there is a cross-cluster network membership organization called 'Cambridge Network.' Cambridge network " builds bridges between the university, the technology companies, and to the outside world"(C2). Interestingly, this organization is not funded by the government and according to C2 that makes them "much thriving and having to work hard and prove that they are valuable for the companies" (C2).

F4 - Guidance of the search

Experts report that the development of the innovation ecosystem has been done without direct funding from the government (C1,..., C6). C3 explains that Cambridge is one of the few areas in the UK that has a positive input on national finances, which means that it pays more tax than it gets back in subsidies. This is also one of the biggest problems for the growth of the Cambridge Cluster because it needs funding to build improved infrastructure and public transport (C3, C4, C5). Besides government financing for infrastructure, C6 reports that there are many subsidies, but these are mostly indirect to startups and other companies. For example, government tax incentives, R&D tax reduction for the development of new products.

F5 - Market formation

All experts report that there is not an overarching entity that directs the Cambridge Cluster in a certain direction because that does not work with a lot of bright minds together (C1,..., C9). Companies are primarily B2B focused, the domestic market is relatively small, and so businesses tend to concentrate on the global tech market. The outward-looking focus results in coopetition rather than competition in the Cambridge innovation ecosystem (C1, C2, C9). Although the 'Cambridge' brand is strong outside of Cambridge for its world-class education(C2, C7, C9), experts argue that there is a lack of corporate companies in the Cambridge Cluster. Therefore, Cambridge is not getting the credit it deserves (C4 C5, C8, C9).

F6 - Resources mobilization

With regards to mobilization of financial resources, there are three VC's present in Cambridge and

a lot of VC's that invest in startups but are not Cambridge based themselves (C4, C5, C6, C9). One interesting VC fund to highlight is Cambridge Innovation Capital; it is "a source of capital that can get a startup from seed all the way through an exit and support the founders along the way" (C9). However, experts do argue that there is not yet enough risk capital in the innovation ecosystem. So there tends to be a discrimination between the best and medium startups (C1, C2, C3, C6, C9).
There were five active angel investor groups in Cambridge but now there is only one left. This is because people in the other groups were getting old and quitted their angel roles. The result of investors quitting and others reaching their capacity, is that the financial capital is lower than it was before (C3, C4, C6, C9). Next to that, experts report that CVC is not common in the Cambridge Cluster, but if it is done, then it is mainly done in the form of acquisitions or internal projects (C6, C9).
With regards to human resources, experts report that the University of Cambridge is a great supplier of highly skilled people (C1,..., C9). However, soft management skills, marketing expertise are lacking in the Cambridge Cluster (C1,..., C6, C8, C9). There are plenty of startups created around a new technology. However, lots of these startups reach their limit of around 250 employees because the soft management skills and marketing expertise are lacking in the founders (C1,..., C6, C8, C9). C4 adds that when he ran a company in Cambridge, the sales were being done in London and later in New York because there was no sales expertise available in the Cambridge Cluster.

F7 - Creation of Legitimacy

Most experts report that local and regional government is scattered and the intention the grow the Cambridge Cluster is not present at the in these levels (C1,..., C9). For example, a local consular said to E3 off the record: "I think the science park is a good idea, but because it is being built on the greenbelt, I must say no for the public opinion" (C3). Moreover, three different members of parliament represent the Cambridge Cluster and have conflicting views and belong to different parties (C3), this makes change very difficult to do realize.
Besides the problems with the local government, several experts also highlight the high cost of living (C2, C3, C4, C6). "If you could find a house, that is already a miracle. But paying for it is another miracle"(C3).

4.4 Cross Analysis & Conclusion

This section has two parts, first I will perform a cross analysis of the three innovation systems to investigate the main similarities and differences. Then, I will conclude this chapter by presenting the main barriers to the functioning of the innovation ecosystem of Eindhoven..

4.4.1 Cross Analysis

History
The history of the three innovation ecosystems is massively different and this has a significant impact on the current functioning of them. One can argue that Cambridge has the longest and richest history of the three, with its 800-year-old track record of excellence in science and academics. However, the modern Cambridge Cluster is post-war just like the other two. In line with Blasini et al. (2013), Cambridge developed itself bottom up, meaning that there was minimal government involvement during the development. Munich, on the other hand, started post-war with global companies which grew even larger together with their suppliers in the region and getting mayor government support (top-down development). Eindhoven experienced a bottom-up approach as well because one can argue that Philips spun off departments which in turn grew to global companies themselves. In turn, they boosted their local suppliers as well.

F1 - Entrepreneurial Activities
Based on the the expert opinions, one can argue that entrepreneurs in Munich are still very risk-averse. To counter this, there are many government service providers to help them to set up their business. The mindset of the entrepreneurs in Eindhoven is somewhat less risk averse than their German counterparts. However, the southern culture of people is just not very entrepreneurial. Cambridge, on the other hand, has a more mature startup ecosystem. Experts reported that there are enough startups are being created and the real focus in on scaling up the businesses. On top, Cambridge already experienced multiple generations of successful entrepreneurs that stay engaged in the innovation ecosystem. Experts of Munich and Eindhoven reported that their startup ecosystems are still young and there are not yet successful entrepreneurs that are willing to recycle themselves in the innovation ecosystem. These findings agree with the 'The Global Entrepreneurship Index' (Ács et al., 2017), where the United Kingdom is placed highest of the three, then the Netherlands and last Germany. It must be stated that this index is nationwide, therefore, it generalizes the whole country and does not focus on Eindhoven, Munich and Cambridge specifically. However, it still provides some generalizability to my findings because they show similar results.

F2 - Knowledge development
With regards to knowledge development and the openness of it, all three innovation ecosystems are being nurtured by high-level universities. And although there is a significant size difference between the universities, experts in all innovation ecosystems are arguing that there is not enough talent present. Open innovation models are present in different forms. Where Eindhoven and Munich do have more formal open models like the 'Institutional model' of Solliance and 'cluster initiative' of BayernInnovativ, Cambridge has more informal models like the 'hands-off' approach of the University of Cambridge. The closed models are most prominent in Eindhoven and Munich because of their corporate culture in the ecosystem.

F3 - Knowledge diffusion through networks
Eindhoven and Cambridge have an advantage here since physical distances are much smaller than in Munich. However, Munich has minimized this disadvantage by investing lots of resources in excellent public transport. In contrast, experts in Eindhoven and Cambridge argued that infrastructure and public transport are lacking behind with economic growth of the city. Knowledge diffusion in the Cambridge Cluster is mainly done via a strong local informal network. This strength is also its weakness because everybody is very well networked with each other within the Cluster, and therefore it becomes less open for people outside of it. The innovation ecosystem of

Eindhoven is characterized by its campus-based ecosystems. There is a strong feeling of being a part of a community on the campus, but the sense of being part of a bigger community is lacking. Because of the size of Munich, knowledge mainly flows through formal technological networks like the 'cluster initiative,' where people meet each other on technology specific events. Also, a shared vision is not present.

F4 - Guidance of the search

With regards to government support for R&D, experts in Cambridge report that firms in Cambridge are mainly business driven and receive minimal government funding. In contrast, experts in Munich argued that there are long-term financing programs in technology domains, but this has made firms very reactive with regards to innovation. They innovate in a technology domain because the government funds this domain. Experts in Eindhoven argued that R&D funding is mainly short term with the attitude of keeping everybody happy, this results in a lack of focus in technology domains.

F5 - Market formation

Perceived competition in Munich is high because most companies are serving the same regional market (D-A-C-H). As Blasini et al. (2013) also describes, "the Munich innovation region is much more characterized by competition and profiling than by integration and we-are- Munich-spirit. The players are so successful because they are fierce competitors" (Blasini et al., 2013, p.21). In Cambridge the opposite happened, there is no local market and this forces firms inside the innovation ecosystem to act globally. Because of this, experts mention that the level of competition is low in and people are open to share information with each other. The problem for the Cambridge Cluster lies in the lack of self-promotion and competition of surrounding clusters like London, but also smaller cities are trying to compete with the Cambridge Cluster instead of collaborating with each other. Like Cambridge, Eindhoven innovation ecosystem does not experience a fierce competition between companies in the region, because of its small local market. However, on a campus level, there is a lack of shared vision to promote the entire innovation ecosystem. Instead, everybody is promoting their campus, and there is no single message to the outside world.
In Munich, global companies do still have much power to direct the innovation ecosystem in a particular direction. In Eindhoven, there are a few global companies as well, but they have less influence than their German counterparts. In Cambridge, there is the least control over the innovation ecosystem. Experts are even arguing about a lack of control and if Cambridge wants to keep growing in the future, somebody has to take control over the innovation ecosystem.

F6 - Resources mobilization

All three innovation ecosystems struggle with the mobilization of financial resources to survive the 'valley of death.' Experts in all three innovation ecosystem argue that, compared to silicon valley, there is not enough risk capital in the ecosystem to grow scale ups. The type of financial resources in Munich is mainly corporate venture capital and venture capital. However, these are both very risk-averse, and the ecosystem lacks believers. Experts in Eindhoven report similar problems. Experts in both ecosystems explained that the startup ecosystems are still quite young. Therefore, they do not have rich individuals with an entrepreneurial mindset who are willing to invest in startups themselves. In Cambridge, experts mention that capital mainly comes from venture capital funds and deep-pocketed business angels. Over the past years, Cambridge has seen the activity of both angels and VC funds decrease, and this creates a gap in funding.
With regards to the mobilization of human resources, experts from all three ecosystems explain that there is a lot of talent present with a 'technology' mindset. But to grow the innovation ecosystem, the ecosystems need to attract more talent to the city. However, in all the places there is an even bigger need for talent with a 'market' mindset. This will be further explained in the next chapter.

F7 - Creation of legitimacy
Munich suffers from the worst investment tax regulations. In Eindhoven, the regulations are better, but there is not a competitive investment climate. Experts in Cambridge did not mention any problems here. Also, the IP regulations from the TU/e (Eindhoven) are not supportive towards technology transfer. While in Cambridge experts highlighted the openness the University has with regards to their IP rights. A shared challenge for Cambridge and Munich is the high cost of living, while experts of Eindhoven do not mention this factor at all.

4.4.2 Conclusion

During the analysis of the three innovation ecosystems, I identified four important barriers for the further development of the innovation ecosystem of Eindhoven. Recall from section 3.4 that one of the sub-question was about the barriers and opportunities to strengthen the innovation ecosystem. One can argue that the most important barriers are the biggest opportunities to strengthen the innovation ecosystem. Therefore, I focus on the barriers in the conclusion of this chapter.

1. The non-entrepreneurial mindset appears to be the first barrier (and thus opportunity) to strengthen innovation ecosystem. The most important factor that for this is the evolution of the innovation ecosystem because it has a significant impact on the entrepreneurial mindset of people in it. Munich's evolution via the relatively slow growth of large individual organizations created a risk-averse mindset of the people in it. Eindhoven had a similar evolution. However, here most large organizations spun out a single one and overtime the grew to be global companies as well. Cambridge's growth is through startups spinning-out from the University and Cambridge Consultants. Therefore, they an entrepreneurial mindset was created throughout the evolution. In the current situation of the innovation ecosystem, experts in Munich and Eindhoven argue people should be more entrepreneurial. However, changing the culture to an entrepreneurial mindset is very difficult considering the decades of evolution has created the opposite.
2. The second important barrier appears to be the local competition which affects the feeling of a common identity and message to the outside world. Throughout the analysis of three innovation ecosystem, I found that the internal competition between organizations and institutions in Munich negatively influenced the internal collaborations. In turn, this had a negative effect on the common identity and there was no single message to the outside world. In Eindhoven, experts argued that everybody is sitting in its own castle. This appears to be a form of internal competition as well, which does not create a common identity for the entire ecosystem of Eindhoven, therefore, lacking a single message to the outside world. In Cambridge, experts mentioned that there is no internal competition, but mainly against the bigger ecosystem of London. As a result, people in Cambridge internally collaborate to compete against London. This resulted in a common identity for the people in it and a single message to the outside world.
3. The third important barrier for the innovation ecosystems to develop appears to be capital. Experts in all three ecosystems argue that when there would be more capital present, more innovative projects and startups could be financed which would improve the competitive advantage of the region. Important to add is that experts in Munich and Eindhoven explicitly highlight the risk averseness of (corporate) venture capital, while this is not mentioned in Cambridge.
4. The last barrier for the innovation ecosystems to grow, appears to be talent. Experts in all innovation ecosystems argue that talent has to be attracted to innovation ecosystem strengthen it. This 'talent' should have technological know-how (i.e., Science, Technology, Engineering, and Mathematics), but also people with a 'market' mindset (see chapter 5).

This cross analysis and conclusion sum up the first phase in the foresight methodology. In the next chapter, the foresight phase will be performed. This process starts with fore sighting some megatrends that will change the world over the next decades. The second part of the foresight process discusses the internal trends and challenges of the innovation ecosystems.

Chapter 5

Main Phase: Foresighting

As mentioned in section 3.6.2, I will first investigate the 'landscape level' (Dufva et al., 2015) to understand what changes will occur globally. The results of this Trend Extrapolation & scanning process are stated in section 5.1 as figure 5.1 shows. The second part of this chapter focuses on the medium term trends and challenges of the innovation ecosystems. Section 5.2 shows the results of this inductive analysis per innovation ecosystem. The overall goal of this chapter is to gain insights and information that can be used later. Overall this chapter addresses the following subquestions:

- *What are the trends in the global environment?*
- *What are the internal trends & challenges for the innovation ecosystems?*

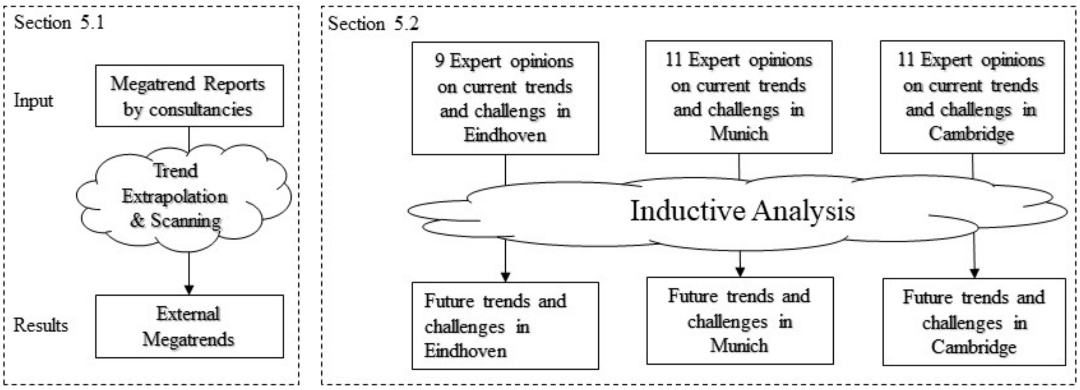


Figure 5.1: Structure and processes of chapter five.

5.1 Landscape Level: External Megatrends

Megatrends "can be characterized as external frame conditions and are considered to be beyond the influence of the actors within the facilities management sector"(Andersen et al., 2014, p.38). Moreover, megatrends are "large-scale social, economic, political, environmental or technological changes that are slow to form but which, once they have taken root, exercise a profound and lasting influence on many if not most human activities, processes, and perceptions" (OECD, 2016, p.18). Megatrends are foresighted mostly around fifteen years in the future and have a high probability of taking shape, therefore, they will fundamentally affect the science, technology and innovations ecosystems (OECD, 2016; KPMG International, 2014). Also, while megatrends have a different impact on each innovation ecosystem, they are also highly interconnected to each other (KPMG International, 2014). For example, with a rising global population (demographics), the demand for of food increases. This puts extra stress on our resources (resource stress), pushing us to cut more forests which results in climate change. Table 5.1 shows a selection of megatrends that are described in reports of strategy consultants, I selected them because I believed they could be relevant for this study. Later I can use them to as forces of change to create future scenarios. I will briefly describe the megatrends in the upcoming parts by 1) present evidence of change, 2) a description and consequences, 3) implications for the innovation ecosystems. The megatrends of climate change and resource stress are described together for ease of understanding.

Table 5.1: External Mega trends. **Sources:** KPMG International (2014) Roland Berger (2011), Ernst & Young (2015), PWC (2016), HayGroup (2014), OECD (2016), UNDP (2017).

Megatrend \ Report	KMPG	Roland Berger	EY	PWC	Hay Group	OECD	UN
Climate change	✓	✓	✓	✓	✓	✓	✓
Resource stress	✓	✓	✓	✓	✓	✓	✓
Demographics	✓	✓		✓	✓	✓	✓
Economic powershift	✓	✓	✓	✓	✓	✓	
Exponential Technologies	✓	✓	✓	✓	✓	✓	✓
Urbanization	✓	✓	✓			✓	
Individual Empowerment	✓				✓		✓

Resource Stress and Climate Change

With a population of 8.3 billion people by 2030, humanity will need 50% more energy, which is mainly driven by economic growth, population growth and technological advancements (KPMG International, 2014). There will be a gap of 40% between water supply and water demand (PWC, 2016), which results in 1 billion people living in areas with water stress (KPMG International, 2014). Last, there needs to be 35 % more food than the present day (PWC, 2016). This combined with problems of climate change will cause global food prices to double between 2010 and 2030 (PWC, 2016). Besides to these enormous challenges, humanity has to slow down global warming to reverse climate change. To do so, humanity reduce global emissions in greenhouse gases emissions from 40% to 70% by 2050 to meet the 2 degrees Celsius scenario (OECD, 2016). However, it is already projected that the average global temperature will rise 0.5-1.5 degrees Celsius between now and 2030 and this will have some serious consequences. According to Ernst & Young (2015), urban centers in developing countries will be heavily challenged by climate change and extreme weather events, therefore, action will be needed to create resilient infrastructure. However, also the developed world will need to strengthen their old infrastructure to protect itself. An unfortunate example of this is Houston (US) where hurricane Harvey caused billions of damage to the city[1]

However, "On the product side, new eco-friendly products or technologies will open up business

[1]Source: https://fivethirtyeight.com/features/hurricane-harveys-impact-and-how-it-compares-to-other-storms/

opportunities and dominate the markets" (Roland Berger, 2011, p.79). For innovation ecosystems, it will be vital to focus on the topics of resource stress and climate change because it is essential to find solutions that counter climate change while decreasing resource stress. To do so, the High Tech Campus in the innovation ecosystem of Eindhoven wants to become a fully sustainable campus by 2025. Also, top talent wants to work on these kinds of topics to engage in the quest of self-fulfillment and self-expression (see individual empowerment). Therefore, Munich will open the 'Mega Space' center to let startups work with the newest technology to find sustainable solutions (will be explained next section).

Demographics

Demographics is the megatrend is described by most consultancies. This includes trends in world's population, life expectancies, and migration. According to Roland Berger (2011), the world population will grow to 8.3 billion people by 2030 and 10 billion by 2050. In contrast, in 1990 there were about 5.3 billion people and 7.5 billion people in 2017 OECD (2016). However, the world's population growth rate has slowed down over the past years. Africa and Asia will be the largest contributors to the increasing world population, while the population in Europe is projected to shrink over the next 15 years(UNDP, 2017).

Life expectancy is expected to rise in the future Hayes and Abernathy (1980). As a result, the global median age will move up by 5.1 years, from 29 today to 34. In the developed regions like Europe, the average age will rise by 4.4 years, reaching 44 years by 2030 (Roland Berger, 2011). This means that developed countries will suffer skills shortages whereas populations in developing countries are booming (HayGroup, 2014). It makes sense that the migration of highly skilled people to developed countries is likely to intensify since there is not enough talent produced in developed countries itself (HayGroup, 2014; OECD, 2016). "For organizations, this means that the 'war for talent' will continue to rage [...] and they will need to understand how to lead, integrate and motivate teams of increasingly diverse employees" (HayGroup, 2014, p.7). Equivalently, for innovation ecosystems, it becomes increasingly important to be attractive for talent, as one expert in Eindhoven emphasizes: "There is not enough technical talent coming out of the university here, so we need to attract top talent from somewhere else. [...] Top talent chooses to maximize their chances. Therefore you need a high concentration of leading firms in your innovation ecosystem, but also cultural activities and dual career opportunities" (E4).

Economic power shift

Most reports also explain the ongoing globalization of the economy. Which is nothing new, but over the next 15 years, this will heavily affect the western society. Because the "projected growth rates for major countries such as China (+5.9%), and India (+6.7%), as well as fast-developing regions such as Sub-Saharan Africa (+5.8%), the Middle East, and North Africa (+4.9%)" (Ernst & Young, 2015, p.7). While the developed countries are lacking behind, and that means the center of gravity of the world economy will shift south and east (HayGroup, 2014).

The economic growth in developing countries will create a huge new middle class (earning between $10 (USD) to $100 a day (KPMG International, 2014)). In 2025, China's middle class will be 75% of the country's population, compared to 40% today. India's middle class will be of 57% of the population (850 million people) by 2030 compared only to 7.1% today (Ernst & Young, 2015). This means that China and India will account for 25% of the global GDP in 2030.

Besides higher growth rates and favorable demographics, the emerging economies will become very well interconnected with each other (PWC, 2016). The trade and investment flow between emerging-to-emerging countries is growing much faster than the traditional routes from developed-to-emerging and developed- to-developed countries (PWC, 2016). This means that innovation will increasingly take place in rapid-growth markets, driven by their nascent middle classes, with Asia surfacing as a major hub (Ernst & Young, 2015). Moreover, China already accounts for the greatest number of patent applications, and predictions say it will surpass the US with regards to R&D investment by 2022 (Ernst & Young, 2015). To keep Europe a competitive region, companies in Europe will have to be encouraged to engage in more cross-country, cross-sector and cross-functional collaborations as well as making collaboration among a range of people with very diverse backgrounds (HayGroup, 2014). Since the innovation ecosystems of Eindhoven, Munich, and Cambridge are all in Europe, they face these challenges as well. However, M6 argues that there is always competition between innovation ecosystems, like Munich and Berlin, while they should work together. C9 also argues that the level of competition is too small inside a European country or even within Europe. E6 mentions that even within the same ecosystem there is a competition going on between campuses, which is ridiculous! To conclude this megatrend: "we do not want to battle within Europe because we are going to lose it against China" (M6).

Exponential Technologies

Technology diffusion will continue and even speed up by 2030 (Roland Berger, 2011). The main reason for this is that it is estimated that the 2 billion mobile broadband connections will increase to 8 billion by 2019, this allows technology and information to spread out much quicker than it did 30 years ago. (Ernst & Young, 2015). Besides the huge increase in diffusion speed in developing countries, technology diffusion will also accelerate in the developed countries as the speed of the adoption of new technologies will increase and existing technologies are being substituted faster by new ones, which means that product life cycles will only decrease (Roland Berger, 2011). KPMG International (2014) mentions that the developed countries will continue to have greater access to new technologies, but developing countries will have many leapfrog opportunities. This means that developing countries can skip technology cycles that the developed countries had in the past. An example of leapfrog is the mobile broadband connection mentioned above.

Next to the acceleration of technology diffusion, four technological application areas will shape the global economy and innovation agendas. These application areas are the Internet (Communication) Technologies (IT and ICT), manufacturing and automation technologies, technologies to secure vital resources, and life sciences technologies (Roland Berger, 2011; Ernst & Young, 2015; KPMG International, 2014; PWC, 2016).

Each of the investigated innovation systems focuses on a subset of those. Experts in Cambridge report a huge 30% increase in the life sciences sector last year, and they are expecting that trend will continue (C1, C2, C4, C5, C9), in which the next focus is on personalized medicine (C4, C9). Experts also report the increasing strength of Internet (Communication) Technologies, where machine learning and artificial intelligence are growing up to be an immense strength in the region (C1, C2, C5). In Munich, the focus is mainly on manufacturing and automation technologies to digitize their industry (M2, M4, M5,.., M9), where the key exponential technologies are 3D printing and robotics (M2, M4, M7, M8). Next to that, IT and ICT sector is also booming in Munich. Experts report that many investments are in AI, IoT, Virtual and Augmented reality (M2, M4, M7, M10). In Eindhoven, manufacturing and automation technologies, technologies to secure vital resources, and life sciences is already present (E2, E3, E4, E5, E6). However, the innovation ecosystem should focus on becoming known for IT and ICT technologies (E2, E3, E4, E5).

Urbanization

Acceleration of urbanization is another megatrend that the entire world faces today. According to Roland Berger (2011), by 2030 4.9 billion people, or 59% of the world's population, will live in cities. Most urbanization will take place in Asia and Africa; together they will account for 90% of the increase in urbanization (Ernst & Young, 2015; Roland Berger, 2011; PWC, 2016). These developing countries will increase their share of the urban population from 45% to 55% in 2030, which is a whole 10% Roland Berger (2011). The developed countries will enhance their share of urban population by only half in contrast to the developing countries, from 75% to 81% in 2030. However, that does not mean that cities in developed economies can lay back. "In developed economies and older cities in the developed world, infrastructure will be strained to the utmostand beyondas populations expand." (PWC, 2016, p.12). Experts from Eindhoven and Cambridge do already see challenges arise for the growing urbanization around their innovation ecosystems. For example, in Eindhoven, one expert argues that more car lanes and more efficient public transport are needed to grow the grow the innovation ecosystem (E5). Cambridge faces bigger problems because sooner or later they will start to have problems like fresh water supply and wastewater disposal (C3).

Ernst & Young (2015) argue that while urbanization increases economic opportunity, it is involved with resource risks as well. Rapid urbanization puts extra stress on the global resources and contributes heavily to global warming. Therefore, "local and national policy-makers, along with other important stakeholders, will need to work closely together to plan, build and govern more sustainable cities" (Ernst & Young, 2015, p.36). As mentioned in section 4.1.2 and 4.2.2, government and important stakeholders in the innovation ecosystems of Eindhoven and Munich are relatively well aligned to plan the growth of the city. However, in Cambridge, experts mentioned government and other stakeholders are not well aligned, and therefore the growth of the Cambridge Cluster is in danger.

Individual Empowerment

The main driver of individual empowerment is the creation of the huge new middle class over the next fifteen years in developing countries (KPMG International, 2014; HayGroup, 2014). The Internet also drives individual empowerment, half of the world's population will have access to the Internet by 2030 (KPMG International, 2014). Therefore, populations will be increasingly connected and information will be spread faster through social media which accelerates actions of groups (KPMG International, 2014).

Individual empowerment is often expressed in the form of entrepreneurship (KPMG International, 2014). In developing countries, the entrepreneurial activity mostly comes out of necessity, that is why the Total Early-Stage Entrepreneurial Activity Index (TEA rate) is much higher in the developing countries (Ernst & Young, 2015). In mature economies, innovative entrepreneurship is mostly explained as "creating a product, service or process that represents a significant commercial opportunity (as opposed to necessity-driven entrepreneurship)" (Ernst & Young, 2015, p.16). Also, entrepreneurship is mostly perused by Millennials (born between 1984 and 1996) as a result of different lifestyle and employment preferences. Another key driver is the massive increase in entrepreneurial education across developed countries. In the US this rose from 100 programs in 1975 to 5000 in 2013 (Ernst & Young, 2015). Moreover, there are also large entrepreneurship centers present in the form of the UTUM and Cambridge Judge Business School in the innovation ecosystems of Munich and Cambridge respectively. While in Eindhoven this is done on a much smaller scale.

However, supportive environments are becoming more and more important to ensure successful entrepreneurship. To do this effectively in the future, (Ernst & Young, 2015) presents five pillars for an optimal entrepreneurial ecosystem: "(1) access to funding; (2) entrepreneurial culture; (3) supportive regulatory and tax regimes; (4) educational systems that support entrepreneurial mindsets; and (5) a coordinated approach that links the public, private and voluntary sectors" (Ernst & Young, 2015, p.20). Experts in all innovation ecosystem have addressed internal trends and challenges regarding these pillars. For example, in Munich experts want to enhance the entrepreneurial culture by exposing students to the latest technologies. In Eindhoven, experts mention that cross-fertilization should be improved in the educational system. Experts in Cambridge mention there is a strong entrepreneurial culture, but the entrepreneurs have to change their mindset. These examples will be explained in detail in the next section.

In addition to individual empowerment through entrepreneurship, HayGroup (2014) reports that in the future careers play an increasingly important role in the quest for self-fulfillment and self-expression. Where in the past factors as payment and promotion counted for important factors for employee loyalty, in the future, this will change to soft factors such as recognition, self-development, self-direction, values-driven engagement and work-life (HayGroup, 2014). This causes employers to change their structure and processes to be aligned with individuals rather than the organization. For example, employers need to create conditions that promote independent work and time management. Besides individualism, creative output increasingly becomes the main source for economic success. Individualism and the need for creative output combined results in new types of people with longer education, career breaks, frequent job changes and even periods of unemployment (HayGroup, 2014). So companies have to react to it by providing decentralized workplaces characterized by flatter, more flexible structures, and cross-functional project teams (HayGroup, 2014). This trend is also addressed by experts from Eindhoven and Cambridge; they emphasize that in the future companies will have to restructure their processes work more network driven. In the next section, this will be explained in further detail.

5.2 Internal Trends and Challenges

During second part of the interview, I asked the experts what kind of network links should be developed to make their innovation ecosystem future proof. As well as what kind of competences will be needed in their innovation ecosystem. This section gives an overview of my findings. The data was analyzed inductively, which means that the results are purely based on what the experts said. In chapter 6, I use these results to strengthen the argument why the innovation ecosystem of Eindhoven needs to be changed. In chapter 7, the project uses these results for best practices.

5.2.1 Munich

Cross Cluster Collaboration
M1 and M11, both cluster managers, explain that the focus of them is to create more cross-cluster collaborations in the future. The reason for this is that until now, most SME collaborations were done inside clusters, but as new technology fields emerge that have an impact on multiple clusters, they should be working to together. M1 explains that 3D printing is a huge trend so he reached out to other cluster managers and soon, the cluster managers are going to set up a cross-cluster project together with SMEs in the clusters of mechatronics, aerospace and new materials on 3D printing.

Entrepreneurial Clusters
However, as mentioned in section 4.2.2, experts criticize that the clusters are mainly technological interest groups financed by the government (M2, M4, M7, M10). For the future, M2 argues that the director of a cluster should be a person with an 'entrepreneurial' mindset instead of a professor with a 'technological' mindset. He explains that this would make the clusters way more efficient and work more business driven. Currently, the topics of interest are being set by the Cluster directors, while in the future they should become out of the benefits of the companies in the cluster (M2).

Entrepreneurship Exposure
To tackle risk averseness, students should continuously be exposed to entrepreneurship to plant a seed in their head that they can start a business at any time (M5, M7, M8, M9). An initiative by UTUM is a platform called 'Project X,' here, UTUM tries to create a community of students that are interested in the same technology. UTUM lets them experience the possibilities what they can do with it, which hopefully results in the creation of new startups (M7). According to M7, the 'Mega Space' project is also an excellent way to expose students to entrepreneurship. "If you have a building where you can live for free, where you get office space, where you get access to a business network, you have access to a maker space, and you have some money to survive, that is it."(M7).
Students must also feel that they are in an entrepreneurial ecosystem, "it would make a difference if you start promoting Munich as a start-up place and put advertisements and billboards everywhere, so everybody thinks about starting their own company" (M7). However, it is easy to start a business, but way more challenging to execute it successfully. M8 argues that in the future, the ecosystem should professionalize startups by teaching them how to think in *business models* rather than solely focus on the *technology aspect.* "There is an education gap. I think the ecosystem needs to pick that up from the university side as well as the school side" (M8). In line with business model thinking, 'Selling technology' is increasingly becoming an essential competence as well because the tech startups must be able to sell their developed technology (M2, M4, M5, M6, M7, M8, M10). Currently, tech startups first make a technology (solution) and then try to find a problem for it. According to M9, this issue makes a startup doomed to fail. Instead,

young entrepreneurs should be teached that they have to first find the problem and then make a solution for it. M8 is addressing this issue by looking "every six months for the top startups in Germany which are around three years old. Then they ship them to the US for three to six months and teach them how to pitch and sell their technology" (M8). So far, startups in this program were able were able to raise € 250 million.

SME Startup Collaboration

The SME Startup collaboration was the most mentioned network link for the future (M2, M3, M4, M5, M7, M8, M9, M10). "In Germany, we say that the Mittlestand (SME) is the backbone of our country, those are typically companies between 100 and 1000 employees. They are the biggest contributor to our GDP that is a fact. A lot of them are hidden champions and are very good at one technology. Most of the time the founder is a great engineer, and he set up a company around this one particular technology. The problem is that they are very good at incrementally innovation in their niche, but not in disruptive innovation and digitalization. The Mittlestand is threatened by those two factors" (M4). In contrast, most startups are characterized by disruptive innovation and a lot of them work in the field of digitalization (M2, M9, M10). Therefore, "if you create a connection between the German Mittlestand and startups. You provide the startups with a first customer, which increases the likeliness that they will get an investment. Furthermore, you bring digitalization faster to the SMEs, which they desperately need" (M10). So there lies a huge potential in bringing the two fields together. M4 even mentions that he advised a student to investigate the relationship between SMEs and startups because the corporate-startup collaboration is already over researched. The main difference between SMEs and corporates is that the corporates have more strategic and innovative thinking in their company; they have entire departments working on these topics. In contrast, the SMEs are very focused on their founder, which means that the CEO mostly decides the direction of innovation. With regards to funding, corporates have way more resources to play around with.
However, at the moment there are two challenges with regards to the creation of this new network link. Firstly, the economy is doing well, so most SME companies do not see the necessity of collaborating with startups (M2). Secondly, SMEs have to open their R&D department, and that is considered to be a threat because then others can steal their innovations (M4). Despite those challenges, M4 still believes that "in the next couple of years, a lot of SMEs are going to do the same as the corporates and start to engage with startups on different levels and trying to find the best fit" (M4).

Role of Business Angel

The future network link between startups and SMEs holds much potential. However, how can both parties make sure that there is value created for both of them? The business angel role hold the key to success. Traditionally, the business angel is seen as an essential actor in the development and growth of new ventures because of their financial contribution, network, and business skills (Politis, 2008). M8 explains that over the last couple of year, more actors in the ecosystem got interested in the same thing: startups. However, SMEs and most corporates have no idea how to collaborate with startups (M4, M7, M9). As more young startups spin out of the university, the overall level of professionalism of startup decreases (M7, M8, M9). This creates a considerable misunderstanding between both startups, SMEs, and corporates resulting in a lack of trust. As an business angel himself, M9 explains that he plays a vital role in aligning the interests of all parties in pre and post investments phase. Moreover, the competence of "understanding startup world and corporate life will become even more important in the future as more SMEs get interested in this kind of collaboration" (M9). So when before, the financial contribution was significant for the role as the business angel. In the future, the business angel role will evolve to a 'startup consultant,' where the primary function of the business angel is to consult how startups can work together with SMEs and corporates.

Successful entrepreneurs

As mentioned in chapter 4, the Munich innovation ecosystem has a lack of believer investors and risk involved capital. To make the innovation ecosystem attractive in the future, successful entrepreneurs, who had a big exit, should stay or join the innovation ecosystem (M2, M4, M5, M7, M8, M9, M10). "The best believers are founders with big exits, which reinvest their money in other ventures. For example, in the US a believer investor just gives you 50000 dollars to start your business" (M10). However, "in Munich, we dont have many of those entrepreneurs yet, but we do see that some entrepreneurs are reinvesting in the community. So the more you get that, the more start-ups you can service" (M7). M9 adds that this is a matter of time because high-tech hardware startups need at least ten to fifteen years before they can make a big exit. The fact that the startup-boom just started five to ten years ago, means that Munich has to wait a bit longer to gain a first generation of successful entrepreneurs (M9).

Internationalization of SME and startups

As mentioned in chapter 4, SMEs and startups in Munich are mainly focused on the D-A-C-H region because of its wealthy economic position. M3 adds that employees do not like to become international because of the language barrier. However, multiple experts argue that in order to further develop the innovation ecosystem, more network links should be made with companies outside the D-A-C-H region (M1, M3, M5, M7, M8, M11). M3 explains that although the D-A-C-H market is big, it reaches its limits quite fast and that is a limiting factor for the growth of a startup. Also, "there should be at least a 100 startups from all over the world stationed in Munich at any time. At the same time, also 100 startups from Munich should work in other places all over Europe" (M5). Because in the end, Germany is not in competition with the Netherlands, Europe is in competition with US and China. Europe is not winning, and not enough people have realized that yet (M3).

Mega Space

Given the rather large physical distances in Munich, the UnternehmerTUM (Entrepreneurship center of the TUM) and the city of Munich have joint forces to construct a building where physical distances between startups, academics, and corporates are minimal (M6, M7). In this partnership, the city of Munich is the landowner, and the building with machines is owned by UTUM. This innovation center will be a similar center like the UTUM in Garching bei München. However, in Garching there are mostly people with a 'technology mindset' but every startup needs different mindsets in their team. Therefore, all competencies that startups need are brought together in this innovation center.

The focus of this building is 'smart cities,' which tackles problems like air pollution, traffic, and mobility. It will have a mega space of 1500 square meters with high-tech machinery that is needed by the startups to build and prototype their solutions. Next to that, courses and programs about entrepreneurship are offered to students. Desks for corporate companies like Allianz, BMW, and Siemens are created in the building as well. This means that startups and corporates are close together and likely to share information with each other to gain speed to market (M6, M7, M8).

5.2.2 Cambridge

B2B2C and B2C

Multiple experts report that Cambridge is excellent in creating B2B startups (C1, C2, C4, C5, C6, C8, C9). However, there is a tendency to say: "look we have world-class technology coming up, the job of an entrepreneur is to get this thing to the point where it can be sold by a global company" (C8). At the moment, C5 and C6 notice that this B2B model is changing to a B2C or B2B2C model, where companies think: "hi guys it works, let's raise another bunch of money and make a factory to produce these products" (C5). Until now, Cambridge mainly has 'hidden champion' startups; they develop technology which is used by almost everybody in their daily lives but nobody knows them. However, for the future, it would be essential for Cambridge to get the public recognition it deserves and one way of doing this is to penetrate end-user markets as well (C1, C2, C3, C5, C9). C5 draws on by giving a metaphor: "if we do not want to have a gap between the Ferrari and the rest, it would be cute to start manufacturing around Cambridge as well" (C5). Emphasizing that the high-tech cluster should not forget other people who live in Cambridge.

Scaling up

In line with the previous trend, within the Cambridge Cluster, there is a trend of moving away from startups and focus more on scale-ups (C1,..., C9). The term 'scale-ups' is used in two distinct phases of company growth.

For the first phase, C1 and C6 explain that a 'startup' is just to have an idea, but "there are startups enough, for scale-ups we help them from having an actual idea to growing a business. That is where we do most of our work." (C1). "There was a movement where the idea was that everyone should start a startup, so you ended with 1000 one person companies" (C6). Now people are more leaning towards growth instead of starting. This led to a school for scale-ups with scaler programs along with other initiatives.

For the second phase, experts mention that the future for Cambridge is to focus on making sure that businesses can grow in a self-sustaining way (C1, C3, C5, C9). This means that firms should not exit when the technology is ready to be commercialized. Instead, they should do the commercialization themselves and use B2C and B2B2C models to do so (C3, C5, C9).

To execute this efficiently, the innovation ecosystem needs "big company skills" (C5) like sales, marketing, leadership, reach to finance, management and manufacturing (C1, C3, C5, C9). However, "most people think you need to employ more people to grow, but for the future, I think we need to take a more *distributed approach to growing companies*. We need to figure out which communities are interesting for Cambridge to build links with. So we can share expertise or acquire different elements of competences that is needed to dominate a market" (C6). In other words, Cambridge needs to connect with other ecosystems to let talent at the other place work for companies in Cambridge. This way, both ecosystems gain competitive advantage by working together on the same product in the same market.

Global Companies

Next to growing large companies within the Cambridge cluster. For the future, multiple experts would also like to see that more corporate companies (like AstraZeneca) would headquarter in Cambridge (C1, C2, C5, C6).C6 believes that headquartered companies in Cambridge increase the connection to global markets for the rest of the businesses in the Cambridge Cluster (C6). C9 adds that "when we increase the quantity of bigger companies, we could increase the awareness of future possibilities and new markets." C4 mentions that four years ago, Amazon came to Cambridge with just 60 employees. Now has 600 employees and will grow to 1000. "This is a problem because it is soaking up all the engineers that could became entrepreneurs as well" (C4). Moreover, "maybe Cambridge is successful for all this time because it is far enough away from the global companies to dont get the struggle. However, close it is enough to get the action." (C8).

Top down structure & government alignment

The previous topics are trends that experts would like to see to develop the innovation ecosystem further. However, to achieve those trends, the Cambridge Cluster first needs to overcome some challenges. These are transport, infrastructure, and housing costs (C1,..., C9). For example, AstraZeneca will headquarter in Cambridge, which means 2000 people are going to work there. That means that another 8000 people extra want to live in Cambridge when families are included as well. The total population of Cambridge is only 124000 people. So bringing another 8000 people in, is roughly 7% increase in 3 years. This growth is almost impossible to accomplish. To make sure this will not fail, Cambridge needs to align local government with these companies. "We need to have somebody who knocks heads together because I think if that is not happening in the next five years. Then 50 years from now, people would ask: How did Cambridge collapse so quickly?" (C3).

To make sure this will not be the case, local and regional government need to get on the same page. An overarching entity should be created that is responsible for the healthy growth of the Cambridge Cluster (C1, C2, C3, C4, C9). The problem is that in times of economic wealth, people are resistant to change. However, Cambridge has to transform its approach for growing the Cambridge Cluster or otherwise the economic bubble might pop in a few decades (C3).
Some people in the Cambridge Cluster have made plans to improve infrastructure and public transport. For example, they made a plan to build a low-cost autonomous underground system to improve the physical network links between campuses and residential areas. This is going to cost around one billion pounds and it is structured in the way that national government lends one billion pounds to the regional government. Then the companies in the Cambridge Cluster will pay it back rapidly in increased taxes (C4, C5). "The big issue of today is that the governments internal figures for the gross value for Cambridge are about a third of what we have internally calculated"(C4).

Shift in mindset

Apart from the local and regional government that radically needs to change their mind, C6 argues that people in high-tech companies need to change their mind as well. Cambridge likes to be right, but you do not have to be right to win. In the future, startups need to get over that bit of correctness and care more about winning. Cambridge startups tend to focus on where you can make money. As a result, you chop off the extremes. "If you would focus on the big potential future markets and explore those as well, it could have significant returns. This is what Silicon Valley does, analyzing where the need is and then develop technology to fill that need"(C6). Interestingly, C4 heavily disagrees with this and discourages to Cambridge to get more like Silicon Valley in the future. "You end up with just one category killer. In the USA there is Amazon for online retail, Google for search, Facebook for social, and everything else gets squashed in the process. This has disastrous consequences because the more you get in well-paid software developers in your innovation ecosystem, the more you push out other people" (C4).

Brexit and diversity

When talking about pushing out people, Brexit cannot be forgotten and many experts in Cambridge have concerns about this (C1, C2, C3, C5, C7, C8, C9). Multiple experts believe that the Brexit will have a significant impact on the supply of highly skilled people because with Brexit the United Kingdom is setting up an anti-immigration posture (C2, C5, C7,C7). "If Cambridge gets a bad reputation along with the UK and is no longer seen as a friendly international place" (C5), it could be very damaging to any innovation activities (C7). Innovation is all about cross-fertilization of highly skilled people, and if Cambridge lost these valuable network links with Europe, it would become more difficult the realize a well-diversified group of individuals (C2, C5, C7).
Two experts believe that *if* Cambridge is going to lose Europe as a pool of highly skilled people, then it should tap into the diversity of London (C5, C7). Although London is only an hour away, the two innovation ecosystems are not well connected because they are more in competition with each other (C5, C7). However, "the scale of competition is too small, so London and Cambridge should be collaborating to help the UK economy and society" (C9). If network links would be strengthened with London, there could be a great cross-fertilization of deep tech competencies, business model & marketing expertise, and financial experts with strong financial networks in the US (C5, C7). If Oxford would be included as well, then the UK has a truly world-class cluster with life science in Cambridge, materials in Oxford, and finance in London (C5). A first step would be to improve the physical network link with Oxford in the form a new train.
C8 adds that one startup accelerator in London is already doing an excellent job with regards to cross-fertilization of tech skills. This is 'Entrepreneur First,' where applicants are selected based on their intrinsic motivation towards entrepreneurship instead based on their idea. Via an eight week program, they find people with complementary skills and create a set up startup team (C8).

The next two future implications are not directly related to the innovation ecosystem of Cambridge. However, they are attractive for both academic and business perspectives. I will describe them briefly.

Optimal Innovation ecosystem mix (C9)

C9 notices that there are a lot of small cities around Cambridge that want to set up an innovation ecosystem as well. However, they do not have the resources to make it an own self-sustaining ecosystem, nor should they. "There is even competition between these little ecosystems and Cambridge which is absolutely nuts!" (C9). C9 believes it is essential that Cambridge pulls in those innovation ecosystems and absorb all the little pockets and hubs that are around 2-hour drive of it.

One can argue that Cambridge is subscale as well, therefore, it should grow by absorbing all the little pockets. Not in a physical way, but just expand the territory so it includes these small pockets as well.

The truly successful innovation ecosystems like Boston, Israel and Silicon Valley are formed as a pyramid. The bottom is the foundation of many startups, one can argue about the middle layers, and the top represents to global companies. In a functional ecosystem, there are always more startups than global companies, and if somehow that pyramid gets reversed, then the ecosystem is broken because there is not enough innovation to continuously create new startups.

Using the Cambridge Cluster as an example, it has a really wide base of the pyramid and too narrow of a tip. This means that there are a lot of startups but not enough large corporations. When looking at truly successful innovation ecosystems like Silicon Valley and Boston, there is a wider tip because they do have the big businesses and a ton of startups as the foundation of the pyramid.

Open innovation with big data (C5)

Together with a couple of companies, C5 runs an interest group based on combining the open innovation paradigm with big data. Three years ago, they felt that the traditional inbound open innovation practices of IP were not innovative anymore. Plus there was always a problem to embed the perfect idea for your company in your business model. By focusing on the problem of embedding the idea in the business model, they found out that Henry Chesbrough's model of trading IP has much more success when the object traded with the other party is data, analytics, or some sort of insight that could be represented in data. These are some cases that we discussed:

1. **Cardboard boxes industry:** Since the margins on cardboard boxes are very small, companies are forced to have streamlined processes. One company that makes and sells cardboard boxes noticed that the healthcare industry uses most of their cardboard boxes for pills and medical devices. They found they could mine data using their invoices and predict some buying and selling trends in the healthcare industry. They set up a forecasting consultancy for the healthcare industry and ended up creating more revenue out of that data than out of the cardboard boxes. However, they could not stop making the cardboard boxes because that is where the data came from. From there on they lost money on the cardboard boxes and made it up with selling data via their consultancy. Their competitors went out of business because they could not sell the cardboard boxes that cheap.

2. **First mile logistics**. When a van is delivering in a particular street, it can track data on where it can park, which floor the apartments are and if anything unusual is happening in the street. Then you can sell that data to your competitors who also have to deliver stuff on that street because as long your analysis is better than the competitor's analysis, they would pay you instead of doing it themselves. Then you can actually lose money on the deliveries, but you compensate for your losses with the data you sell.

3. **Trucks to Germany** When a company sends trucks from the UK to Germany to deliver something, it can send information of the trip to somebody else who also needs to go to Germany. Not necessarily in your supply chain but in a parallel one. They are going to be in the same traffic jams, weather conditions, and face the differences in gas prices. So if it

possible to make the trip to Germany a little bit less painful for other truck drivers, then the companies would be happy to pay for it.

Most CEO's have heard about data mining, and assume that it is about mining the company's data for its benefit. They have not seen that next step which is to mine the company's data for somebody else's benefit. However, the examples show that data opens up many new ways to create revenue out of their value chain, parallel value chain, and even their competitors. This was also the first idea of Chesbrough: create extra revenue with your IP or reduce costs by using somebody else's IP. However, C5 firmly believes that using data instead of IP makes the open innovation model way more available to use for multiple companies.

5.2.3 Eindhoven

Closed group innovation
E2 argues that the current model of open innovation is outdated because of two reasons. "Firstly, in the original open innovation model, there is still a dominant player. Secondly, this dominant player only shares his leftovers" (E2). So the next model for innovation is where there are no dominant players in the ecosystem anymore, and everybody is willing to share his or her technology roadmap with each other. However, due to huge investments in R&D and high risk, something like this is not possible. Therefore, open innovation evolves to closed group innovation: a group of organizations without a dominant player, here, everybody shares his technology roadmap, and a wall of patents protects the entire group. A company is only allowed to join the group when it is not in direct competition with one of the group members and pays an entrance fee to come in. "These kinds of models will be the future" (E2), "because you are not smart enough on your own to keep up with the rest of the world" (E7). E6 agrees on this and adds that this model should be worked out to a European level. "We have to bundle on specific technologies with multiple institutes on a European scale. We should not think that the Netherlands by itself is going to make the difference" (E6).

Network driven companies
Another trend mentioned by multiple experts is that high-tech companies will be operating in a network driven system (E1, E3, E4). Although E5 (head of excellence at a global company) mentions that they have been spreading out their innovation activities for a long time, E3 believes that global companies will make an even stricter separation between their innovation activities. "What am I going to do myself and what activities will be done by research institutes and Universities?" (E3) This will be done on an international level. The globals keep only the most important activities, and the rest will be outsourced (E1, E3, E4). According to E4, this will be done with 'real-time matchmaking,' like in other industries: "I need these kinds of skills for this particular project for this amount of time" (E4). This also means that the organizational structure of global companies is going to change, you would see high-tech hardware corporates going from a stringent regime and culture towards loosely coupled organizations (E4). There will be small companies created to solve tackle these project and after completion, broken up again (E6).

Diversity and cross fertilization
In chapter 4, I stated that the innovation ecosystem of Eindhoven needs to enhance its entrepreneurial mindset. A way of doing it is via the approach of cross-fertilization. Many experts agree that the Eindhoven has many exciting competences spread across campuses in the city (E1, E3, E4, E5, E6, E8). Although there is already some cross-fertilization, most experts argue that in the future, campuses and companies on campuses should cross-fertilize more to increase the entrepreneurial mindset (E1, E2, E3, E4, E8, E9). E4 criticizes that "everybody is sitting in his castle, while the interesting things happen between the castles. Silicon Valley is one big melting pot of different people and cultures, and that is where to interesting ideas arise, which is not a coincidence"(E4). So for the Eindhoven, it is a challenge to break down these walls and create a continuous exchange of talent with different backgrounds (E1, E2, E3, E4, E5).

Apart from the challenge of integrating knowledge workers between campuses, in the future, the TU/e should also endorse cross-fertilization between its employees and students (E5, E8, E9). E5 argues that the university should change from a sum of mono-disciplinary units to a multidisciplinary one where people with different backgrounds are coming together because that is what's needed to start a business (E5). E9 mentions that there are some multidisciplinary projects, but this should be increased way more. For example, the TU/e can introduce cross-university projects or masters tracks (E5, E9). Cross-university projects and master tracks are particularly interesting since the TU/e has the technical competences, but it lacks skills in business model development, sales, and marketing (E2, E3, E4, E5, E6, E8, E9). Therefore the network link with Tilburg university should be strengthened.

Open mindedness

This challenge for the future builds on the previous one. To break down walls and allow people to cross-fertilize starts with a change in mindset from within the innovation ecosystem. Based on my time on the HTCE, I experienced that most people's mindset is still quite closed. The willingness to help others and the open-mindedness towards getting advice need to improve to create a functional innovation ecosystem. I give two examples:

1. When a person tries to advise a CEO of a knowledge institute about incorporating business model courses in their tracks, he gets kicked out.
2. When a startup tries to get a first customer, the first customer only looks at the initial offer without considering other ways to help.

These two examples are given to illustrate that you can call something an innovation ecosystem. However, to honestly have a functional innovation ecosystem, people in it must also feel part of it and be willing to help and take advice from each other. A challenge for the people in the innovation ecosystem is to become more open-minded because in the end, an innovation ecosystem comes down to people helping people (E1).
This is in line what most experts say in Eindhoven: We have all the ingredients for a functional innovation ecosystem, but we have to find a way to work more intensively with each other (E1,..., E9). In an informal conversation, E3 mentioned: "When I am in a meeting with other campus managers, we all say yes to future opportunities. However, after the meeting, everybody goes back to what he or she normally does because there is not much necessity to change the current way of working. The region is economically doing very well, so the need to change current practices is low" (E3). E7 adds that because of this, every organization is busy to sell its own brand, while if everybody would sell the entire innovation ecosystem as a brand, greater things could happen. Moreover, E2 emphasizes that in the future, Eindhoven must think that "two combined elements is larger than the separate value of both of them" (E2).

HTCE: the center of networks

For the future, E2 argues that the HTCE should become the center of intangible networks. Furthermore, it must become the center for some specific technologies. For example, when a company wants to do something with photonics, all 'roads' lead to the HTCE. "And when they are there, they should be welcomed and triggered to share information" (E1). However, to become the center of networks, you have to be present in the them and know the problems of all actors in it (E1). Proactively solving the problems by bringing people together makes you part of the success stories of others, which is the most valuable source of promotion for the HTCE (E1). E3 agrees with E1, that CSM should be more present in the technological networks of the region.

Physical network Links

Although physical distances are relatively small in Eindhoven, many experts argue that in the future, the physical network links in Eindhoven should be improved. (E3, E4, E5, E8, E9). E5 mentions that "the economy in Eindhoven grows every year by 3%, so in 8 years you need four driving lanes, instead of three" (E5). But also other infrastructure like a direct connection to the airport and a high-speed rail are needed. Those are essential to make the innovation ecosystem future proof. E3, E4, E5, E8, and E9 argue that public transport between campuses across the city should be improved to increase cross-fertilization of knowledge workers. Several opportunities are mentioned: on-demand flexible vans (E5), an underground autonomous system (E4), and electric bikes (E3).

Risk Capital
To attract risk capital to the innovation ecosystem is another challenge in the future. Multiple experts mentioned that more startups would be attracted to come to Eindhoven if there was more risk capital present in it, (E4, E5, E9). E5 has taken matters into his own hands and is working on a venture capital fund to fund startups in their accelerator program. Besides his own efforts, he believes that a retirement fund should become active in Eindhoven (E4). When both expertise and capital are present in the ecosystem, it become more attractive for startups to join it (E1, E4, E6, E9).
Another way to gain risk capital is that successful entrepreneurs start investing their money which they earned via a big exit (E4, E9). These actors are not yet present in the innovation ecosystem but hopefully will enter in later stages of it (E4 E9). The startup ecosystem of Eindhoven is still relatively young, and high-tech startups tend to have a long time to market (E4, E9). This means it takes a long time before successful founders can start to re-invest their money into the innovation ecosystem (E4, E9).

Digitalization of HTCE
According to E2, it is essential that the 'digitalization' trend is going to be in the DNA of the High Tech Campus, to do so, large ICT companies have to open offices on it. E8 agrees that the 'digitalization' trend can be incorporated in the HTCE, but it should be done via the hardware that is needed for it. "It will be very important for Eindhoven to exploit the digitalization trend by attracting companies making the hardware for this" (E8). Propositions that incorporate hard and software will become more interesting for the HTCE. For example, complex algorithms for a new state of the art chip machine (E8). E4 mentions that he believes the IoT trend will become huge and therefore wants to create a shared research center on the HTCE based on this trend.

Conclusion
It can be stated that the innovation ecosystems of Eindhoven and Munich focus on trying to change the mindset of people in the ecosystem to a more entrepreneurial one. I discussed several trends and challenges that experts highlighted to develop a more entrepreneurial ecosystem in Munich and Eindhoven. Munich and Eindhoven are effectively trying to become an attractive ecosystem for startups to join as well. Many efforts are taken to promote the ecosystem as well as educating the people in it. Because Cambridge already has 60 years startup generations, they don't face similar trends and challenges as Munich and Eindhoven. In Cambridge, the focus was on creating robust infrastructure so that physical place does not impede the development of innovation ecosystem. Besides, some experts believe that Cambridge needs to attract more globals to gain international competitiveness, while other say that the lack of globals is the reason for success.

Chapter 6

Main Phase: Scenarios for the Future of Work in Eindhoven

Until this point, this master thesis diverged as much as possible to gain insights on how the future might look like. As illustrated in figure 6.1, in this chapter I will converge the results gained over chapter 4 and 5. The chapter outlines as follows: First, section 6.1 describes drivers of change for the future work. Section 6.2 explains two models for the future of work. The last section (6.3) provides a change plan to get to the better model. Overall, this chapter addresses the following sub questions:

- *Which trends are the most significant forces of change for the future of innovation ecosystems?*
- *What competencies are needed in the innovation ecosystem to become future-proof against these trends?*
- *What approach should be used to strengthen the innovation ecosystem?*

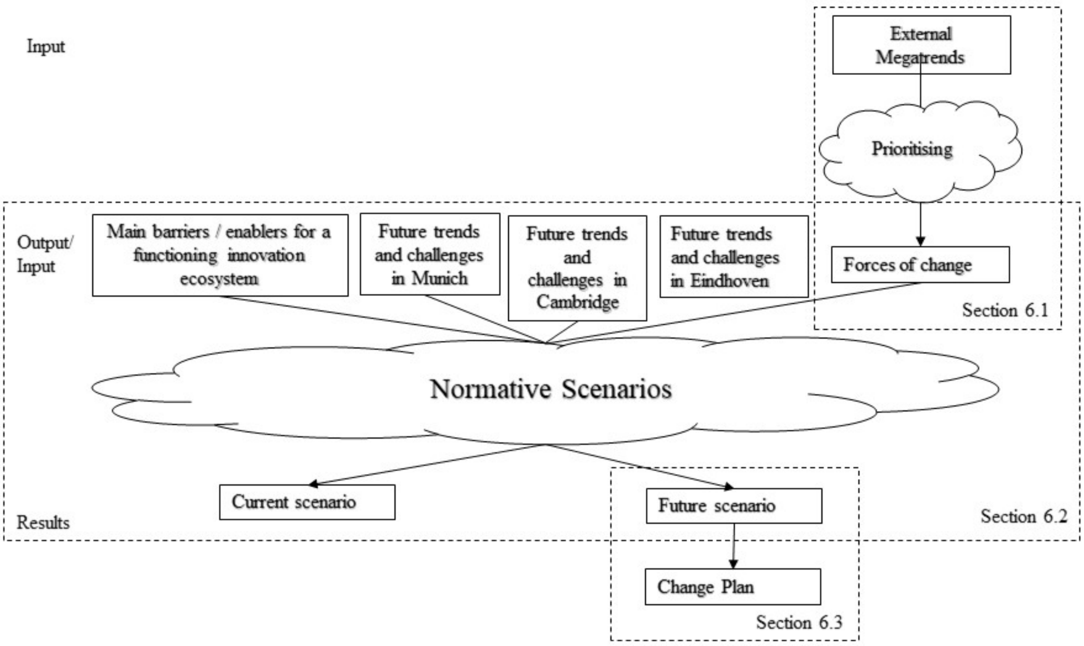


Figure 6.1: Structure and processes of chapter six.

6.1 Forces of Change

In this section, I describe the most important forces that will change work in the innovation ecosystem of Eindhoven. Work, in its broadest sense, is essentially how people collaborate with each other in and between companies and institutions. Therefore, if an innovation ecosystem - or an actor in it - wants to respond to these changes, they first have to take a step back and see the forces that will change the way humans work and work with each other in the future. I used the reports of Hagel et al. (2017), Higgins (2016), Abbatiello et al. (2017), Bersin (2017), and Manyika (2017) to converge from seven megatrends, which I described in chapter 5, to three *forces of change* that will affect the innovation ecosystem of Eindhoven. These forces of change are:

Demographics, Individual Empowerment, Exponential Technologies

These are the three trends that will change the future of work and therefore also the way that the innovation ecosystem of Eindhoven is functioning. These three forces are already playing out for an extended period. The only difference is that before, exponential technologies, were not evolving rapidly. However, in the future, this force will accelerate the rate of change. Therefore, I explain the exponential technologies most extensively. However, the project starts by explaining the other two forces of change.

Demographics

First, I investigated the demographics of the future workforce. As mentioned in the megatrend 'demographics' (section 5.1) significant demographic changes are going on globally. Overall, people will live longer, and there will be growth in both older and younger populations. As a result, the workforce will have a greater diversity in age and nationality. The challenge lies that in developed countries the population is getting older and in developing nations the concentration of younger people will grow. This megatrend impacts the way of working in several ways. First, when people become older they also tend to work longer, and this affects the pace at which new ideas of young talent can transform organizations in developed countries (Hagel et al., 2017). In line with chapter 5, developing countries will supply most young workers, and these young workers will be increasingly available because of the increased connectedness of the world as illustrated by figure 6.2. Important to note is that these new minds are not coming online like the developed countries did

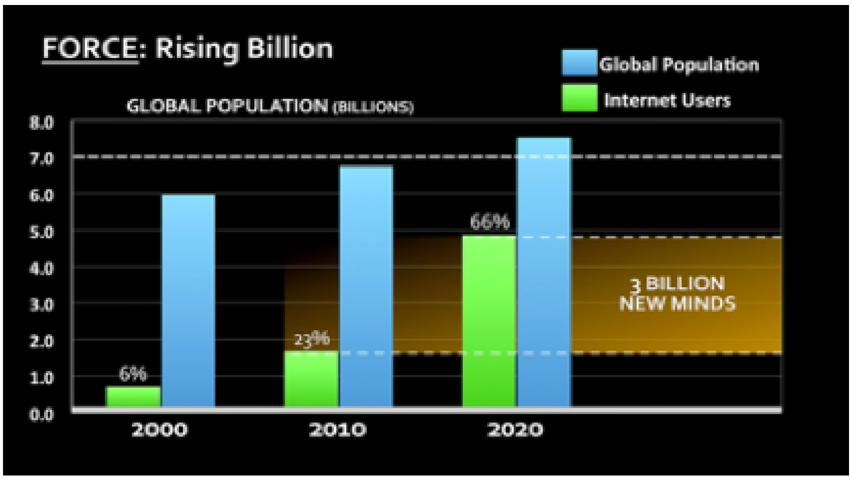


Figure 6.2: Exponential growth of global connectedness via internet. Source: (Diamandis and Kotler, 2015).

twenty years ago, they will come online with a super fast Internet connection and access to services like cloud 3D printing, Amazon Web Services, artificial intelligence, crowdfunding, crowdsourcing, and more[1]. The effect of a decreasing growth of population in developed countries and a more available younger workforce in developing countries is increasing pressure to deepen the talent pool by including workers from more backgrounds. So the net effect of this all will be that ”the workforce expands to historically underrepresented populations, as well as organizations needing to change work practices to accommodate a more diverse employee base” (Hagel et al., 2017, p.33). For innovation ecosystems, it becomes increasingly important to be attractive for talent from different backgrounds. Therefore, ecosystems need cultural activities and dual career opportunities. But also a high concentration of leading firms in the innovation ecosystem (E4). The following statement summarizes this force of change.

> Demographic changes will transform the characteristics of the workforce leading to even more diverse teams and organizations.

Individual Empowerment

The second force of change for future work is the empowerment of individuals on the demand and supply side of work. On the demand side, customers have gained empowerment because of their increasing connectedness which increases the ability to find products and services all over the world (see section 5.1). As a result, they will become less satisfied with highly standardized products and instead will search for creative, tailored niche products, services, and experiences (Hagel et al., 2017). Exponential technologies like cloud 3d printing strengthens this empowerment because more people have the ability develop and produce products.”The result is likely to be a growing fragmentation of product and service businesses, with small companies employing more of the overall labor force”(Hagel et al., 2017, p.34).

On the supply side, there are three driving forces which will change the way of working in the future.

1. Firstly, experts in Cambridge and Eindhoven both foresighted that in the future, large companies would fragment their business more and more to work with talented people that are present in a specific location (see section 5.2.2 and 5.2.3). Hagel et al. (2017) also highlighted this shift because of digital infrastructures, companies can easily connect with talent, combine them, and leverage them wherever they are needed.

2. Secondly, individuals are also more and more connected, this enables them to pursue entrepreneurial careers more easily. Entrepreneurs can find financial and human resources via online communities to accelerate their startups (Hagel et al., 2017). As mentioned in section 5.1, as more individuals think about pursuing an entrepreneurial career, it is essential for innovation ecosystems to create supportive ecosystems over time to help the potential entrepreneurs.

3. Thirdly, work will play a more important role in the for quest self-expression and self-fulfillment of individuals. Where in the past factors as payment and promotion were important for employee loyalty. In the future, this will change to soft factors such as recognition, self-development, self-direction, values-driven engagement and work-life (section 5.1).

> Individual empowerment will transform customer expectations, global talent pools, and employee loyalty.

[1] source: https://singularityhub.com/2015/04/06/rising-billions-dramatic-positive-change/

Exponential Technologies

The most important force for change is exponential technology. Technology has changed work, jobs, business, and society for an extended period, but what is different is that these new exponential technologies (AI, robotics, sensors, and data) are affecting every sector instead of just the manufacturing and low-skilled labor sectors (Hagel et al., 2017). To fully understand why exponential technologies are increasingly becoming a substitute for work, one has to know what an exponential technology is, how it evolves, and why it has a larger impact on work in the future. An exponential technology is a technology whose performance relative to cost (and size) doubles every 12 to 18 months[2]. The best known exponential technology is the transistor combined with Moore's law. Moore noticed that the number of transistors per square inch on integrated circuits had doubled every year while the costs halved. However, Kurzweil (2005) argues that this was not the first technology that brought exponential growth to computing power, but the fourth. Figure 6.3 shows the other exponential technologies that were responsible why computing power per second per \$ 1000 has exponentially grown over the past 110 years. Although the overall computing trend is exponential, the single technology life cycles of each technology is an S-curve with initial slow growth, explosive growth, and leveling off as the technology matures. However, these technology S-curves overlap, so when one technology slows down, a new technology takes over and accelerates. Also, the overtaking S-curve needs less time than its predecessor to reach new levels of performance. At the moment, the S-curve of the integrated circuit is coming to an end but Kurzweil (2005) believes integrated circuits are just the latest technology in a larger, longer exponential trend in computing power, which will continue with a sixth paradigm (for example silicon chips). If this exponential growth of computing power continues, then one could buy the same computing power of one human brain for \$1000 in 2025, and in 2050 the same computing power as all human brains together Kurzweil (2005). This seems far-fetched but is not the case.

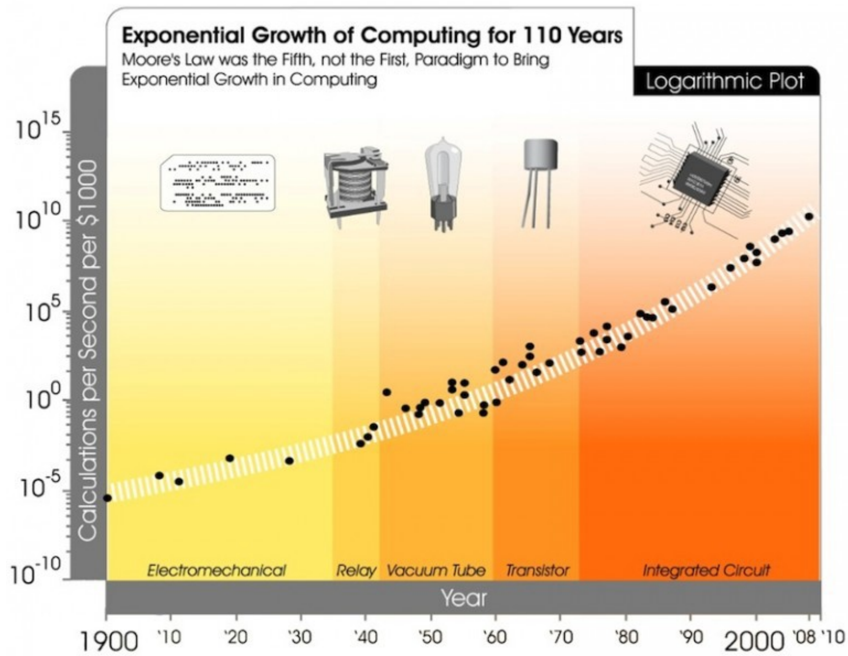


Figure 6.3: Exponential growth of computing power for 110 years. Source: (Kurzweil, 2005).

The reason is that human intuition about the future is linear while the rate of technology is exponential and this creates a significant difference in the outcome. For example, if somebody takes 30 linear steps, he or she gets to 30. While if somebody takes 30 exponential steps, he or she gets to

[2]source: https://dupress.deloitte.com/dup-us-en/focus/tech-trends/2015/tech-trends-2015-exponential-technologies.html

a billion (Kurzweil, 2005). To put it into perspective, technology advanced more in the last thirty years than it did in previous two thousand years.
Although the computing trend of is one of the most cited exponential trend, it is definitely not the only one. Figure 6.4 shows four other technology trends with each of them having the same exponential characteristic. The wireless data devices chart is interesting to highlight because this is one of the reasons that technology diffusion is accelerating while becoming cheaper as well. This has a significant effect on the empowerment of individuals, which the previous paragraph explained. Examples of current exponential technologies are AI, robotics, sensors, and data (see

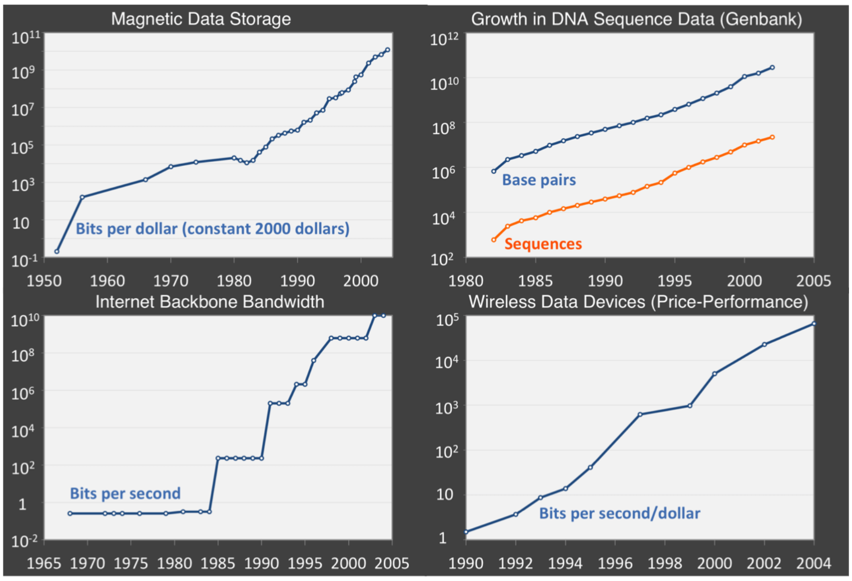


Figure 6.4: Four exponential technologies examples plotted on logarithmic charts: magnetic data storage, DNA sequencing, Internet backbone bandwidth, and wireless data devices. Source: (Kurzweil, 2005).

chapter 5.1). At this point, one should wonder why all these exponential technologies are apparently so important and why they will change our way of working in the future? The reason is that most companies often dismiss exponential technologies as trivial and inconsequential in their early stages. However, when these technologies and affiliated entrepreneurs get into the disruptive stage, they will disrupt entire industries and the players in it. To explain this in detail, Diamandis and Kotler (2015) presents the six D's of growth cycles of exponentially advancing technologies:

1. **Digitized:** Anything that becomes digitized enters the same exponential growth as the computing power example because digital information is easy to access, share, and distribute.
2. **Deceptive:** When something becomes digitized, its initial period of growth is slow as because an exponential trend (and functions) don't grow fast in the beginning. However, under the radar, the technologies advance quickly. Drones are such an example.
3. **Disruption:** Once refined, these technologies disrupt established industries, because the exponential technology outperforms the current players in effectiveness and costs. Researchers often quote Ubers disruption of the taxi industry as an example.
4. **Demonetized:** Money is increasingly removed from the equation as the technology becomes cheaper, often to the point of it being free. An often quoted example is how Netflix removed the need to buy dvds.
5. **Dematerialization:** The exponential technology removes separate physical products from the equation. For example, a camera, GPS, and maps, all fit into one device your pocket.
6. **Democratized:** When something is digitized, more people can have access to it. Powerful technologies are not only for governments and large organizations.

The point I want to make is that exponential technology trends like AI, robotics, sensors, and data are technologies that have been digitized a long time ago. They went through a deceptive phase for a long time, but now they are in a disruptive phase. These technologies will replace cognitive tasks more and more, just like in the industrial revolution when machines replaced physical labor, [3]. Humanity now has to face the distinct possibility that machines and robots will become increasingly better in doing what humans used to do. So the impact of the accelerating pace of technology evolution will change the skills required to do work. "More and more knowledge is being created - with other knowledge becoming obsolete - at an accelerating rate, making it necessary to update our skills and job descriptions ever more rapidly to keep up" (Hagel et al., 2017, p.7). However, recall that technology evolves exponentially while humans are evolving linearly. This means that in the future, machines will become much smarter in specific areas than us humans could ever be. Therefore, institutions need to reconsider how work is defined in the first place.

Exponential Technologies will transform the nature of work itself and the skills needed for it.

Conclusion
To conclude this section, in the future, demographics will change the characteristics of the workforce leading to even more diverse teams and organizations (with regards to age and nationality). Also, the nature of the workforce will change over the coming decades; millennials will try to solve societal problems by clustering together or joining an organization which gives them the opportunity to do so. Last, exponential technologies will increasingly automate routine tasks. However, they will also create new opportunities for creative work to fulfill a growing array of unmet needs. The next section discusses how these forces will affect the innovation ecosystem of Eindhoven.

6.2 Scenarios for the future of work

To understand what needs to change in the future, one needs to take another step back an reflect on the current situation of Eindhoven. Then, and only then, one can understand why some innovation ecosystems are functioning (i.e. there is an entrepreneurial mindset, capital, talent, and a shared identity) and others do not. The first scenario explains the current situation of the innovation ecosystem in Eindhoven and what happens when the forces of change *are not used* as a catalyst for change. The second scenario explains when the forces of change *are used* as a catalyst for change. These two models are adopted from Hagel et al. (2017) and applied to the innovation ecosystems. During this section, I refer back to chapter 4 for the barriers of a functioning innovation ecosystem and to chapter 5 for the competencies needed in the innovation ecosystems.

6.2.1 Scenario One: Scalable efficiency

Many of the problems that the innovation ecosystems face today are the outcomes of how they been operating for the last decades. Barriers like a non-entrepreneurial culture and risk-averse (corporate) venture capital in Eindhoven and Munich (section 4.4.2) are a result of the culture that has been developed over time. Hagel et al. (2017) call this culture the model of 'Scalable Efficiency'. Scalable Efficiency describes work as a set of routine, predictable, standardized and highly integrated tasks and over time these tasks should be executed most efficiently.

[3]source: https://www.forbes.com/sites/gregsatell/2016/06/03/3-reasons-to-believe-the-singularity-is-near/#124cc67c7b39

Scalable Efficiency: work is as a set of routine, predictable, standardized and highly integrated tasks.

This model has been the standard for so long that most people do not even consider this as the underlying problem for the barriers that the innovation ecosystem faces today. Recall from section 4.4.2 that Eindhoven faces the following barriers: non-entrepreneurial mindset, venture capital with high-risk averseness, lack of shared identity, and difficulty to find talent. The enumeration explains these problems with the scalable efficiency model:

1. **Non-entrepreneurial mindset** is present because schools and universities have been using the scalable efficiency. All students are expected to learn a specific set of material about a particular topic in a relatively short period. Then they take an examination to prove that they retained the knowledge. The 'best' students are the ones who do not fail and perfectly replicate the gained knowledge. Entrepreneurship is all about creating new ideas, try to execute them, fail, reflect and try again. So how can someone expect an entrepreneurial mindset of people when he or she is trained to obtain and repeat specific tasks?
   The bigger problem is that the government is using the same scalable efficiency model to codify university programs into rules and policies to judge and maintain the quality of all programs and anything different is often criticized[4]. So even if educational institutions want to change, the reward systems in education refuse to take creativity and innovation into account. Therefore, there is little incentive for professors to change their methods of teaching and evaluation as well as their content. Which in turn does not train an entrepreneurial mindset. A shift in education needs to happen that allows students and educators to become more creative and innovative. Recall from chapter 4 and 5 that experts from Eindhoven and Munich argued that the university should promote entrepreneurship better throughout the students time at the university. In Cambridge this was not mentioned at all, experts mentioned that there are too many ideas to handle (see section 5.2.2).

2. **Venture capital with high-risk averseness** is also a result of the scalable efficiency model that has been present in the innovation ecosystem of Eindhoven and Munich. According to M9, CVC managers must have positive quarterly results from their supervisors (=scalable efficiency). This means that CVC managers do not get the freedom they need to take some risk when investing in startups, which is seen by outsiders as risk averseness. With regards to VC, experts from Munich and Eindhoven argued that most investors earned their money by running family businesses, which is entirely different from setting up a startup. One can argue that running an existing family business is way more conservative than setting up a business and sell it after 10 to 15 years (4.2). Conservatism is typically focusing on short-term profitability, which in turn is according to the scalable efficiency model. Cambridge does not have this 'problem,' because of its entrepreneurs who started a small business, grew to a big company fast and sold it. Then they used the capital to invest in like-minded people.

3. **Lack of shared identity** relates to the fact that all campuses have their own short-term goals that they achieve because of the scalable efficiency model has thought them to do so. E3 has mentioned in an informal conversation with me that he has quarterly goals set by the owner of the business park. If he does not meet those targets time after time, there is the chance that he will get fired. The point here is that the short-term vision that the campus managers have, is a result of the scalable efficiency model. There is not enough interest to look in the long term and see how they can collaborate more extensively with each other to improve the branding of the entire innovation ecosystem. Experts in Munich also argued that universities compete on startups because they need to their meet their short-term goals (which is typical for the scalable efficiency model). In Cambridge, experts emphasized the

[4]source: https://hackernoon.com/does-education-kill-creativity-f3178540f5e3

strong informal network and the absence of internal competition in the cluster, which is the opposite of the scenario in Munich (4.3).

4. **Difficulty to find talent.** As mentioned in the exponential technology trend, the creation of new knowledge in an accelerating rate, makes other knowledge becoming obsolete faster as well. As a result, in 1970 the half-life of skills was 30 years, but this has shrunk to only five years at the moment (Bersin, 2017). Looking at the problems of the innovation ecosystems again, one can see that experts in all three innovation ecosystems are arguing that more talent needs to be attracted. The underlying problem here is that all institutions have defined work according to the scalable efficiency model. However, the world around them is changing exponentially. The easiest thing to do when a particular skill is missing, is to hire someone who has those skills. But if the half-life of skills is getting shorter and shorter because of the exponential technologies described in section 6.1, a company simply can't keep up. Therefore, organizations are constantly on the hunt to attract talent with new skill sets who can execute new sets of tasks. This is confirmed by a survey of Mourshed et al. (2012), who found that 60% of employers argued that new graduates were not sufficiently prepared for the world of work. There were gaps in STEM (science, technology, engineering, and mathematics) degrees, more importantly, soft skills such as working in teams, communication and punctuality were also missing (Mourshed et al., 2012).

Based on this enumeration, I argue that Munich and Eindhoven developed themselves via the scalable efficiency model and Cambridge not. This makes sense because both Munich and Eindhoven evolved in a corporate setting while Cambridge evolved in an entrepreneurial setting. In large corporations, work is divided over the employees as a set of tasks per employee. Therefore, I argue that work in the innovation ecosystems is defined around the scalable efficiency model if corporates have been the main driver in the evolution of them. Cambridge did not experience that a corporate was the driver of the innovation ecosystem's evolution, therefore it did not evolve via the scalable efficiency model but via something else.

However, if Eindhoven and Munich want to create a functioning innovation ecosystem, they have to change the underlying model of scalable efficiency in their innovation ecosystems.

Besides the effects in the innovation ecosystem in Eindhoven, there is also a larger problem in the scalable efficiency model because it basically says the best employees are machines. Machines are more predictable than humans, can be programmed to be more efficient as humans, and don't have emotional problems like humans. So if work is defined according to the scalable efficiency model, machines will outperform humans in every way. Recall that over the past 30 years technology has become exponentially smarter and will probably continue to become smarter even faster. Therefore more and more tasks will be automated to increase efficiency. In fact, an AI algorithm might do better than the CVC managers mentioned in the example above[5]. Therefore, CVC managers will become obsolete according to the scalable efficiency model. Another recent example is Exact, a Dutch software company, who developed accountancy software that operates way more efficient than humans. As a result, there is a 94% that Dutch accountants will see their jobs being automated over the next ten to twenty years[6]. This makes accountancy a dying career choice and all jobs that relating to accountancy becoming obsolete as well.

The point I want to make is that the current definition of work will increasingly lose its potential in the future. Machines will become better and cheaper than humans for the routinized work that humans are currently doing. Also, the scalable efficiency model operates optimal in stable environments which do not evolve rapidly. However, today the world is evolving fast because of exponential technologies disrupting market after market. Therefore, institutions have to redefine work at a fundamental level.

[5]source: https://www.weforum.org/agenda/2017/07/computer-ai-machine-learning-predict-the-success-of-startups/

[6]source: https://www2.deloitte.com/nl/nl/pages/data-analytics/articles/arbeidsmarkt-resultaten-2015-state-of-the-state.html

6.2.2 Scenario two: Scalable Learning

The other way of looking at the future of work is by using the exponential technologies as a catalyst for change to redefine work that suits humans better. To do so, one should ask the question: What are humans uniquely qualified to do? And furthermore, what should be our skill set of the future?
Experts in Munich (5.2.1), Cambridge (5.2.2) and Eindhoven (5.2.3) highlighted several competencies that will be important for the 'strengthening' of the innovation ecosystems in the future.
To further develop the innovation ecosystem of Munich, experts highlighted the competences of sales, thinking in business models, collaborators, and people with a believer & entrepreneurial mindset. To further develop the innovation ecosystem in Cambridge, experts highlighted the competencies of sales, marketing, leadership, the knowledge to reach finance, and collaborators. At last, to further develop innovation ecosystem of Eindhoven, experts highlighted the competencies of business model thinking, sales, marketing and an open, believer and entrepreneurial mindset.
To what extent are these competencies related to scalable efficiency? Alternatively, is it possible to define these competencies as a set of routine, predictable, standardized tasks? Not really. Instead, these competencies are more in line with solving business problems (entrepreneurial mindset), finding and providing new services (business model thinking) and establishing new relationships (sales, marketing and collaborators). So, instead of disassembling work into a set of tasks and try to optimize that, for the future, work should be defined around solving business problems, providing new services, and establishing new relationships. This view is called 'scalable learning.' "In this view, employers should become much more focused on exploring opportunities to create work that takes advantage of distinctively human capabilities such as curiosity, imagination, creativity, and social and emotional intelligence" (Hagel et al., 2017, p.35). In other words, institutions have to find ways of connecting humans to learn faster and achieve more potential. By logic reasoning, I argue that scalable learning is in line with the definition of entrepreneurship because at its core, entrepreneurship is a mindset a way of thinking and acting. It is about imagining new ways to solve problems and create value[7]

Scalable Learning: work is defined around solving business problems, finding and providing new services, and establishing new relationships.

In the model of scalable efficiency where tasks are predefined, there is very little room for curiosity, imagination, and creativity. Instead, one should execute the tasks predictively as he or she was told to do. This is not in line with the 'scalable learning' view as well as the quest of self-fulfillment and self-expression of millennials (section 6.1). As a result, many millennials quit their job because they have the feeling they cannot contribute to a greater goal[8].
Also in education, there is little room for self-expression. According to the scalable efficiency model, the student goes to school to gain knowledge, and that reproduce that knowledge as predictively and with as minimal errors as possible. This is in complete contradiction with the 'scalable learning' model because in order to learn one has also to fail. However, in the model of scalable efficiency, failure is seen as something bad, and it should be eliminated.
Notice that in the current situation of Munich and Eindhoven, there is still a negative opinion about failing a startup (section 4.1 and 4.2). However, this was not mentioned by experts in Cambridge at all. In fact, experts called Cambridge a 'safe place to do risky things' and emphasized its supporting culture(section 4.3). Therefore, I argue that the innovation ecosystems of Munich and Eindhoven mainly operate like the scalable efficiency model, while the innovation ecosystem of Cambridge leans more to the 'scalable learning' model. This makes sense because of the fact that Cambridge evolved in a bottom-up entrepreneurial way, therefore, the scalable learning model is

[7]source:http://www.businessnewsdaily.com/2642-entrepreneurship.html
[8]source: https://www.forbes.com/sites/vanessamcgrady/2016/11/29/survey-three-main-reasons-why-millennials-quit-their-jobs/#61fefcd722ae

already much more embedded in the innovation ecosystem of Cambridge.

Next to the way that individual work will be done, exponential technology, demographics, and individual empowerment (see section 6.1) are also changing the way how companies source labor. The best-known example of the new model is Uber, where employees are short-term contractors. The 'employees' of Uber are known as gig-workers working in the gig economy. Until now the gig-economy mainly consists of jobs which are relatively routine and therefore will be automated as well (think about autonomous cars). In the future, the gig-economy will consist of human capabilities which are emphasized by the scalable learning model (curiosity, imagination, creativity, social intelligence, and emotional intelligence)(Hagel et al., 2017). So the future of an innovation ecosystem system will be a pool of talent that will form small teams or diverse work-groups which collaborate with companies on different projects over extended periods of time. This will be the result of forces of change in demand and supply of work as described in section 6.1. Because of the demographic changes, the work-groups will become much more diverse in age, nationality, and gender. This causes employers to change their structure and processes to be aligned with work-groups rather than the organization.

Conclusion
The actors in the innovation ecosystem of Munich and Eindhoven generally evolved via the scalable efficiency model, and this resulted in the barriers they are currently facing. The actors in the innovation ecosystem of Cambridge generally evolved via the scalable learning model and that is why they do not face similar barriers as Munich and Eindhoven do. Demographic changes, individual empowerment, and exponential technologies are rapidly changing the world, but the scalable efficiency model lacks the agility to move with it, therefore, losing its potential for the future. The problems described in section 4.4.2 and 6.2.1 are just the symptoms of the underlying structure. The model of scalable learning increasingly gains potential in the future, because it uses the forces as a catalyst for change to bring back humanity to work. Therefore, if Eindhoven wants to change the barriers into enablers, then all actors in the innovation ecosystem should change to the model of scalable learning.

6.3 Change plan

To change to a model of scalable learning, some kind of innovation needs to be performed. People talk about product and technology innovation and to a lesser extent about process, service and business model innovation. However, to fundamentally change the view of working, Eindhoven will need institutional innovation, here, the institution is the innovation ecosystem and all actors in it. Institutions (government, education, industry) are the foundation of the ecosystem, but the ecosystem as a whole can help with the transformation. This means that every organization within the innovation ecosystem needs to change their view of work fundamentally. This seems like an impossible process to go through, and there will be several barriers to overcome. Higgins (2016) performed a survey under all industries about the barriers to change to the 'scalable learning' model. Figure 6.5 shows their results; 51 percent of respondents had insufficient understanding of the forces of change discussed in section 6.1. Also, 50 percent did not have the resources that to the process of institutional innovation. The last important finding is that 42 percent of the respondents report that the pressure from stakeholders and short-term profitability is a barrier to change for them, which are two characteristics of the scalable efficiency model. If there are going to be fundamental changes in the institutions and the innovation ecosystem as a whole, we should not underestimate the immune system of the institutions and the ecosystem as a whole. Hagel et al. (2012) and M9 (expert from Munich) both mention that a 'top-down' approach does

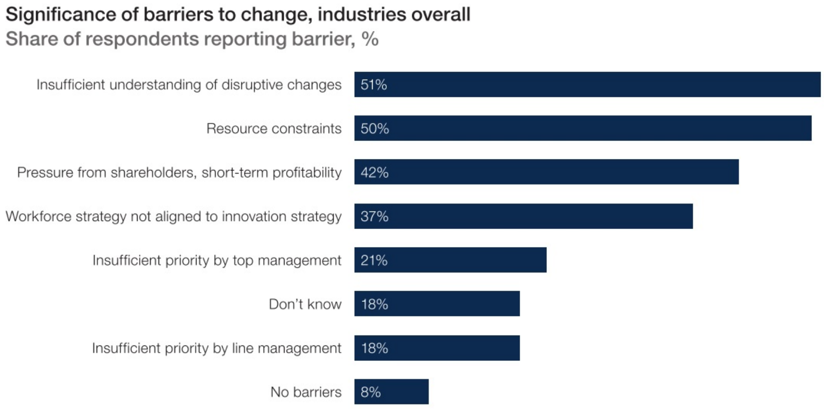


Figure 6.5: Significance of barriers to change in all industries for institutional change towards scalable learning. Source: (Higgins, 2016)

not work in these kinds of innovation projects because the immune system (in the form of the main actors of the innovation ecosystem and institutions themselves) will easily kill the idea of fundamental change. Instead, one should find an 'edge' in the innovation ecosystem, which means this is also an edge of an institution that can be scaled over time. These edges should not be scaled via the mother's resources. Instead, the edge should 'learn' to be self-sustaining. Therefore, the edges should be scaled overtime by third party resources by setting up new network links in the form of relationships.
According to Hagel et al. (2012), edges are new customer segments, geographic markets, or products which have the potential to change the institution's core business fundamentally. M9 sees the edges as the 'shared grand challenges' that institutions in the innovation ecosystem have. So it is key for the innovation ecosystem of Eindhoven to identify the edges that use the model of scalable learning and scale them overtime till they become the core of the institution. Also, the ecosystem can find edges that support the way that companies will source labor in the future (according to scalable learning) and scale them using exponential technologies. Both Hagel et al. (2012) and M9 emphasize that this edge should not be pulled into the core of a business. Instead, it should thrive on third party resources to realize its scaling. In the next chapter, I will discuss several edges .

Chapter 7

Main Phase: Action Plan for Scalable Edges

As illustrated in figure 7.1, this chapter aims to bring the knowledge gained over chapter 4, 5, and 6 together to solve the problems that the innovation ecosystem of Eindhoven faces today. In each section, I present a desired future state according to the scalable learning model of section 6.2.2. Next, I identify an edge in the innovation ecosystem according to the change plan described in section 6.3. Then, I provide an explanation to scale the edge over time till it becomes the new core of the institution and solves the problem in the innovation ecosystem. Last, each section provides a recommendation to CSM what kind of actions they should take to successfully create meaningful relationships with new parties. Over the course of this chapter, there will be several references made to chapter 4, 5, and 6 to provide information or argumentation about a specific topic. Here, the last subquestion of this master thesis is addressed:

- *What actions can CSM take to strengthen the innovation ecosystem of Eindhoven?*

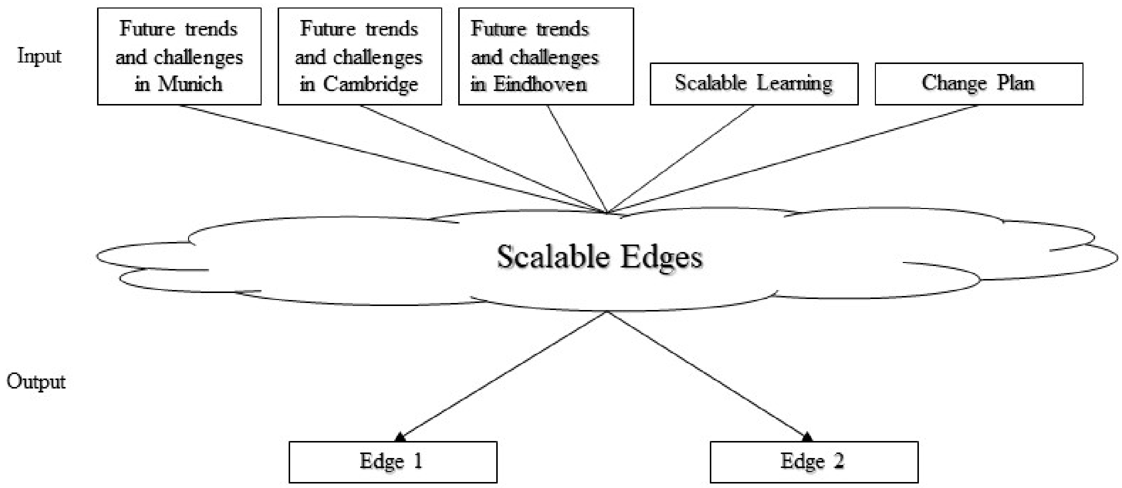


Figure 7.1: Structure and processes of chapter four.

7.1 Edge one: Scalable learning at the TU/e

A first future scenario is that knowledge workers in the innovation ecosystem of Eindhoven have greater entrepreneurial mindset than in the current situation (see section 4.1 and 6.2.1). To get this entrepreneurial mindset, experts argued that there should be more diversity and cross-fertilization in the innovation ecosystem of Eindhoven 5.2.3. In the current situation, I have identified two edges that will increase the entrepreneurial mindset and operate via the new scalable learning model (section 6.2.2).
These edges are the 'The Engine' and 'Innovation Space,' which are both parts of the TU/e. In both 'The Engine' and 'Innovation Space', students work on real-life problems in multidisciplinary teams. This means that the students have to use their imagination, creativity, and curiosity to get new innovative ideas to solve these problems. Also, they train (by doing) their social intelligence, and emotional intelligence by working together in groups with different backgrounds. Not only is this a great edge with regards to the scalable learning model, but it also utilizes other trends mentioned in this thesis to its advantage. For example, the driving force demographics explained that in the future the workforce would be more and more diverse, and because of individual empowerment, there will be more diverse working groups as well (6.1). So if the students are already trained to work in these kinds of teams, it will help them in their future career. By logic reasoning, I claim that solving real business problems with a diverse group of people is also one of the main characteristics of an entrepreneurial mindset. Therefore, when students are trained in this way, they increase their willingness to tackle other business problems by setting up business.

Innovation Space: Innovation Space is a community and facility that supports multidisciplinary, hands-on education, engineering design and entrepreneurship and a place where students learn to deal with complex societal and industrial challenges, create prototypes and develop innovations in collaboration with researchers, businesses, and each other [a]. **The Engine:** The engine is a collaboration between the knowledge institutions and the industry. Here, real problems are formulated as a big difficult challenge and solving them in teams. Also, often with a temporary residence of employees of the companies. It is a vibrant breeding ground, with research-hackathons, in the middle of the greater-Eindhoven ecosystem [b].

[a]Source: https://www.tue.nl/en/tue-campus/meeting-working-together/tue-innovation-space/
[b]Source: https://steinbuch.wordpress.com/2017/07/02/eindhoven-engine/

The real-life problems that will be tackled have to come from real businesses. To nurture the pipeline of problems that will be solved, Innovation space need and The Engine need partners (third parties) to provide them with problems and opportunities (resources). This is where CSM should become a partner for Innovation Space and The Engine to provide it with problems and research opportunities. I advise CSM to build this new *network link* via the bottom-up approach like the evolution of Cambridge (4.3). This created a powerful informal network; people knowing people that want to help each other without the necessity of financial compensation.
A first step would be to start promoting to companies on the HTCE to send their ideas, problems, old patents or anything else that needs a fresh look towards Innovation Space and The Engine. Next, CSM could build a network of mentors that can support students at Innovation Space and The Engine. This should be done from goodwill and the goal of creating a strong informal networked community like Cambridge.
I validated the ideas of a problem pipeline and mentor network at one of the employees of Innovation Space. He was very enthusiastic to start this informal network link between CSM and Innovation Space.
When there is an excellent informal relationship between Innovation Space, The Engine, and CSM, a formal connection can be realized. In this official relationship, one can think of creating a better

physical network link between the two campuses (5.2.3). Until the establishment of the formal connection, it is essential that CSM keeps a robust informal relationship. At the moment, Innovation Space and The Engine are still very young and need many resources to set up. However, because of the presence of the 'scalable learning' model in these two edges, I expect that these edges will become the new core of the TU/e in the future. That is why now is the perfect timing to start a relationship with these edges of the TU/e. When CSM helps to scale these edges over a sustained period, the relationship scales overtime as well. At some point, the relationship can be formalized.
Also, when CSM provides The Engine and Innovation Space with problems coming off the HTCE, students will feel more driven to visit the HTCE or even work at it. When students are coming to the HTCE to work there, CSM can create flexible workplaces for them. Then, students work at the HTCE on problems arising directly from the companies from it. In turn, this will improve the diversity and cross-fertilization in the entire ecosystem (see section 4.1 and 5.2.3). Figure 7.2 the steps that CSM could take to help scale this edge.

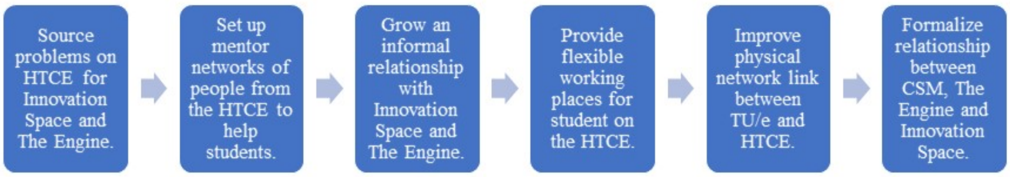


Figure 7.2: Overall process for scaling edge one.

By executing this edge, CSM actively provides their residents access to new a value source, therefore improving their facilitation in innovation processes of individual companies (van der Borgh et al., 2012). So, on an organizational (firm) level, this edge creates a new reason for firms to entry and reside on the HTCE. On the inter-organizational (ecosystem) level, this edge improves the value network and competitive strategy (van der Borgh et al., 2012). In turn, this creates a more vibrant innovation community. Therefore, if CSM executes this edge, they will gain value over an extended period as well. A variation on this edge is presented in appendix J; this modification does require more work though.

7.2 Edge Two: Light City Eindhoven

A second desired future scenario is that there is an entrepreneurial culture in the innovation ecosystem, risk capital present, talent present, and a robust internal community in the innovation ecosystem of Eindhoven (see section 4 and 6.2.1). This means that global companies, research institutes, universities, startups, and students are working together to solve business problems, find and provide new services, and establish new relationships. In other words, the future scenario would be to set a scalable learning setting inside the innovation ecosystem of Eindhoven. To realize this, these actors must have a reason to start collaborating with each other. As seen in Cambridge (4.3), the way of doing this is to create a shared identity over the entire innovation ecosystem. In Cambridge, this happened over the course of 70 years, but in Eindhoven, this is also possible in a fraction of that time. To do so, actors in the innovation ecosystem must not only have a mindset of maximizing their own value but also get a personal connection to the innovation ecosystem and try to maximize the ecosystem's value as well (Blasini et al., 2013). This means that a shared identity over the innovation ecosystem must be created and every actor must have a personal connection with that shared identity. According to M9, a shared identity comes from two aspects; the overlapping technological domain that actors in the innovation ecosystem have in and the history they all share with each other. Next, these two aspects will be discussed.

A good starting point is the HTCE. The current application areas of the HTCE are health, energy and smart environments. However, these application areas cover the markets that the companies of the HTCE are in. These organizations share the common technological theme of *Light*(including optic and photonic technology). For example, Philips Lighting works on light in smart environments. Royal Philips works with photonic systems in health systems, Holst Centre with OLED in smart environments, Solliance with solar power technology, ASML with photolithography systems, and SMART photonics uses light in photonic semiconductors. Not only high tech companies share light as a technological domain, designers and artists also use light in their work, which means that the design academy has a special connection with light as well. Overall, this means that a variety of actors have an affiliation with this specific theme. Therefore, *Light* could become the shared identity of the innovation ecosystem. However, as mentioned earlier, the shared identity must be rooted in the history of an innovation ecosystem as well.
With regards history, Eindhoven, as a whole, has its roots in *Light*. Back in 1891, Philips started producing the first light bulbs near the city center. As mentioned in 4.1, this was the start of the city Eindhoven. The light bulb made Philips a huge success, and this made Eindhoven a prosperous town as well. Other companies like ASML, NXP, Philips Lighting, and even the TU/e find their roots in Philips' story as the inventor of *Light*. On top, Eindhoven's story with Philips and its light bulb are known throughout the world. Therefore, it makes it even more clear why startups, investors, and talent should come to Eindhoven: To innovate *Light*!

Because the of the facts I described above, I strongly suggest that Eindhoven should use the shared identity of *Light* as the edge to transform the innovation ecosystem towards a scalable learning model. This means that global companies, research institutes, universities, startups, and students are working together on the technological theme of *Light* to solve business problems and find and provide new services. Also, according to M9 and E2, it is essential that an innovation ecosystem should take a long-term view and should become known around one theme and can carry out the same simple message over a sustained number of years. This theme, shared identity, and message would be that every startup, investor, designer, artist, and company who feels attracted to the newest technology based around *Light* must come to Eindhoven.

Next, I will discuss how to scale the edge *Light* over time till it becomes the new core of the innovation ecosystem. A startup accelerator/incubator based on light technology would be a good start because it can bring multiple actors together without interfering with the current operations of the companies. Here, CSM can become the main initiator to scale this edge. To do so, I advice CSM to form two teams. A strategic and operational team. The strategic team consists of regional and international "pragmatic bridgebuilders" (M9) who understand the industry, startups, and academics. To avoid politics, CSM should not select these people based on their current job position, but on their open mindset and personal visions (M9). The strategic team is responsible for developing the blueprint of the edge. In turn, the operational team will execute the visions of the strategic team. The role of CSM in scaling this edge is threefold:

1. Someone of the management team should be present in the strategic team to set a direction for the future.
2. CSM should provide the startup accelerator with housing on the HTCE.
3. CSM can use its marketing platform to promote this edge (see 'marketing platform').

Figure 7.3 shows the process of how to effectively build a startup accelerator with the entrepreneurial ecosystem around it. I developed this process based on the interview I had with M9 and iterated it several times with him.

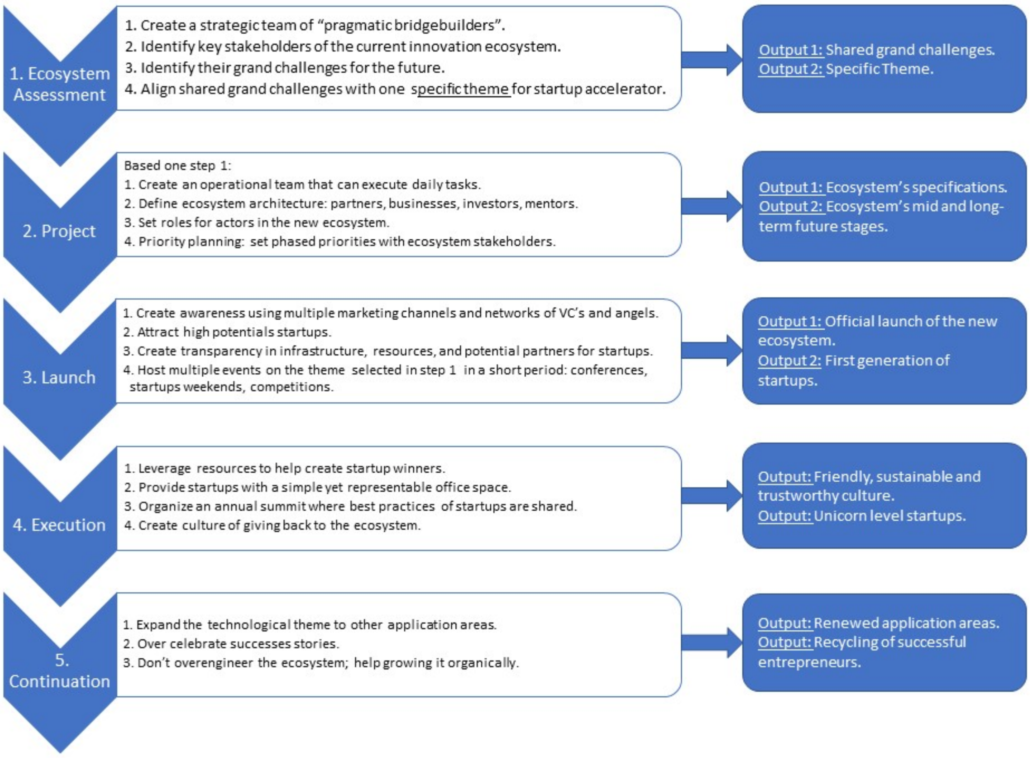


Figure 7.3: Process to build an startup accelerator with an entrepreneurial ecosystem around it.

When CSM decides to execute this edge, it should keep the following in mind. First, companies who are not affiliated with the technology domain might feel pushed off the campus. Second, it is essential, but very difficult, to involve companies and research institutes in the correct setting (according to m9). The correct setting is that the companies can *join* the edge, but not *control* it. Third, a good first round of high potential startups is essential to create the feeling of success in the innovation ecosystem.
After step one, which is to build the startup accelerator based on light, CSM can use other best practices to scale the edge. The other best practices were gathered via the interviews I had in Munich and Cambridge. I selected them because of their link with scalable learning. Figure 7.4 shows the overall steps CSM can take to scale the edge of *Light* further on the HTCE. On the next page, these best practices are explained in detail.

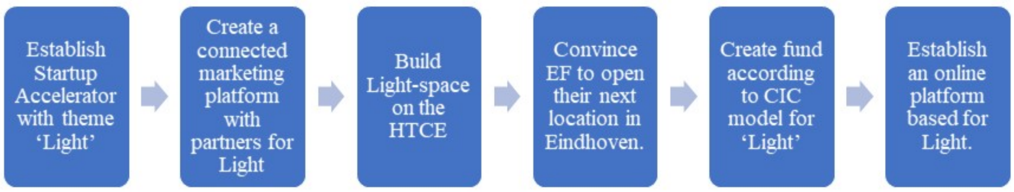


Figure 7.4: Steps CSM can take to further scale the edge of light on the HTCE.

HTCE: marketing platform
This best practice is the combination of the mega trend 'enabling technology' and the trends of

'open data innovation'(C5) and B2B2C models (C5, C6). I observed that the marketing department of CSM is using an inbound marketing and sales software. This tool saves data of people who have visited the website of the high tech campus and by doing so creates more transparency for CSM who is interested in the High Tech Campus. Currently, this information is only for internal usage, but this information can also be of great interest for residents on the High Tech Campus or the rest of the innovation ecosystem. For example, when in a single month, a substantial amount of people looking on the 'solar' application field of the website, this means that there is a lot of interest in the topic. Then the HTCE can proactively communicate to campus residents on this field that a lot of people are interested in this particular topic. In turn, residents and CSM can organize a specific event on this theme and attract people who were interested in the 'solar' application. This process is illustrated in figure 7.5. When performing this effectively, CSM can

Figure 7.5: Data flow between actors.

create a new source of value for its residents by giving heads up for interesting events they can organize. CSM also captures value, because events will most likely be given in the conference center of the HTCE. Most importantly, residents will see CSM as a proactive partner that wants to ensure success for both parties. As seen in Cambridge, this increases the chance of residents providing services back to the CSM, creating a stronger connection on the organizational and ecosystem level (van der Borgh et al., 2012).

Light-space

Another best practice that CSM can is 'mega space' from Munich (see section 5.2.1). Mega space is an all-in hotel for startups. It gets an office, it gets money to survive, it gets access to a network, and there is a maker space with the necessary equipment. According to M9, that is it. Then the ecosystem attracts the best talent and startups from all over the world. This edge is also in line with the scalable learning model because you bring people together based on their imagination, creativity, curiosity, and entrepreneurial drive towards light and put them in a building where they can learn faster from each other. This kind of building can be constructed on the HTCE as well. However, to make sure that this is not becoming just a property play, it must be done when the shared problems of large companies on the HTCE are evident. Then, CSM and the other stakeholders know what kind of technical infrastructure is needed to help specific startups accelerate their technology.

Company Builder: Entrepreneur First

In section 5.2.2, C8 introduced the Entrepreneur First (EF) model. Here, entrepreneurs are brought together based on their talent and individual entrepreneurial drive (5.2.2). From 2011 to date, EF has helped 500 entrepreneurs building 100 startups which have total evaluation over $ 1 billion dollars [1]. Reid Hoffman, CEO of Linkedin and investor in EF, says that this model is helpful an area that has talent, creativity, and interest towards entrepreneurship but has not yet developed an entrepreneurial culture [2]. Hoffman adds that he would like to see this model grow to 50 other cities around the world. According to the results in chapter 4, this would fit in the situation of the innovation ecosystem of Eindhoven. Also, the EF model and the scalable learning model (6.2.2) have almost identical characteristics (maybe that is why it is working so good). Therefore, I expect it will give a boost to the entrepreneurial culture in Eindhoven.
Because of those reasons, I advice CSM to invite EF to come the HTCE and show them why the

[1]source: https://techcrunch.com/2017/09/11/ef-greylock/
[2]see footnote 1

next location of EF should be there. Or they can to incorporate the EF model in own startup accelerator. However, CSM should try to connect with EF first because of the huge network of investors and alumni they have.

Seed through exit venture capital fund
With regards to venture capital (finance), CSM can strengthen the startup accelerator with a VC fund. This venture capital fund will be similar to the fund of Cambridge Innovation Capital (CIC)(see 4.3.2). The University of Cambridge created CIC to fill the funding gap of one million and above (C9). The same funding gap is present in the innovation ecosystem of Eindhoven(4.1). A regular VC can fill this gap, but these funds tend to focus on short-term profits (=scalable efficiency), which can be damaging for the startup founders. CIC focuses on long-term profits, and it supports the startup along the way (=scalable learning), which a win-win for everybody and creates a founder-friendly ecosystem (C9). Appendix K shows the structure of the CIC fund. The CIC model can be used for the light accelerator as well. This means seed through exit fund is created to fund world-class innovation on optical technology in Eindhoven. Every investor that believes that light technologies are the future in chips, solar, or just cool, can invest in the fund. So using the CIC capital fund as a best practice in the concept of optics will help to solve the problem of risk-averse capital and works according to the scalable learning model as well (6.2.2).

Online Platform
As mentioned in section 6.2.2, in the future, an innovation ecosystem system will be a pool of talent that will form small teams or diverse work-groups which collaborate with companies on different projects over extended periods of time. Also the future digital will bring platform-driven ecosystems in which multiple actors participate [3]. Combining these two notions creates the idea that the theme light can become a platform-driven ecosystem. This platform shows all technological infrastructure, capital funds, experts, startups, crowdsourcing options in the theme of *Light*. People can connect via this platform based on the ideas they have and together they can reach the physical infrastructure via the online platform. In fact, in the future, they can even design their products via this platform. NVIDIA created Holodeck, a photorealistic, collaborative virtual reality environment. The Holodeck environment allows creators to import high-fidelity, full-resolution models into VR to collaborate and share with colleagues or friends and make design decisions more comfortable and faster. This might be still far away but can hold a lot of potential value. Also the most the most influential companies will be the ones that position themselves as platform owners. This makes a straightforward rule: HTCE becomes a platform, or it will be killed by one [4]. Therefore, I strongly advice CSM to start looking for ways to platform their business. As a start, it can change its vision to "*High Tech Campus is the best platform to put passion into successful business*".

Last, I will discuss why scaling this edge 'strengthens' the HTCE and later the innovation ecosystem of Eindhoven to become future proof. On the inter-organizational (ecosystem) level, this edge makes the innovation future proof by creating:

1. A subsystem which endorses scalable learning on the HTCE.
2. A shared identity on the HTCE and Eindhoven.
3. A more diverse innovation community on the HTCE and Eindhoven.
4. A vibrant entrepreneurial ecosystem on the HTCE and Eindhoven.
5. A simple message for startups and investors to come to the HTCE and Eindhoven.

Recall that these are the main enablers for a functioning innovation ecosystem, a great entrepreneurial culture in the innovation ecosystem, risk capital present, talent present, and a strong internal community in the innovation ecosystem. Therefore, when scaling this edge, CSM creates a functioning innovation ecosystem on the HTCE. In turn, this will help them to make the ecosystem of Eindhoven future proof.

[3]source: https://hackernoon.com/technology-inst-fast-enough-in-a-platform-economy-d6627fd97a27
[4]Source: https://hackernoon.com/technology-isnt-fast-enough-in-a-platform-economy-d6627fd97a27

Chapter 8

Follow-Up Phase: Conclusion & Implications

In this chapter, I draw conclusions for following parts. Firstly, I answer the research question of section 3.4. Secondly, I zoom in on the practical implications for Campus Site Management. Thirdly, I discuss the theoretical implications and future research directions. Lastly, I reflect on the foresight methodology and discuss the limitations of it.

8.1 Answer to the Research Question

This study investigated how the innovation ecosystem of Eindhoven can be strengthened to become future proof. To investigate this, I performed an innovation system foresight study. I used qualitative data from industry experts in three different innovation ecosystems to gain insights into the future. The client, High Tech Campus Site Management, was interested to find out how the innovation ecosystems of Munich and Cambridge have evolved, are functioning, and should be further developed (according to experts working in them). The data from the other two innovation ecosystems were used to extrapolate on how CSM can strengthen the innovation ecosystem of Eindhoven.
To bring structure to this enormous task, I split the project up into four parts; mapping of the current situation, foresighting in future trends and challenges, constructing future scenarios, and developing actions for the innovation ecosystem of Eindhoven. Now I use the information gained from these chapters to come to an answer to the main research question:

"How can CSM 'strengthen' the innovation ecosystem to become future proof?"

I used two units of analysis: Firstly, I studied the broader innovation ecosystem of Eindhoven and secondly developed actions for specifically CSM to 'strengthen' the HTCE and Eindhoven. Also, project took a longitudinal view to answer the research question. This implies that the evolution, current situation, and future insights are used to come up with an answer. Based on the analyses of chapter 4 and 6, I concluded that the investigated innovation ecosystems evolved in two different ways. In Munich and Eindhoven, the innovation ecosystems evolved according to the *Scalable Efficiency* model. This is mostly due to the fact that big corporations were the primary driver in the evolution of those innovation ecosystems. Therefore, work in these innovation ecosystems is defined as a set of routine, predictable, standardized and highly integrated tasks. Furthermore, Cambridge evolved via entrepreneurs building small businesses and selling them when the technology was proven. Here, work evolved around solving business problems, finding and providing new services, and establishing new relationships. This definition of work is called *Scalable Learning*.
Based on the foresight analysis, I concluded that three forces will have a significant impact on

individuals, organizations, and government (i.e., the entire innovation ecosystem). Exponential technologies are going to transform the *nature* of work, demographics changes will transform the *workforce*, and individual empowerment will shift the *relationship* between employer and employee. Reflecting these forces on the two definitions of work, I concluded that scalable learning gains potential in the future while scalable efficiency loses its potential. This is primarily due to the fact that scalable efficiency works best in stable and predictable environments. The previous century was stable and predictable, but the coming century will increasingly be unstable and unpredictable. The innovation ecosystem of Eindhoven already feels the barriers of scalable efficiency. These barriers are a non-entrepreneurial mindset, risk-averse (corporate) venture capital, the lack of talent, and the local competition which affects the feeling of a shared identity and message to the outside world.
To become future proof, the innovation ecosystem of Eindhoven and all actors in it must change the current model of scalable efficiency to the model of scalable learning. In turn, this will also solve the main barriers the innovation ecosystem faces today. This means that institutions have to fundamentally change themselves, which will be a long and painful process. Fundamental to institutional innovation is that it should not be done top-down. Instead, the innovation ecosystem should identify an 'edge' that embraces scalable learning and scale that via third-party resources until it becomes the new core of the innovation ecosystem. I identified two different edges in the innovation ecosystem of Eindhoven. The first edge consists of two initiatives from the TU/e, these are 'Innovation Space' and 'The Engine.' In both cases, students work on real-life problems in multidisciplinary teams. I argue that it is the job of other actors in the innovation ecosystem to become a third party in scaling these edges. The role of CSM is to fill the pipeline of problems and research opportunities for 'Innovation Space' and 'The Engine' by proactively sourcing them on the HTCE. Additionally, CSM should set up a mentor network to provide Innovation Space and The Engine with mentors for students. The other edge that embraces scalable learning is in the form of a technological theme for the entire innovation ecosystem of Eindhoven. Together with an expert, I analyzed the key actors and history of Eindhoven. We concluded that technological theme, shared identity and a simple message to the outside world for Eindhoven is *Light*. Using this theme, the innovation ecosystem can attract startups and investors to overcome the barriers it faces today. The role of CSM is to become the leading initiator and sponsor to scale this edge, this should edge should be initiated on the HTCE and later be expanded to rest of Eindhoven. The first step is to build a startup accelerator based on the theme *Light* for health, energy and smart environments. To do so, CSM should create a strategic team with "pragmatic bridgebuilders" and an operational team to execute the plan for the startup accelerator. This edge can be scaled over time using best practices I found during the analysis; a marketing platform, Light-space, Company Builder: Entrepreneur First, seed through exit venture capital fund, and an online platform.
By scaling these two edges in the long term, they can become the new core the HTCE and later the *entire* innovation ecosystem. When the edges become the new core of the innovation ecosystem, CSM has successfully strengthened the innovation ecosystem of the HTCE and Eindhoven and is likely to become future proof.

8.2 Practical implications for Campus Site Management

This part provides the practical implications for Campus Site Management. First, I will briefly explain my opinion on the level of impact CSM has on the current situation and future. Second, I elaborate on what CSM can learn from Munich and Cambridge. Last, what CSM can do to develop their innovation ecosystem further.
For CSM it is crucial to understand that the evolution of an innovation ecosystem has an enormous impact on the situation as there is today. Just like many people say that you can't replicate Silicon Valley somewhere else, it is also impossible to copy the innovation ecosystem of Eindhoven, Munich, and Cambridge to another place. Historical events in an innovation ecosystem created the mindset that is present today and changing the mentality of people is something that is extremely difficult to do.

Trying to change a mindset of an entire innovation ecosystem top down does not work because the immune system, in the form of the actors of the innovation ecosystem, will kill the change CSM tries to create. Therefore, for the future, CSM must create a small setting that facilitates communication, knowledge transfer and collaboration. Overtime they can scale this small setting and make it the new core of the HTCE and later the entire innovation ecosystem.
According to the analysis of chapter 6, this is not endorsed in a world of scalable efficiency (6.2.1) but is encouraged in a world of scalable learning 6.2.2. Therefore CSM should create a setting for scalable learning on the HTCE. Based on chapter 7, CSM can do this in two ways. First, I advice CSM to do this via setting up a startup accelerator on a theme that all large companies on the HTCE have an affiliation with. This topic is *Light* with optic and photonic technology included. CSM can organize hackathons, startup weekends all based around *Light* in the three application areas the HTCE has. This way, startups and investors from all over the world can come to Eindhoven to help the globals and research institutes speeding up their technology transfer in the scope of *Light* and setting of scalable learning. Over time, this creates a solid base of startups on the HTCE and will make the High Tech Campus future proof, later this should be expanded over the rest of the innovation ecosystem of Eindhoven. The first step would be to establish a startup team with "pragmatic builders" and execute the process provided in section 7.2. When CSM successfully established the startup accelerator based on light, it can further scale the edge by creating a connected marketing platform with partners on the edge of light. Next, it can build Light-Space, a shared office building with all high tech infrastructure needed by the startups (or make Philips Innovation Services a partner). Then, CSM can attract EF to open their next location on the HTCE (or initiate an own accelerator based on the EF model). Later, it can create a venture capital fund based on the model of Cambridge Innovation Capital specifically for startups that use light as a technology. Last, CSM can attract a partner to create an online platform based on the theme light with a variety of services on it.
Besides scaling this edge to let it become the new core of the HTCE, it should keep attracting high-tech corporates, SMEs, and startups on the strategic areas they have set themselves. However, they should keep in mind that a healthy mix of residents is necessary for a well functioning ecosystem (5.2.2). Based on information I gained in Cambridge, CSM should proactively support startups and SMEs using financial and non-financial resources. When a startup becomes successful, it will look to its history and is more likely to return the favor to the ones that supported them from the very beginning. Next to that, several startups are growing too fast for the office space they have on the HTCE. To make sure that they will not choose other places to continue their business. CSM should create new offices with competitive rents for startups. CSM can also choose to outsource this to for example 'WeWork,' a highly successful startup that creates shared office spaces globally. By choosing WeWork, the HTCE gets connected to an international network of startups.
Next, CSM should become the third party that scales the initiatives done by the TU/e. To do that, they can use their network on the HTCE to nurture the pipeline of problems and research opportunities needed at Innovation Space and The Engine. A first step would be to start showing The Engine and Innovation Space on all screens on the HTCE, endorsing all campus residents to send their unused IP or current problems to these initiatives. Besides, CSM should also promote HTCE residents to become a mentor for these student teams. These bottom-up approaches should be used to create an open community of people that like to discuss ideas with each other (how Cambridge is developed over time as well). Like in Cambridge, when the bottom up approach simply does not work anymore because of the 'chaos' it created, CSM has an excellent foundation to formalize the collaborations with the University.

8.3 Theoretical Implications for Future Research

Although I did not use a theoretical framework in my study, I can still contribute to existing theory by providing new insights in the process of collaboration for innovation in high-knowledge industries. During the analysis of the innovation ecosystems, I noticed that there were differences in evolution of them. These evolutions in innovation ecosystems resulted in different current situations. Moreover, it stroke me that most experts were highlighting the mindset and culture of people as a primary factor for a "working" innovation ecosystem. Which goes beyond Porter (1998), who concluded that loosely coupled companies and institutions in a particular sector foster entrepreneurship and innovation. Munich had interrelated companies and institutions in a particular sector, but experts argued that there was no entrepreneurial and collaborative mindset. In contrast, Cambridge had no interrelated companies and institutions in a particular sector, but experts highlighted the entrepreneurial and collaborative mindset. This means that having the complementary actors in the same geographic location does not necessarily mean an entrepreneurial and collaborative culture. However, mainstream literature tends to focus on creating the right roles for actors in a small geographic location. When this is optimal, it's expected that the innovation ecosystem is functioning well. However, I disagree and argue that there are more factors in play. Boschma (2005a) found the same and argued that geographic proximity just facilitates four other important factors (=proximities), which are: organizational, social, institutional and cognitive proximity. These proximities describe why some innovation ecosystems function well and other's fail to function. Also, this means that there is an (optimal) level across proximities whether the connection between actors will lead to a higher level of innovative performance or not (Boschma and Frenken, 2010). This is indeed the case in Munich, Munich has a gap between structural inputs and entrepreneurial and innovation outputs while Cambridge has the opposite. Munich puts in a lot of effort to create an entrepreneurial culture, but experts argue that the culture is lacking (see section 4.2). Cambridge has a great entrepreneurial culture, but there were a no structural efforts to create one. Experts mentioned that it just happened overtime4.3. The proximities of Boschma (2005a) provide an explanation for this gap in inputs and outputs. Therefore, I connect the proximities with the findings in my study. To do so, I build on earlier work of Ben Letaifa and Rabeau (2013), a researcher in this field, who showed that geographic proximity does not explain social proximity nor fosters collaboration for innovation. Her multi-level case study led to three propositions:

1. **Proposition 1.** "Geographic proximity does not lead to social proximity, especially in high-rivalry contexts.
2. **Proposition 2.** Formal institutionalized clusters impede spontaneous social proximity.
3. **Proposition 3.** Geographic distance is seen as an accelerator of entrepreneurship and innovation."(Ben Letaifa and Rabeau, 2013, p.2077)

Here, *geographic proximity* is defined as the physical distance between the players (Howells, 2002). *Social proximity* relates to the individuals' levels of relationships and includes trust based on friendship, kinship, and experience (Boschma, 2005b). The nature of relation between actors is defined as *institutional proximity* (Moore, 2006). This includes weak ties, a joint venture, or a well-coordinated and interdependent innovation ecosystem. Last, *cognitive proximity* relates to the shared view that actors perceive, interpret and evaluate the world.

Using the findings in my research, I can build on the future research suggestions of Ben Letaifa and Rabeau (2013); she suggested a longitudinal multiple case study should compare the evolution of spontaneous and institutionalized ecosystems to build on the propositions stated above. This is exactly what I did during my study, therefore, I can connect the two studies. In my study, I argued the evolution of Munich is institutionalized while the evolution of Cambridge is spontaneous. Eindhoven developed itself spontaneous until the triple helix collaboration was established in the 1990s. From there on, Eindhoven evolved in a more institutionalized way.
Next, I will discuss each proposition individually using the findings in each case (i.e. Munich, Cambridge, and Eindhoven).

Proposition 1. Geographic proximity does not lead to social proximity, especially in high-rivalry contexts.

Ben Letaifa and Rabeau (2013) challenged the existing literature by arguing that geographic prox-

imity not directly increase trust, social relationships, and collaboration. This study supports this proposition because of its findings in the innovation ecosystem of Munich. According to experts in Munich, there was a fierce competition inside the innovation ecosystem for startups. Some experts even claimed that corporate accelerators forbid their startups to engage any form of relationship with their competitors. Another expert argued that every time he links his colleagues (CTO's, head of developments, product managers) to a startup, his colleagues want to have an NDA signed. He adds that the startups are not open as well, they believe that the corporate will steal their idea. These two examples show that geographic proximity does not increase any curiosity or trust (social proximity) between the startups and corporates in Munich. Also, these findings are in line with Fitjar et al. (2016), who argues that geographic proximity not automatically lead to useful relationships between actors.
In contrast, an expert is Cambridge explained that two companies in the same kind of business (so competitors), each chose a different niche to give each other room in the other one market. According to the experts, this was an act based on friendship and kindship. So in this case, one could argue that geographic proximity did lead to social proximity. So why does one geographic location did lead to social proximity and the other not? This study adds that the evolution of an innovation ecosystem has a *moderating effect* on the relationship of geographic proximity on social proximity. Based on the longitudinal view I took, I found that the evolution of Munich is based on successes of individual companies and government interventions (=institutionalized ecosystem). It appears that this negatively affects the relationship of geographic proximity on social proximity. The evolution of Cambridge is bottom up without government support (=sponteanous). Therefore individuals had to collaborate to succeed. This evolution appears to have a positive moderating effect on the relationship between geographic proximity and social proximity.
The theoretical implications above contribute in two ways. First, it provides more generalizability to the findings of Ben Letaifa (2014). Second, it opens up a possibility for future research that investigates the effect of geographic proximity on social proximity with ecosystem evolution as a moderating effect (spontaneous or institutionalized).

Proposition 2. Formal institutionalized clusters impede spontaneous social proximity.

I found that the evolution of the innovation ecosystem of Munich is characterized by economic policies like 'BayTEP' and the 'Cluster Initiative.' These policies created transparency and collaborations between companies. However, experts argued that this has made companies very reactive (passive) in the innovation ecosystem. They collaborate because the government provides the funding to collaborate. Also, experts argued that in the current situation, people should try harder to keep people engaged in the innovation ecosystem (meaning that more spontaneous social proximity is needed). This is in line with Ben Letaifa and Rabeau (2013) who claims that artificial clusters start collaborations based on geographic, organizational, cognitive and institutional proximities rather than social proximity. This institutionalized evolution of Munich created passive and reactive companies in the ecosystem, in turn, the passiveness impedes the creation of spontaneous private networks. The Munich case is in line with proposition two of Ben Letaifa and Rabeau (2013), which increases the generalizability of it.
On the other hand, the innovation ecosystem in Cambridge evolved based on social proximity: individuals starting companies based on friendship and trust. According to interviewees, there were no economic policies during the evolution of Cambridge; this means that Cambridge is not a formally institutionalized cluster. This resulted in a current situation with a highly informal network. Experts mention that there is already so much happening in Cambridge that people are less interested in looking for a partner outside of it. This statement highlights the spontaneous private networks of Cambridge. To conclude, Cambridge developed itself without any economic policies, and this resulted in a great private, spontaneous network. The Cambridge case is in line with the second proposition of Ben Letaifa and Rabeau (2013), therefore, generalizing the results of her study.
This proposition is difficult to generalize for Eindhoven case. Eindhoven *did* evolve spontaneous but *not* using social proximity as a basis. Instead, I argue that Eindhoven evolved with institu-

tional and cognitive proximity as a basis. In the current situation, this resulted in cooperation and knowledge spillover between firms. However, experts argue that different groups of people are sitting in their castle and are not well integrated. This may be the result of too much institutional and cognitive proximity in the innovation ecosystem, resulting in a lack of understanding and communication (Nooteboom, 2000). This is also in line with Molina-morales et al. (2015) who claims that too much cognitive proximity and institutional proximity degrades the formation of inter-cluster linkages. This seems to be the case in the innovation ecosystem of Eindhoven, that there are too many people and companies with a similar view on a single campus, resulting in a lack of inter-campus linkages. However, I used logical reasoning to make this statement. Therefore, future research must validate if a high cognitive and institutional proximity on campuses results in a lack of inter-campus linkages in the broader innovation ecosystem.
To conclude this proposition: while Munich evolution appears to be in line with institutionalized innovation ecosystem and Cambridge spontaneous innovation ecosystem (and thus strengthening the generalizability of the proposition), Eindhoven's evolution is not directly in line with either of the two. This suggests that other factors, like cognitive and institutional proximity, are also in play. An additional explanation might be found in the dominant definition of work in the innovation ecosystem (i.e. scalable efficiency or scalable learning). As argued in this study, Munich and Eindhoven share the same evolution with regards to scalable efficiency while Cambridge is more in line with an evolution in scalable learning. In the current situation of Munich and Eindhoven, employees do the set of tasks that their employer expects from them. Therefore, if the employer does not tell them to establish new relationships to solve business problems, the employees will not engage in social activities. This might be an answer why there are less private spontaneous networks in Munich and Eindhoven.
Overall, the implications of Cambridge and Munich contribute to the generalizability of the results of Ben Letaifa and Rabeau (2013). The implications in Eindhoven suggest that future research is needed between spontaneous social proximity and dominant definition of work in the innovation ecosystem.

Proposition 3. Geographic distance is seen as an accelerator of entrepreneurship and innovation.

Ben Letaifa and Rabeau (2013) based this proposition on a single case study in a *ICT* ecosystem, she highlighted that individuals would rather work with global companies that are geographically far away. Then trust is easier to build because both entrepreneur and global company do not feel threatened in their local market. I will validate this claim by testing it on three other cases.
Because there were large companies present throughout the evolution of Munich, one can argue many potential entrepreneurs ended up working for large companies, therefore limiting entrepreneurship and innovation. However, experts also highlighted that the close proximity of global companies makes it attractive for startups because it has its first customers geographically close. Nonetheless, both startups and globals were not open to share their ideas with each other and this could be because of the local competition. However, the local competition argument can be refuted by the fact that in the early stages of the Munich innovation ecosystem, there was a lack of social proximity because each company was pursuing individual success and the result of this is the third proposition of Ben Letaifa and Rabeau (2013). Overall, the discussion stated above does not provide a clear indication that geographic distance by itself explains entrepreneurship and innovation in Munich. Instead, the arguments suggest that other proximities are in play as well. Therefore, the Munich case does not support proposition three of Ben Letaifa and Rabeau (2013). Future research should investigate how the other proximities evolved during the development of the innovation ecosystem of Munich.
For the case of Cambridge, one of the experts stated that one of the reasons why Cambridge is so successful could be the fact they are close enough to the global companies for the action but far enough to don't get the struggle of them. This statement suggests that too much geographic proximity would impede entrepreneurship and innovation. However, geographically too distant from the 'action' is limiting as well. This is in line with previous research of Boschma (2005b), who concludes not only too little but also too much proximity may be harmful to interactive

learning and innovation. Therefore, based on the Cambridge case and Boschma (2005b), I suggest that the relationship between geographic proximity and entrepreneurship and innovation is a *inverted U-shape*, the optimum might be somewhere in the middle. However, this is not in line with Ben Letaifa and Rabeau (2013), who says that more distance will accelerate entrepreneurship and innovation. The case of Cambridge highlights that the optimal scenario is somewhere in the middle. Future research could try to find to optimal geographic proximity for entrepreneurship and innovation. However, given the complexity and interrelatedness of all the proximities, this will be extremely hard to do.
The last case is Eindhoven. The evolution of Eindhoven is similar to Munich, but with less global companies involved. However, experts did emphasize the importance for engineers to be near each other to learn and interact with each other, which contradicts the proposition above. The additional explanation might be found in the increasing technological complexity of high tech hardware that is being developed in Eindhoven. This requires more inter-firm collaboration at short geographical distances. This is in line with the findings of Balland et al. (2013), who investigated the role of proximities in the video game industry and found similar explanation. In another context, like the ICT ecosystem that Ben Letaifa and Rabeau (2013) investigated, geographic proximities might matter less because code can easily be communicated via the Internet. This is not the case for high-tech hardware. Therefore this study adds the proposition of Ben Letaifa and Rabeau (2013), that geographic distance, as an accelerator of entrepreneurship and innovation, is highly *context dependent* and therefore not generalizable.
I will go one step further, if geographic proximity becomes context dependent and not generalizable, it becomes clear that geographical proximity is neither a necessary nor a sufficient condition for innovation (Boschma, 2005a). Therefore, I argue that one should not look at the geographic distance to accelerate entrepreneurship and innovation. Instead, as I have seen in Cambridge, an innovation ecosystem must focus on creating a collaborative culture where actors catalyze entrepreneurship and innovation. This is in line with Ben Letaifa and Goglio-Primard (2016), who argues that clusters must first build trust, social ties, and relationships to catalyze entrepreneurship and innovation. For individuals, building trust, social ties, and relationships require work to be defined by these activities.I used the notion 'scalable learning' for work defined by social ties, and relationships. Therefore, my study adds a new view to the existing theory: when work in an innovation ecosystem is defined around scalable learning, the culture in an innovation ecosystem will become more collaborative. In turn, a more collaborative culture catalyzes entrepreneurship and innovation (Ben Letaifa and Goglio-Primard, 2016).
Via these steps of logic reasoning, two future research directions can be formed. First, when scalable learning is the dominant model of work during the evolution of an innovation ecosystem, entrepreneurship and innovation will be high. Second, when scalable efficiency is the dominant model of work during the evolution of in an innovation ecosystem, entrepreneurship and innovation will be low.

Via the theoretical discussion, I provides more generalizability to the propositions of Ben Letaifa and Rabeau (2013) by reflecting them on multiple cases by using a longitudinal view. Also, because of the longitudinal view I took, my study added several new insights and future research directions to the existing literature of proximities in ecosystems. Besides, appendix L provides *eight* other future research future suggestions related to the open innovation literature.

8.4 Reflection

Here, I reflect on the 'innovation system foresight' methodology as a theoretical framework for analyzing innovation ecosystems in their current situation as well as systematically trying to link current problems with future opportunities (Andersen and Andersen, 2012). To confirm or deny this statement, one has to know why Andersen and Andersen (2012) combined foresight with the innovation system approach of Bergek et al. (2008). In the past, researchers criticized that foresight is highly context-dependent and therefore hard to generalize to theory (Cariola and Rolfo, 2004). Also, foresight was criticized because it emphasized toward priority setting instead of implementing insights and realizing structural change (Edler and Georghiou, 2007). To tackle these problems, Andersen and Andersen (2012) combined foresight with the innovation system approach of Bergek et al. (2008). The reason Andersen and Andersen (2012) chose the innovation-system approach was because it mainly focused on understanding the evolution of innovation and identifying current barriers. Therefore, it can give foresight tools for addressing such issues systematically and try to link current problems with future opportunities. I can confirm that the combination of foresight and the innovation system approach helped me to find the main problems of the innovation ecosystems. However, given the high context-dependency of the selection of participants and area of interest, external validity and reliability cannot be assured, and this is a limitation of this research. However, I can confirm the innovation-system framework can supply *some* founding for decision making and therefore make it analytically coherent (Andersen and Andersen, 2012).
With regards to the goals of this research (3.3) and innovation system foresight (3.6.2), I can confirm that the methodology presented by Andersen and Andersen (2012) can accomplish those goals and so I advice other researchers to use the approach to reach similar goals. Next to that, I believe that innovation system foresight is a useful methodology for exploratory research without a strict theoretical scope. For exploratory research with a strict theoretical scope, other methodologies will be more suitable.

I did not use a strict theoretical framework to investigate the current situation in innovation ecosystem; therefore, the findings of the mapping phase are difficult to generalize as proof why innovation function. Future research can examine if the main barriers for a functioning innovation ecosystem are indeed the four that I identified in this study.
During the foresight phase, I did not use a theoretical framework at all to investigate how to make innovation ecosystems future proof. Therefore, the findings of chapter 5 have limited validity and generalizability. However, in appendix L I suggested several ways for to create a theoretical foundation the findings. For example, the findings of this thesis can be used for further development of a conceptual framework on how start-ups and large firms can collaborate in a mutually advantageous way (Usman and Vanhaverbeke, 2017).
I did not use a theoretical framework to construct future scenarios. Instead, I used several reports to converge from seven megatrends to three forces of change. Then, via logic reasoning, I connected scalable efficiency and scalable learning to the evolution of the three innovation ecosystems. Since no theoretical framework was used during this phase, it limits the validity and generalizability of the findings. I suggest that future researchers investigate the effect of scalable efficiency/learning during the evolution of innovation ecosystems on the current mindset in them. In section 8.3., I presented useful starting points to do so.

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Appendix A

Research Background

Innovation System Generations

If future Innovation systems are going to be predicted, then the history of innovations sytems have to be explained first. Did companies change their innovation strategies in the past? And which innovation strategies are firms using at the moment to ensure successful innovations?

Before World War 2, science was not seen as an important factor for production and economic growth. This changed after the war due to the fact that science helped the allied forces winning it (Lundvall and Borrás, 2005). The 'science-push' model emerged, this process started from basic science by a firm, then via its own design and engineering made into a product, manufactured by the production, promoted by marketing and finally sold by sales. This meant that innovation was seen as a linear process (Dosi, 1982). The main assumption was that the successfulness of new products, was only dependent on the amount of R&D a company was doing (Rothwell, 1994). Only little attention was given to the actual transformation process itself or what the customer needs were.
In the mid 1960s, the focus changed from R&D to growth, productivity and large scale industry. Most products introduced were based on incremental technological innovations of older products. Due to less focus on radical innovation, firms started to compete on productivity and efficiency levels. Firms also put more strategic emphasis on marketing, as large and highly efficient companies fought for market share. Perceptions of the innovation process began to change with a marked shift towards emphasizing demand side factors, i.e. the market place. This resulted in the emergence of the second generation or market-pull (Rothwell, 1994). The innovation process started with market needs, the needs were developed into products, manufactured and eventually sold. The problem with the market-pull model was that firms were mainly focused on short term R&D and neglected their long term R&D programmes. Therefore, they became locked in to a regime of incremental innovation as they kept changing existing product groups to meet changing user demands in various maturing performance trajectories (Hayes and Abernathy, 1980).
The third generation innovation process is called "coupling" model (Rothwell and Zegveld, 1985). The incentive for a new model started when Shah (2006) criticized a number of empirical studies from the 1970s and concluded that technology-push and need-pull models of innovation were extreme and atypical examples of a more general process of interaction between, on the one hand, technological capabilities and, on the other, market needs. Innovation was now seen as a process consisting of distinct but interacting and interdependent stages. Also feedback loops were applied between different innovation stages. Up to the mid 1980s, the coupling model was seen as best practice by most western companies. De facto, it was a still a sequential process, but it had feedback loops(Rothwell, 1994).
In the early 1980s, the world saw the introduction of information and communication technologies (ICT). Also, the western world saw the rise of Japanese firms and their superiority in innovation.

It became clear that the 'western' way of innovating had become obsolete and managers had to look for inspiration in the east. The Japanese firms saw the stages of the innovation process not as sequential, but rather as mutually integrated. Moreover, they were putting emphasis on early stage collaborations with early phase integrate firm-external and -internal actors in product development processes simultaneously, which resulted in shorter product life cycles and lower production costs (Rothwell, 1994). This increase in performance was noticed by the western companies and they started to copy this 'integrated' model.
Rothwell (1994) describes a fifth generation of innovation process that Andersen and Andersen (2012) called 'the systems generation'. The fifth generation model is characterized by the introduction of ICT systems that are able to speed up the innovation processes. In fact, Kozioł-Nadolna and Świadek (2011) criticizes that the fifth generation was the fourth generation with faster parallel and integrated process because of the better communication technology. However, because of this communication technology firms could become further globalized. The innovation process increasingly took the shape of a network where firms were becoming mutually interdependent (Andersen and Andersen, 2012). As a result, participating in these knowledge networks is becoming more important than owner the actual knowledge (Dodgson et al., 2005).
This knowledge economy is one of the factors that eroded the underpinnings of Closed innovation. Closed innovation is a view that successful innovation needs control (Chesbrough, 2006). Closed innovation claims that in order for successful innovation, companies have to do the ideation, the development, the manufacturing, the servicing, and support of products (Chesbrough, 2006). When the author recapitulates, he notices the first to the third innovation system generation represent the characteristics of closed innovation. The fourth and fifth generation is when the innovation system starting 'opening' up, meaning that R&D process breaks out of the boundaries of the firm (see section A). Researchers also noticed this shift and started to investigate this paradigm. This change in innovation system and new paradigm is discussed in the next section.

Open Innovation

As one could see from the previous section, the innovation system is continuously changing. However, most innovation systems mentioned so far are "closed" (Andersen and Andersen, 2012), meaning that the companies only use R&D resources of their own. However, the R&D processes started to open up in the fourth and fifth innovation system. Reasons for this for this shift were the growing mobility of highly experienced and skilled people, the growing presence of private venture capita, a reduced time to market for products and services shortening technology life cycles (Chesbrough, 2006). One of the researchers who noticed this shit was Chesbrough and Crowther (2006) and called it "Open Innovation", which referred to "that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology" (Chesbrough, 2006, p.24) In 2014, Chesbrough et al. changed the meaning of the paradigm to "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model" (Chesbrough et al., 2014, p.12).
However, this one-liner of the paradigm is still very vague, so to want to understand what Open Innovation (OI) actually is, the author has to study the drivers of implementing practices of OI (Huizingh, 2011). Chesbrough (2006), has divided these open innovation practices into two categories: Inbound OI and Outbound OI. Inbound OI is described by Chesbrough (2006, 2011) as the exploration and integration of external resources for internal development. He presents examples such as customer involvement, inter-firm collaboration, networking and acquiring technology from other companies. Gassmann and Enkel (2004) say that firms drivers for inbound OI are that they can obtain access to new, complementary and unique resources. However, this comes at its cost. It takes a lot of resources, time and the ability to effectively use external resources and knowledge. Outbound OI describes the process of using an external path to market for internal developments. Gassmann and Enkel (2004) give examples of outbound OI practices such as forming alliances, out-licensing or selling IP and creating spin-offs. It can be risky to use outbound OI, because if

you sell your technology to another firm, you may make your competitors stronger. Therefore as a company who performs outbound OI, you must be an expert in negotiation and making profitable agreements. The benefits of outbound OI can be both strategic as well as monetary (Lichtenthaler and Ernst, 2007).
One might argue that the practices mentioned above are not beneficial for the company and cost a lot of resources. To find out if open innovation is beneficial for a company or not, Du et al. (2014) analyzed 489 projects inside a large European industrial manufacturer. Their results showed that R&D projects with open innovation partnerships are associated with a better financial performance. Also Laursen and Salter (2006b) examined the relationship between the openness to external search activities and internal R&D, they interacted the measures of openness with R&D intensity. The results indicate the existence of a substitution effect between the two activities. Besides performance and business benefits, companies can also expect better innovation results (Chesbrough and Brunswicker, 2014). These are only a few examples of positive research results on open innovation and business outcomes, but it can be stated that open innovation is beneficial for manufacturing companies. Open innovation practices also come with several risks. With regards to outbound OI, it may weaken a firms competitive position based on transferring relevant knowledge (Laursen and Salter, 2006a). Also, companies can over-commit to their own products and technologies, making it difficult to out-license their IP (Lichtenthaler and Ernst, 2007). When sourcing for external ideas and knowledge (Inbound OI), it's possible for a firm to lose their focus because of the many information sources (Laursen and Salter, 2006b). Moreover, Sapienza et al. (2004) mentions that difficult to choose and combine between too many alternatives. When a firm is acquiring inventions, it can run in the problem of maintaining a good relationship with the different partners (Ahuja, 2000).
So far, the history, practices, benefits and risks of open innovation are discussed and while the original phenomenon is firm-centric (Chesbrough, 2003), researchers are now linking it to many other related innovation literature. For example, open source software (von Krogh et al., 2012), innovators (Bogers et al., 2010), and campus based ecosystems (L. Romme, 2017)(van der Borgh et al., 2012). Due to the various research contexts and multiple level of analyses, open innovation literature has become widespread, but also incoherent. For the future of open innovation, Chesbrough (2017) sees two related concepts becoming more important around the application of open innovation. That is the role of business model innovation Osterwalder et al. (2009) and servitization (Lusch et al., 2007). An organizations business model helps to determine which inflows of knowledge can help fuel innovation, and which knowledge should be released to other organizations. However, most organizations still treat R&D quite separately from the design of business models. This is a mistake; linking technological innovation and business model innovation can amplify the value of each (Chesbrough, 2017). The servitization is the business model change from selling products to selling services(Lusch et al., 2007). For example, instead of selling an industrial printing machine and receive an one time payment, you will get a fee per month to run the industrial printing machine. Now you created a "platform" where multiple companies can built their business model on. This can become a community and together you can innovate toward newer business models. Managing these kinds of innovation communities is going to become increasingly important to the future of open innovation, and innovation in general. At last, Chesbrough claims "A future that will be more extensive, more collaborative, and more engaged with a wider variety of participants." (Chesbrough, 2017, p.35).
To conclude this section: open innovation "basically means that innovation is generated by accessing, harnessing, and absorbing flows of knowledge across the firms boundaries." Chesbrough (2017, p.35). It's important to mention that open innovation is not only about acquiring technology or only about creating spin offs. It's about embracing the paradigm as a whole and try to use as many suitable practices as possible. Because of the wide variety of practices, open innovation literature has become widespread and incoherent. Therefore, it's important for the author to clarify which stream of open innovation literature he is building on. This will be further explained in section A and 3.5.

Open Innovation Research Levels

This section will cover the different level of analyses in open innovation literature. Within the different level of analyses, there are multiple research themes of open innovation. These will be explained as well. In section 3.5, the theoretical scope of this master thesis will be be explained.
Section A briefly mentioned an innovation community. An innovation community is an extra-organizational level of analysis for open innovation research (Bogers et al., 2017). It discusses the role of users and communities for OI. According to Bogers et al. (2017), this is the second highest level of analysis within OI research. Two levels lower is the organizational level, this is about organizational design, practices, and processes for integrating external sources of innovation. The lowest level of analysis is intra-organisational, here the researcher focuses on individual-level challenges and coping strategies strategies for OI. Or he/she can investigate OI at the functional and project level (Bogers et al., 2017). However, when looking at the problem statement in section 3.2. One can see that the focus of this master thesis is more in line with the interactions between companies. Therefore, the higher level of analysis are explained in more detail in the next part.

Inter-Organizational
When investigating how organizations practice OI in ecosystems and industry platforms, the researcher is in the inter-organizational level of analysis Bogers et al. (2017). The inter-organizational perspective claims that effectiveness of OI depends on the knowledge flows between firm in the entire innovation process (Chesbrough et al., 2014; Dahlander and Gann, 2010). Therefore, the research theme 'innovation ecosystem' is defined Bogers et al. (2017), where firms are required to actively participate in an innovation ecosystem and carefully select useful actors to collaborate with in different stages of the innovation process (West and Bogers, 2014). van der Borgh et al. (2012) use the notion *knowledge-based ecosystem* to describe a heterogeneous set of knowledge-intensive companies and other participants that depend on each other for their effectiveness and efficiency, and as such need to be located in close proximity (Iansiti and Levien, 2004). Moreover, van der Borgh et al. (2012) describe a knowledge based ecosystem as a small geographical area, like a park- or campus- based initiative with relatively high managerial support. This management can provide *access to innovation services* and create and sustain *an innovation community* for their tenants to facilitate their R&D and product development. The need for such an innovation ecosystem depends on the complexity of the technology and business model (Chesbrough et al., 2014). However, the 'need' of the residents can change over time and so does the business model. To not become obsolete, the ecosystem management has to change the envisioned ecosystem business model as well, by identifying and locating new kinds of resources, knowledge, and complementaries (van der Borgh et al., 2012). If done well, the ecosystem at large can achieve a new base of sustainable competitive advantage in a fast-changing business environment (Voelpel et al., 2004).
Two other research themes are developed by Bogers et al. (2017) within the inter-organizational level of analysis. First, Innovation Platforms, where the governance of digital platforms is investigated to align individual success with collective welfare. Second research theme is called Crowdsourcing. The relationship between OI and crowdsourcing can help to better understand the relationship between openness and firm performance importance of OI in general and the need for support of data providers and organized involvement of distributed contributors in particular.

Extra-Organizational
One level higher than the inter-organizational level of analysis, is the extra-organizational level (Bogers et al., 2017). The extra-organizational level says that at different stages of the open innovation process, a firm should use different stakeholders "as either contributors to the creation of new knowledge and innovations or receivers of knowledge that is used to generate innovations" (Bogers et al., 2017, p.18). At this level, Bogers et al. (2017) identified three research themes: (1) Stakeholders: Here a researcher can investigate the nature and type of knowledge that is provided by stakeholders at different stages of the innovation process. (2) Users as Innovators: Where one can identify and how to leverage the knowledge produced by individual users with different

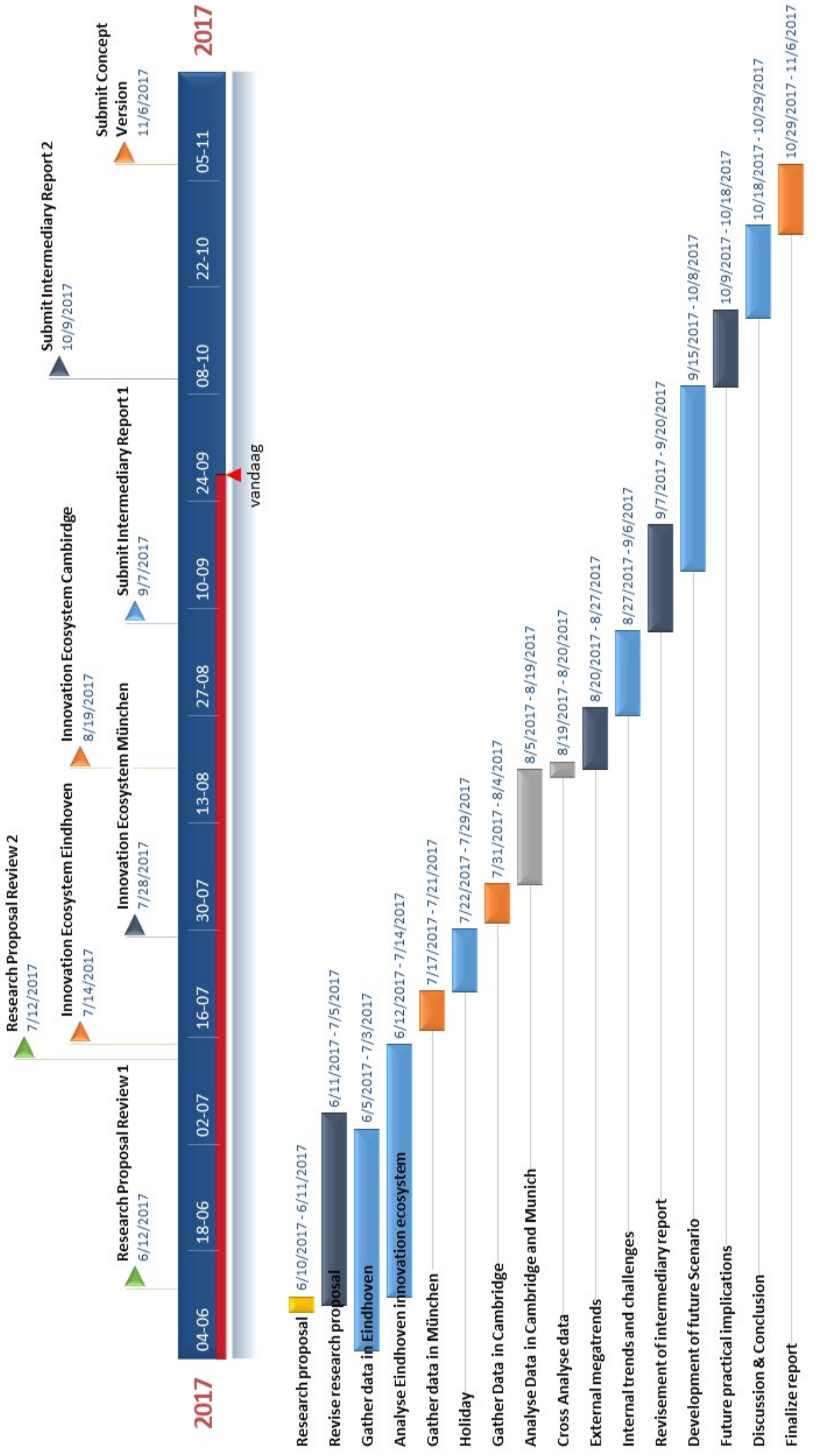
abilities and motivations. This can be done by frame-working user characteristics, intellectual and emotional property. (3) Communities: Here you could further explore the relational aspects between communities and organizations.

Industry, regional innovation system and society
The highest level of analysis known in open innovation research is 'industry, regional innovation system and society' (Bogers et al., 2017). Here, relevant contingencies, such as the R&D intensity, modularity and the breadth of knowledge distribution in the industry, spatial challenges (including virtual and real platforms), and new forms of democracy and managerial skills for collaborative public management in the context of cities, regions, and governments. New types of policies and services are required for OI to function at this highest level of analysis.

This section gave an overview of the open innovation landscape that is of interest for this study. In section 3.5 a decision will be made on what level of analysis the paper will focus on.

Appendix B

Planning


2017
04-06
18-06
02-07
16-07
30-07
13-08
27-08
10-09
24-09
08-10
22-10
05-11
2017
vandaag
Research Proposal Review 1
6/12/2017
Research Proposal Review 2
7/12/2017
Innovation Ecosystem Eindhoven
7/14/2017
Innovation Ecosystem München
7/28/2017
Innovation Ecosystem Cambirdge
8/19/2017
Submit Intermediary Report 1
9/7/2017
Submit Intermediary Report 2
10/9/2017
Submit Concept Version
11/6/2017
Research proposal
6/10/2017 - 6/11/2017
Revise research proposal
6/11/2017 - 7/5/2017
Gather data in Eindhoven
6/5/2017 - 7/3/2017
Analyse Eindhoven innovation ecosystem
6/12/2017 - 7/14/2017
Gather data in München
7/17/2017 - 7/21/2017
Holiday
7/22/2017 - 7/29/2017
Gather Data in Cambridge
7/31/2017 - 8/4/2017
Analyse Data in Cambridge and Munich
8/5/2017 - 8/19/2017
Cross Analyse data
8/19/2017 - 8/20/2017
External megatrends
8/20/2017 - 8/27/2017
Internal trends and challenges
8/27/2017 - 9/6/2017
Revisement of intermediary report
9/7/2017 - 9/20/2017
Development of future Scenario
9/15/2017 - 10/8/2017
Future practical implications
10/9/2017 - 10/18/2017
Discussion & Conclusion
10/18/2017 - 10/29/2017
Finalize report
10/29/2017 - 11/6/2017

Appendix C

Background information on the nature and capabilities of foresight

Foresight process has two fundamental attributes, the *nature* of its methods and the *capabilities* of those methods (Popper, 2008). With regards to the nature of foresight, methods can be characterized as qualitative, quantitative or semi-quantitative. Qualitative refers to the meaning, the definition or analogy characterizing something (Blumberg et al., 2011). Such interpretations tend to be based on subjectivity or creativity that is often difficult to corroborate (Popper, 2008). Quantitative assumes the meaning and refers to a measure of it (Blumberg et al., 2011). Quantitative research focuses on measuring variables and apply statistical analyses, using or generating reliable and valid data (Popper, 2008). Semi-quantitative methods are that apply mathematical principles to quantify subjectivity, rational judgments and viewpoints of experts and commentators. As mentioned in stated 3.7, this study will use qualitative methods due to the limited knowledge available on this topic.
The other fundamental attribute is the capability of the methods used. This refers to the ability to gather or process information based on evidence, expertise, interaction or creativity (Popper, 2008). Creativity refers to the mixture of original and imaginative thinking, these methods rely heavily on the inventiveness and ingenuity of very skilled individuals (Harper, 2013). Expertise refers to the skills and knowledge of individuals in a particular area. These methods rely on the tacit knowledge of people with privileged access to relevant information or with accumulated knowledge from several years of working experience on a particular domain area (Scapolo and Miles, 2006). Interaction recognizes that expertise often gains considerably from being brought together and challenged to articulate with other expertise, these methods are important so that data is not just reliant on evidence and expertise (Cuhls, 2003). Evidence recognizes that it is important to attempt to explain and/or forecast a particular phenomenon with the support of reliable documentation. These methods are particularly helpful for understanding the actual state of development of the research issue (Armstrong, 2006). These four capabilities can be mapped in the so called foresight diamond as shown in figure C.1. The methods used in a foresight project are placed in the diamond. On average, five methods are used in a single foresight project (Popper, 2008). First, interviews are used to get insight of the current situation. Then, mega trend reports are used to describe the landscape level. After that, interviews are used again to gain knowledge about internal trends and challenges of the innovation ecosystems. Last, scenarios are built for further innovation ecosystem development. These methods will be further described on the next page. The methods used in this master thesis are stated in figure C.1 in appendix backgroundinfo.

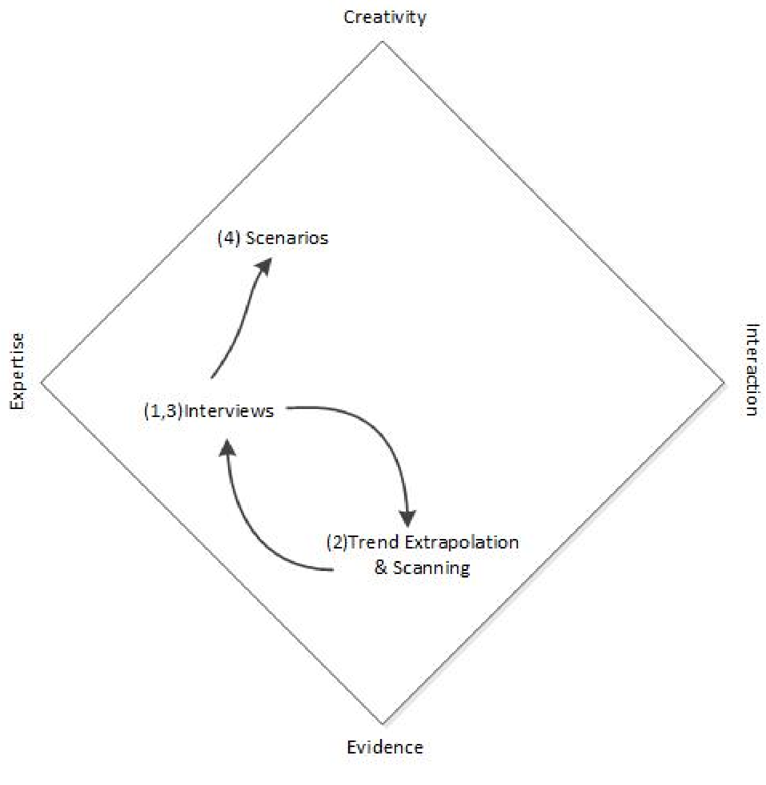


Figure C.1: Foresight Diamond.

Appendix D

Interview Protocols

Interview protocol: Eindhoven

At start of the interview

Briefly explain the reason why you are going to interview the participant. Explain to him the topic of the project and what the goals are. Also explain the set-up of the interview. First some general information about the participant, then discuss the current situation and last the far future focecast.

1. Can you tell me about your work experience?
2. What is your current job and what are your responsibilities?

(1) – Mapping the current situation

3. With regards to the current situation, how do companies ensure successful innovation? You can think of social innovation and the assets needed for innovation?
   a. Start-Ups
   b. SME
   c. Globals
4. With regards to the current situation, can you tell me how campus-based ecosystems contribute to social- and assets aspects of successful innovation?
   a. Start-Ups
   b. SME
   c. Globals
5. What are improvements for the HTCE on the short term?
6. What are strengths and weaknesses of the Eindhoven innovation ecosystem?

(2) – Future situation

With regards to the far future situation, can you tell me how campus-based ecosystems contribute to social- and assets aspects of successful innovation?

   a. Start-Ups
   b. SME
   c. Globals

2. With regards to the far future situation, can you tell me how campus-based ecosystems contribute to social- and assets aspects of successful innovation?
   a. Network Links
   b. Competences

Interview protocol: Munich

At start of the interview (5 minutes)

Briefly explain the reason why you are going to interview the participant. Explain to him the topic of the project and what the goals are. Also explain the set-up of the interview. First some general information about the participant, then discuss the current situation and last the far future focecast.

1. Can you tell me about your work experience?
2. What is your current job and what are your responsibilities?

(1) – Mapping the current situation (30 minutes)

3. Why did the government started to cluster the innovation process in the Bayern region?
4. Can you tell me about the *organizational structure* of the cluster you are part of? (ask the interviewee to draw the structure)
    a. What is the role of your organization within the cluster?
    b. Is there a common goal for the entire cluster? To what extent are the companies / institutions / universities willing to contribute to that?
    c. Who is responsible for making sure that parties are contributing?
    d. Who is going to utilize the benefits created by the cluster? Who creates business with the technology that is being developed?
5. To what extent is knowledge/resource being exchanged between companies?
    a. How are companies stimulated to work together?
    b. How 'open' is the cluster for companies outside it? I.e. can international companies join the cluster with a German entity?
6. To what extent are companies in a cluster collaborating with a university / research institute?
    a. What kind of projects are this? Long term research programs on well-defined themes or small projects?
    b. Who is the leading party that sets the programs for the cluster?
7. *Entrepreneurial orientation (divided in 4 questions):*
        i. Are there a lot of graduated students who start their business within five year of their graduation?
        ii. What is the common opinion on entrepreneurs or people working for a startup? Is failing a startup seen as a failure?
        iii. With regards to social security, are the Germans risk takers? And If you fail, is there a something to fall back on?
    b. Are start-ups considered to be important the functioning of a cluster?
    c. What actions are taken to promote entrepreneurship?
        i. University programs?
        ii. Startup accelerators?
        iii. Part time education after University?
    d. To what extent is venture capital an important resource when the innovation process is clustered?
8. How is innovation financed in the cluster?
    a. What is the role of subsidies in clustering the innovation process?
9. What are advantages and disadvantages of clustering the innovation process?

(2) – Future situation (25 minutes)

1. When we take the cluster innovation system as a standard. How do you think this cluster should be further developed to become future proof?
    a. What new network linkages should be created?
    b. What network linkages do you think should be strengthened?
2. What competences do you think will become more important in the future for the clusters?
    a. Entrepreneurship?
    b. Academic?
    c. Business?
3. What network linkages and competences have top priority? And why?
4. Can you name a technical wildcard?

Interview protocol: Cambridge

At start of the interview (5 minutes)

Briefly explain the reason why you are going to interview the participant. Explain to him the topic of the project and what the goals are. Also explain the set-up of the interview. First some general information about the participant, then discuss the current situation and last the far future.

1. Can you tell me about your work experience?
2. What is your current job and what are your responsibilities?
3. What is the role of your organization within the innovation system?

(1) – Mapping the current situation (30 minutes)

Organization structure:

4. Is there a common goal for the entire Cambridge Cluster? To what extent are the companies / institutions / universities willing to contribute to that?
5. Who is responsible for making sure that parties are contributing?
6. Who is going to utilize the benefits created by the cluster? Who creates business with the technology that is being developed?

University – Research Institutes – Company collaborations

7. To what extent are the research institutes part of the university?
    a. Is there a leading party that sets the research programs / projects?
    b. What kind of projects are this? Long term research programs on well-defined themes or small projects?
    c. To what extent are the companies involved in these projects?
8. To what extent is knowledge/resource being exchanged between companies?
    a. How are companies stimulated to work together?
    b. How 'open' are the companies in Cambridge to collaborate with companies outside the city?

Entrepreneurial orientation (divided in 4 questions):

i. Are there a lot of graduated students who start their business within five year of their graduation?
ii. What is the common opinion on entrepreneurs or people working for a startup? Is failing a startup seen as a failure?
iii. With regards to social security, are the Englishmen risk takers? And if you fail, is there a something to fall back on?

c. Are start-ups considered to be important the functioning of the Cambridge Cluster?
d. What mechanisms are used to tackle the problem that a startup is not too focused in:
    i. Technology?
    ii. Market focused?
e. To what extent is venture capital used for the growth of startups? And to what extent is corporate venture capital present in Cambridge?
f. What mechanisms are used to make sure that startups don't take early stage funding in return for equity?

9. What is the role of subsidies in the Cambridge innovation ecosystem?

Best Practices:

a. What initiatives create a lot of value for the innovation ecosystem?
b. What initiatives were initially good, but did not work out well?
c. What are the main strengths and weakness of the innovation ecosystem?

(2) – Future situation (25 minutes)

1. When we take the cluster innovation system as a standard. How do you think this cluster should be further developed to become future proof?

    a. What new network linkages should be created?
    b. What network linkages do you think should be strengthened?
2. What competences do you think will become more important in the future for the clusters?
    a. Entrepreneurship?
    b. Academic?
    c. Business?
3. What network linkages and competences have top priority? And why?
4. Can you name a technical wildcard?

Appendix E

Coding Schemes: Current Situations

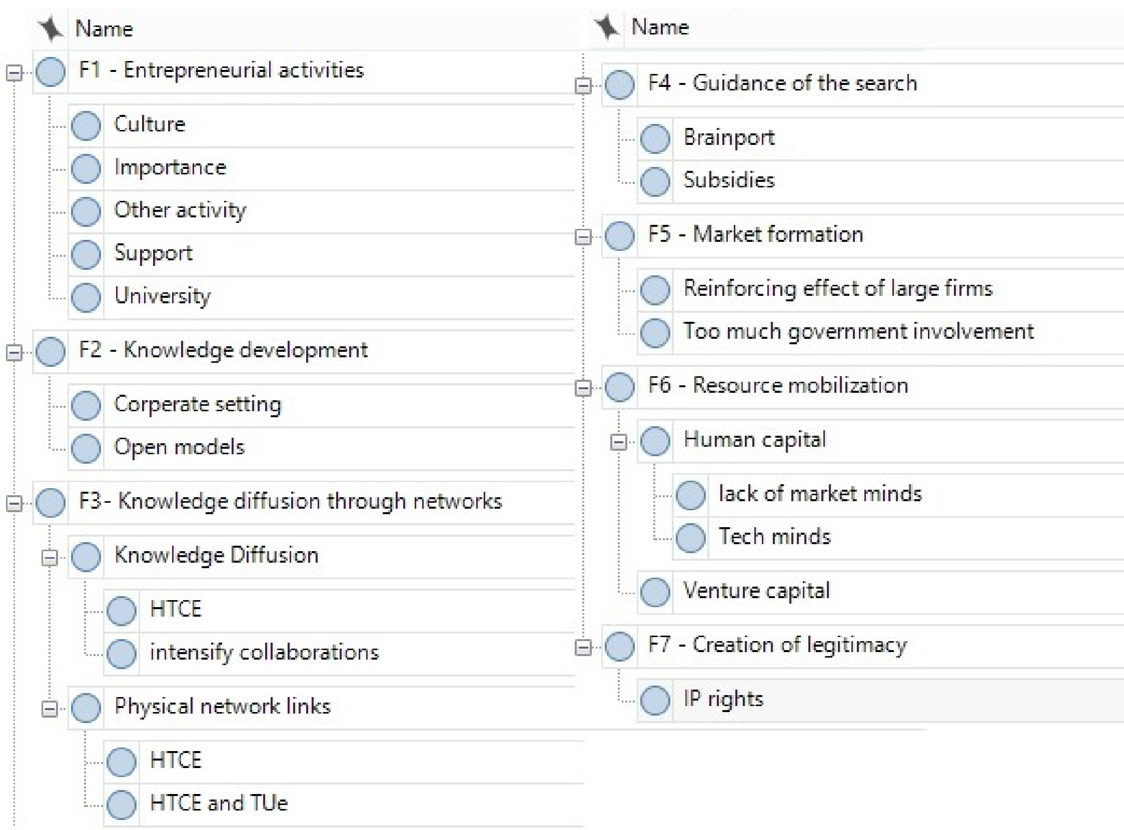


Figure E.1: Final coding scheme for the current situation of the innovation ecosystem of Eindhoven.

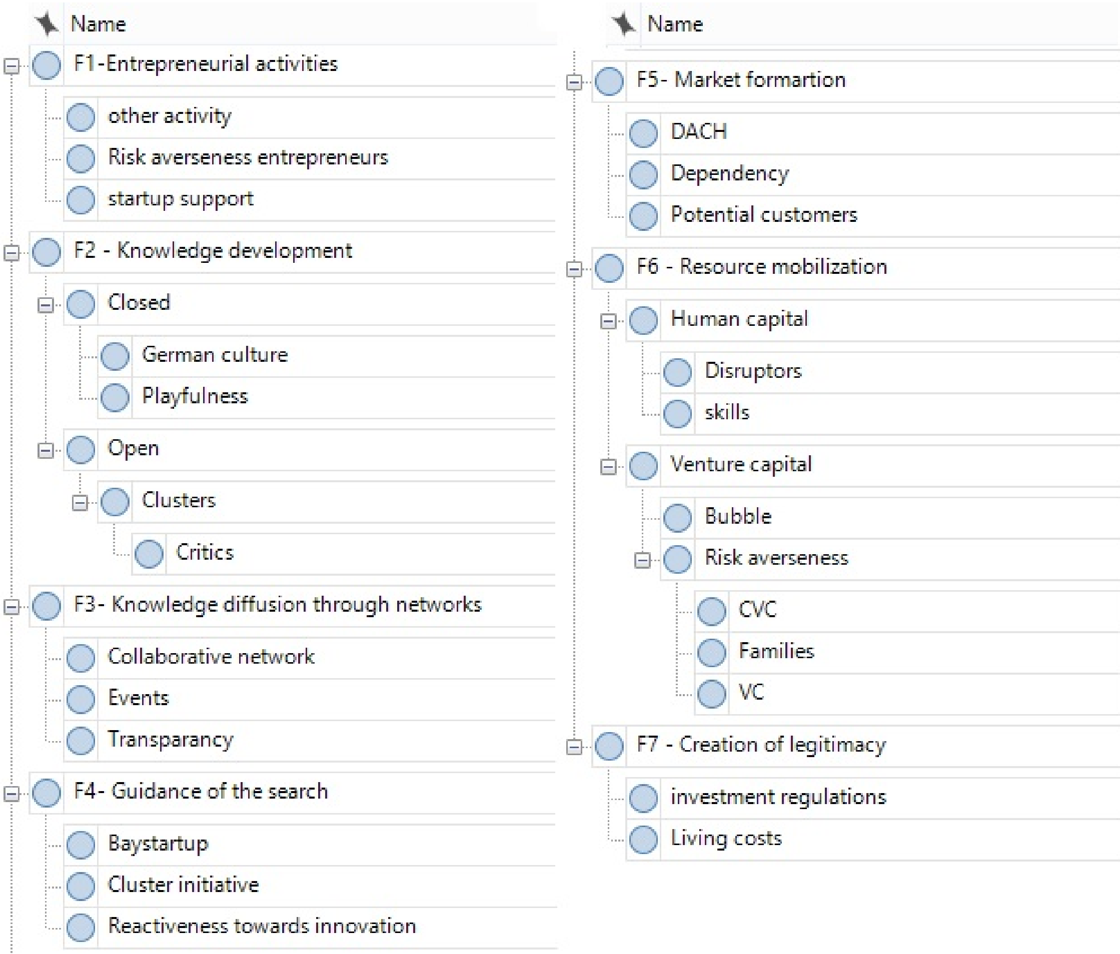


Figure E.2: Final coding scheme for the current situation of the innovation ecosystem of Munich.

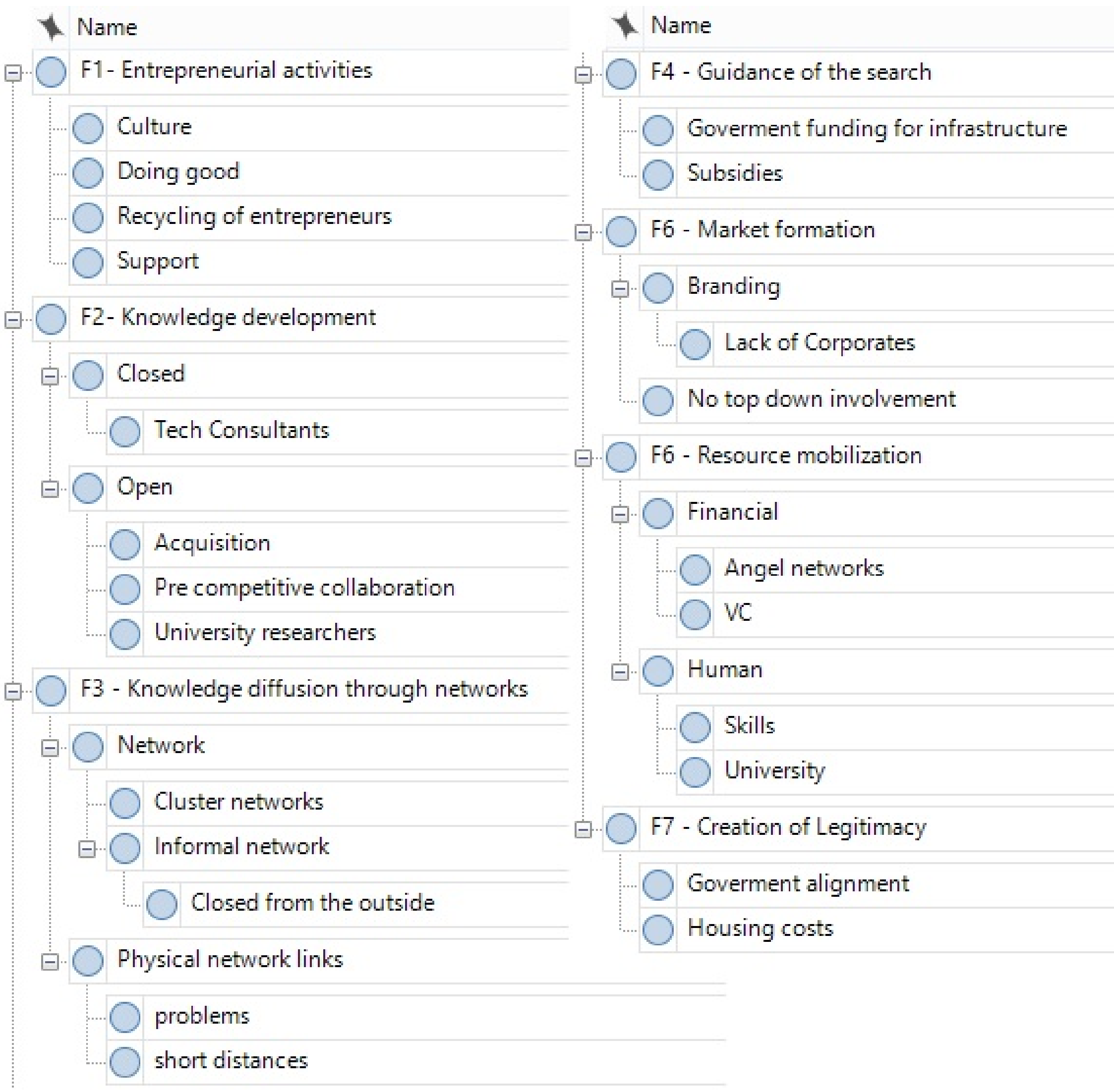


Figure E.3: Final coding scheme for the current situation of the innovation ecosystem of Cambridge.

Appendix F

Coding Schemes: Internal Trends and Challenges

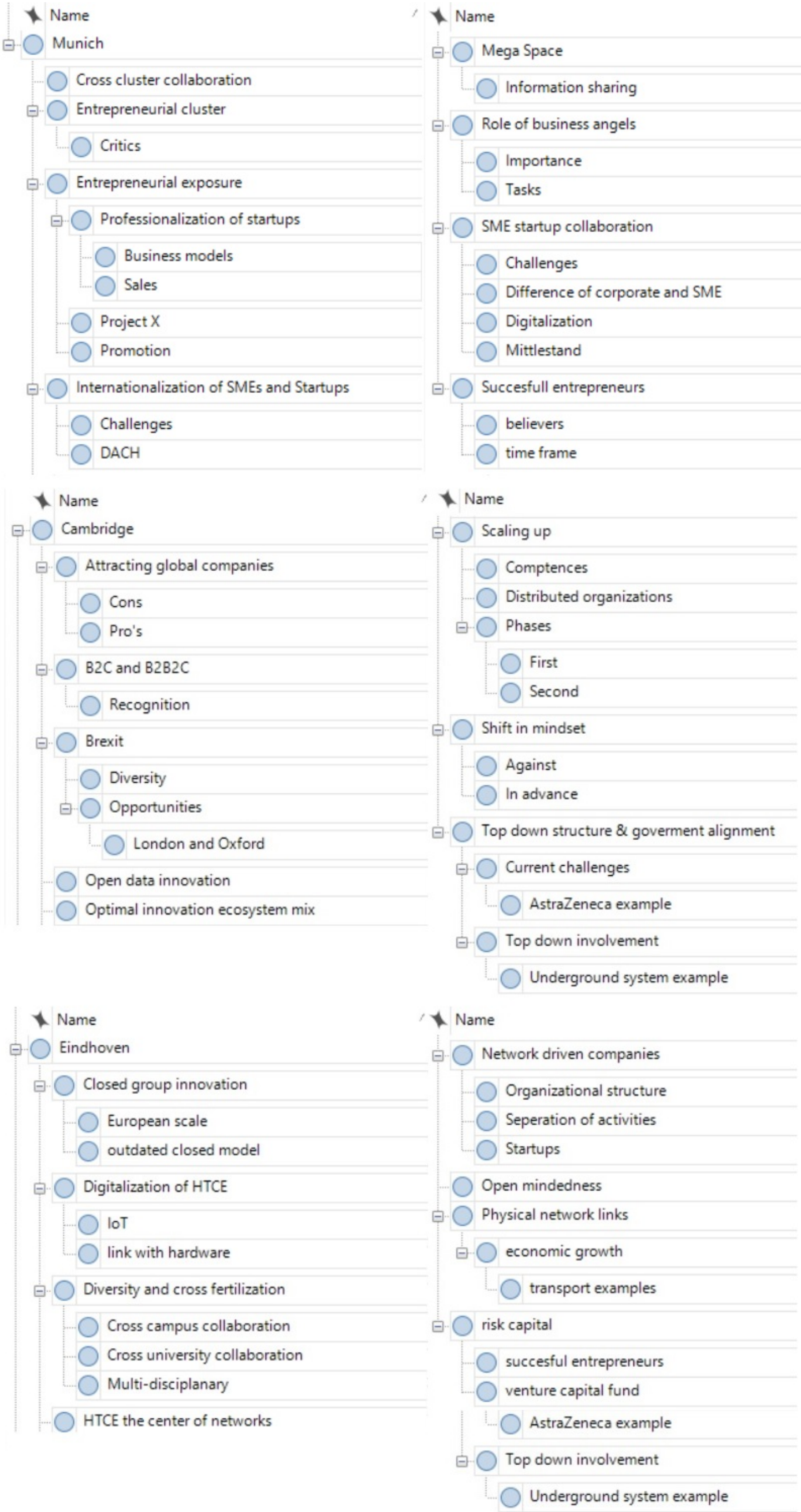


Figure F.1: Final coding scheme for the internal trends and challenges in Munich, Cambridge, and Eindhoven.

Appendix G

Names of Interviewees

Table G.1: List of Interviewees.

Code	**Interviewee**	**Code**	**Interviewee**
E1	Bert-Jan Woertman	M7	Alexander Meyer-Scharenberg
E2	Arnold Stokking	M8	Andy Goldstein
E3	Cees Admiraal	M9	Willem Bulthuis
E4	Guus Frericks	M10	Marvin Rben
E5	Ferry Aalders	M11	Matthias Konrad
E6	Huib van den Heuvel	C1	Charles Cotton
E7	Pieter Noordzij	C2	Claire Ruskin
E8	Sjoerd Romme	C3	David Gill
E9	Victor Donker	C4	Peter Cowley
M1	Rdiger Busch	C5	Peter Hewkin
M2	David Stephenson	C6	Stewart McTavish
M3	Natalia Garca Mozo	C7	Claire Johnson
M4	Tobi Gutmann	C8	Chris Coleridge
M5	Herbert Gillig	C9	Michael Anstey
M6	Gabriele Bhmer		

Appendix H

List of Interviewees

Table H.1: Experts interviewed in Eindhoven.

Code	Current Occupation	Position	Company Profile
E1	Create links between Academia and Industry.	Commercial director	University
E2	Strategy development and implementation, networking and alliance management.	Director industries	Research Institute
E3	Responsible for the growth of the HTCE.	Business development manager	Technology park
E4	Entrepreneurial orientation in Corporate Companies, mentor startups and angel investor.	CEO	Startup Accelator
E5	Continuous improvement of technology and business creation.	Head of excellence at CTO organization	Global
E6	Managing partnerships within a research institute.	CEO	Research institute
E7	Attract and service companies that want to settle in Brainport region.	Business development manager	Government
E8	Assisting Ph.D. candidates and perform research on innovation management.	Professor	University
E9	Responsible for operations and partnerships.	COO	Startup

Table H.3: Experts interviewed in Munich.

Code	Current occupation	Position	Company Profile
M1	Bring together companies and institutes and initialize collaborative research projects involving regional partners.	Cluster-Manager New Materials	Government
M2	Foreign trade promotion, vocational training, regional economic development, and general services to their members.	Technology transfer and entrepreneurship	Government
M3	Promotion of entrepreneurship, the institutional support for SMEs and economic/strategic cooperation of the companies.	Head of unit SME advisory services	Government
M4	Managing venture and technology within startup accelerator. Own company with a company builder. Ph.D. in corporate venturing.	Manager venture and technology	Corperate accelerator
M5	Supports the startups on the first idea until they are ready to go into the market.	Professor for entrepreneurship (MUAS)	University Accelerator
M6	Oversees entrepreneurship, strategy, innovation, technology and international affairs also the chief editor.	CEO	Government
M7	Consulting and coaching to students, scientists, and science-based start-up ventures to assess, incubate, develop, and commercialize their IP - providing support from inception to market entry.	Startup fonsultant	University Accelerator
M8	Identifying major digital business opportunities, bring the right founder team and add the worldwide digital assets of a big consultancy firm. Startup consultant and	Co-founder at Consultancy digital department, co-founder of university entrepreneurship center and professor	Consultancy and University
M9	Building bridges between business partners, cultural teams, between large corporations and fast startups, between technology and sales and between Board and workforce.	Global High-Tech Executive, Board Advisor, Business Angel, Investor	Global, Business Angel and Investor
M10	Developing a process mining tool that analyzes and visualizes every process in a company.	Head of innovation management	Startup
M11	Bring together companies and institutes and initialize collaborative research projects involving regional partners.	Clustermanager Nord Bayern	Government

Table H.5: Experts interviewed in Cambridge.

Code	Current occupation	Position	Company Profile
C1	Building global hi-tech companies and the development of technology clusters.	CEO, chairman and non-executive director	Global/ University
C2	Bringing people together - from business and academia - to meet each other and share ideas, encouraging collaboration and partnership for shared success.	CEO	Network organization
C3	Providing early stage knowledge-based companies with tailored business services and flexible accommodation.	CEO	Incubator & Accelerator
C4	Investing in high potential startups mentor them to become successful.	Serial entrepreneur, angel investor & mentor	Entrepreneurship and investing
C5	facilitating top-tier engagement in disruptive technology and new business process opportunities by linking movers and shakers from business/ government and academia.	CEO, serial entrepreneur	Networking organization
C6	Supporting entrepreneurs, innovators and members of the University of Cambridge in exploring ideas, innovations and building startups.	CEO	Startup incubator
C7	Helping small and medium size enterprises to create value, maximise growth and improve business performance.	International Development and Innovation adviser	Incubator & Accelerator
C8	Teaching Strategy, Innovation and Entrepreneurship on the Executive MBA and other Executive programmes in the Business School.	Senior Faculty in Management Practice	University
C9	Investing in intellectual property rich companies in the health care and technology sectors.	Investment Director	Venture Capitalist

Appendix I

Summary of Strengths and Weaknesses

Table I.1: Strengths and Weaknesses of innovation ecosystem Eindhoven.

	Strengths	**Weaknesses**
F1 Entrepreneurial activities	Global companies show efforts to be part of the startup ecosystem. (2) Several service companies to support startups	(1) Non-Entrepreneurial mindset of people. (2) Mono disciplinary university does not create an entrepreneurial environment.
F2 Knowledge Development	(1) High concentration of high tech companies. (2) Collaborative university with globals.	(1) Size of the university. (2) Closed mindset of high tech companies.
F3 - Knowledge diffusion through networks	HTCE enables knowledge workers to exchange information by various offerings. (2) Physical distances are little in the innovation ecosystem.	(1) Lack of exchange knowledge workers and students between campuses in the innovation ecosystem. (2) No efficient public transport between campuses.
F4 - Guidance of the search		(1) No single message for the innovation ecosystem of Eindhoven. (2) Subsidies' role is too big when deciding what direction innovation is being done.
F5 -Market formation	Strong global companies with local suppliers give a reinforcing effect.	There is a high dependency on the global companies.
F6 - Resources mobilization	Deeply rooted skills in mechatronics, high precision engineering and embedded software.	(1) Venture capital for investments between million 1 and 5 is not present. (2) Lack of human resources that can connect technology to market needs.
F7 - Creation of legitimacy		(1) unattractive IP rules of the TU/e. (2) Investment legislation is not competitive for venture capital investments. (3) High R&D investments forces global to be 'closed'.

Table I.3: Strengths and Weaknesses of innovation ecosystem Munich.

	Strengths	**Weaknesses**
F1 Entrepreneurial activities	Large network with a lot of service companies to service startups.	(1) German risk averseness is still very present. (2) Entrepreneurs are lacking professionalism.
F2 Knowledge Development	(1) The 'Cluster Initiave' creates transparency for companies. (2) Large number of research institutes and universities create a solid base of knowledge	(1) Proud German culture limits the openness of companies. (2) German perfectionism lacks speed to market. (3) Innovation ecosystem can be more 'playful'.
F3 - Knowledge diffusion through networks	(1) Very good public transport and infrastructure (2) Very good events to meet up with potential partners	(1) Large distances between actors results in low serendipity of information exchange. (2) Too many events that don't add value.
F4 - Guidance of the search	(1) 'Cluster initiative' great for streamlining funding programs (2) Funding of startups using government based VC.	(1) Government funding has made SME (mittlestand) very reactive (2) Too much government initiatives that don't add value.
F5 -Market formation	(1) D-A-C-H region is very rich (2) A lot of globals that can serve as potential customer (3) Many different sectors are present in the innovation ecosystem	(1) Innovation Ecosystem has a highly dependent on the global companies. (2) Lack of internationalization by startups, because big local market.
F6 - Resources mobilization	(1) Efforts are taken to tackle funding problem for startups. (2) Very strong and large knowledge base in hardware and embedded software.	(1) VC, CVC and angel investor have high risk averseness. (2) Lack of human resources that can connect technology to market needs.
F7 - Creation of legitimacy	There are a lot of Technology Transfer units to diffuse IP and knowledge through the innovation ecosystem.	(1) Investment legislation is not attractive for venture capital. (2) High cost of living in Munich. (3) Global companies offerings limit the number of startups being created.

Table I.5: Strengths and Weaknesses of innovation ecosystem Cambridge.

	Strengths	**Weaknesses**
F1 Entrepreneurial activities	(1) Cambridge is a safe place to do riksy things. (2) People from every age tend to start their own business	
F2 Knowledge Development	(1) A very open community that likes to discuss ideas (2) Excellent university produces high level of skilled people	
F3 - Knowledge diffusion through networks	(1) High serendipity to meet people in the informal network in Cambridge (2) People recycle themselves in the Innovation Ecosystem. (3) Membership networking organization work very well.	(1) Very bad public transport and infrastructure. (2) Not very open to outsiders.
F4 - Guidance of the search	Close enough to London but to draw on the resources of London, but far enough away to be creative and independent.	(1) Government only extracts money out Cambridge. (2) Lack of communication between Cambridge Cluster and government.
F5 -Market formation	(1) Coopetition rather than Competition. (2) Many different sectors are present in the innovation ecosystem. (3) 'Cambridge' is a strong brand and used by all actors.	(1) Small domestic market (2) Not enough global outreach.
F6 - Resources mobilization	(1) Recycling of expertise and capital.	(1) Loss of Angels investor groups (2) Lack of soft management skills and marketing expertise
F7 - Creation of legitimacy	(1) University of Cambridge's IP licensing rules.	(1) Misalignment of interests of Cambridge Cluster and government. (2) High cost of living in Cambridge. (3) Size of Cambridge limits its growth.

Appendix J

Variation on edge one

As mentioned in chapter 5.1, millennials (which are students at the moment) in developed countries are increasingly interested in entrepreneurship or working for a startup or SME. On the other hand, startups and SMEs need cheap but highly educated human capital (E9). However, on both sides there is a lack of transparency, startups experience difficulties finding the right students (E9) and students experience difficulties in finding a master thesis for example (E8). This creates an opportunity for CSM to become the facilitator of human capital for startups and SMEs on the High Tech Campus. Instead of having contact with just Innovation Space and The Engine, CSM should try to become in direct with the professors of the TU/e via informal network links, which are based on goodwill. Several organizations already try to fulfill this task. However, they do not have the same strong network as CSM has on the HTCE. Also, these secondment agencies target the global companies on the HTCE. This leaves an unfilled gap to be filled. Figure J.1 shows the structure of this collaboration.

As seen in the structure, the CSM is in direct contact with the professors of the TU/e, which

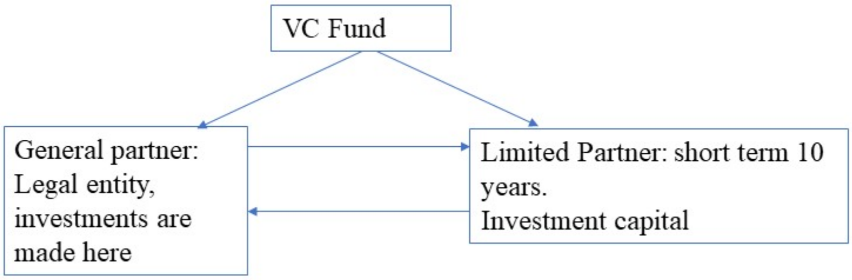
Figure J.1: Network links between actors.

are in contact with their assistant professors and assistant professors are in direct contact with the students. For example, the assistant professor can show a slide before or after the lecture of startups that need help from students. Alternatively, when a student is searching for a bachelor or master thesis, a fast connection can be made. On a small scale, this is already done between professors and companies on the HTCE. But as E8 explains, there is much unused potential in this structure, because the professors don't have connections at all companies on the HTCE and the companies don't have connections with all the professors of the TU/e. CSM has all a whole network at the HTCE and can act as a main portal between students/professors at the TU/e and companies of the HTCE.

Appendix K

Structure Venture Capital Fund

Structure: GPLP model



Problems:

- a 10 year fund and 10 years is often not long enough to build a company especially when you do early stage stuff.
- The other issue is that the way GP is compensated is a percentage of funds that are in the LP. What the GP is motivated to do is fund raise.

Structure: Cambridge Innovation Capital

CIC Fund: Longterm.
General Partners
Limited Partners
Investment captial: 125 Mln.

Advantages:

- There is a really close link between the money and the investors. So everybody's interest are totally aligned.
- No time limit, CIC can go on forever if they want, which is great for building businesses.

Appendix L

Future Research

This appendix provides other future research topics based on the results of chapter 4, 5, 6, and 7.

During the mapping phase this study (chapter 4), I noticed that the history, evolution, and location of an innovation ecosystem were essential factors for the current culture and mindset and of the people in it. In turn, the current culture and mindset of people in innovation ecosystems affect value creation and value capture in innovation ecosystem Ben Letaifa (2014). While it is important to understand the entire evolution of an innovation ecosystem, Ben Letaifa (2014) argue that only a few authors have focused on longitudinal cases of the entire innovation ecosystem lifecycle. Therefore, in their conclusion, they mentioned that future studies should focus on how different *cultural* contexts could lead to different value-creation and -capture processes. Also, Valkokari et al. (2017), who explored how firms can orchestrate innovation ecosystems to enhance collaboration for innovation among different actors, mentioned that future research should research undertake a longitudinal study of an ecosystem from composition to orchestration through to the strategic choices of all involved actors. Last, Tsujimoto et al. (2015) also argue ecosystem analysis requires the longitudinal observation of the product/service system's dynamic evolution or extinction. So according to these papers, there is a high need for understanding value creation and value capture at the ecosystem level. Researchers addressed that culture and mindset of people are essential drivers of value creation and value capture. In this thesis, I noticed that the culture and mindset of people is heavily dependent on the country (or region). For example, many experts from Munich argued that the risk-averse culture is a barrier to the development of their innovation ecosystem (see section 4.2). Moreover, the risk-averse mindset is deeply embedded in the German culture, which makes it even harder to change it. The point I want to make is that culture and mindset of people are dependent on country and history. Therefore, if researchers want to understand value creation and value capture at the ecosystem level, they should take a longitudinal country-comparison approach. Then, researchers can understand what factors are likely to remain constant under different conditions and what would change.

Ben Letaifa and Rabeau (2013) investigated the role of geographic, institutional, organizational, cognitive and social proximities affect collaboration, entrepreneurship and innovation. Based on a single case study, they proposed that formal institutionalized clusters impede spontaneous social proximity. During the mapping phase of this study, I noticed a big difference between evolutions of the innovation ecosystem of Munich and Cambridge. The Cambridge Cluster developed itself bottom up (i.e. spontaneous) and experts highlighted the strong informal network and willingness to share information with each other (i.e. high social proximity). On the other hand, the Munich innovation ecosystem developed itself top down (i.e. institutional) and experts highlighted the lack of willingness to collaborate and the competition inside the cluster (i.e. low social proximity). While I did not specifically investigate this, the data strongly suggests that this is the case. Ben Letaifa and Rabeau (2013) also mentioned that future research should build their on the proposition, by performing a multiple case study could compare the evolution of different ecosystems. The information in this master thesis can be used as a starting point for this multiple case study between Munich and Cambridge.

Next, interesting future research topics that were found during the foresight phase (chapter 5). First, a large number of experts in Munich emphasized that startups should collaborate with SMEs to help them with digitalizing their businesses (5.2.1). However, they also mentioned that both parties lack any idea on how to do this efficiently. Also, an SME does not have the same financial resources or innovation departments as the globals. One expert even emphasized that the next master thesis topic should be about this collaboration because corporate startup collaborations over-researched already. So based on these results, this thesis concludes that there is a need in the industry to get clarification on this topic. According to Spender et al. (2017), who performed a literature review on startups and open innovation, also observed that multiple studies investigated the collaboration between large organizations and startups. However, researchers mainly took the viewpoint of the large companies leaving a gap in the viewpoint from a startup (Spender et al., 2017; Usman and Vanhaverbeke, 2017). M7 highlighted this as well by arguing that many corporates work with startups, but most of the time both parties lack any idea how to do this effectively. So when combining Spender et al. (2017) with the results of this thesis, I can conclude that more research is needed on the effective collaboration between corporates with startups taking the viewpoint of the startup. On top, this thesis argues that more research is needed on effective collaboration between startups and SMEs, here both viewpoints are interesting for future research.

Usman and Vanhaverbeke (2017) recognized this gap as well and performed an exploratory study based on two case studies taking the viewpoint of the startup. One of their findings was that start-up managers play a pivotal role in establishing and nourishing open innovation practices with large companies. They found that startup managers without experience in large corporations do not have the credibility among managers of the large firm (Usman and Vanhaverbeke, 2017). Also, since an experienced startup manager is familiar with the processes in large companies, he knows to knock at the right door at the right time. This master thesis adds a new viewpoint to this practical implication of Usman and Vanhaverbeke (2017). In section 5.2.1, I discussed the role of the business angel. M7, who is a business angel himself and a manager in several large companies before, explained that he played a major role in the collaboration between startups and large companies or SMEs. Moreover, he played the role of the experienced startup manager described by Usman and Vanhaverbeke (2017). He understood both worlds entirely, therefore, he was able to have the credibility among managers in large firms as well as the credibility of the startup managers. This made him an independent skillful negotiator for startups who wanted to engage in open innovation practices with large corporations and SMEs, but also secure funding and convince venture capitalists to invest in the startup. Therefore, he played a pivotal role in the inbound and outbound open innovation practices for startups and SMEs (Usman and Vanhaverbeke, 2017).
The limitation of the research is that these statements cannot be confirmed. However, the findings of this thesis can be used for further development of a theoretical framework on how start-ups and large firms can collaborate in a mutually advantageous way. Future qualitative and quantitative studies can contribute to a more in-depth understanding of the role of a business angel/startup consultant in using open innovation as a tool to reach commercial success.

The next theoretical implication comes from section 5.2.2, here C9 explained the 'optimal innovation ecosystem mix.' He argued that a truly successful innovation ecosystem has a shape like a pyramid; a foundation of many startups and the tip represents the number of global companies. The middle levels do not have a representation yet. Moreover, C9 argues that if somehow this pyramid gets reversed, meaning that there are more global companies than startups, the innovation ecosystem is broken because there is not enough innovation to continuously create new startups. Although C9 has no theoretical argumentation to support his claims, it would be fascinating to investigate if the pyramid structure can become a foundation of a theoretical framework for innovation ecosystem configuration, and in later stages for innovation ecosystem performance. When investigating innovation ecosystem configurations and performance, researchers mostly use the triple or quadruple helix models (Carayannis and Campbell, 2009; Sharif and Tang, 2014). Here, researchers investigated the collaborations for knowledge transfer between university research facilities, research institutes, industry, and government. However, (Spender et al., 2017) argues that this area of research need a refinement concerning research constructs. Moreover, they pointed out that for future research it would be interesting to define and investigate possible innovation ecosystem configurations and their impact on the diffusion of knowledge and trust and, ultimately, on firm and ecosystem performance. The pyramid structure of C9 could be a theoretical framework to investigate this in various innovation ecosystems. Researchers could even try to link the innovation ecosystem pyramid to Maslow's pyramid of human needs, which would result in the pyramid of innovations ecosystem needs [1]. However, it will take much research to make the innovation ecosystem pyramid usable as a theoretical framework for ecosystem configuration and performance. Knowledge-based ecosystems as defined by van der Borgh et al. (2012) could be a useful starting point because of their small geographic area and logical ecosystem boundaries. Therefore, limiting the number of stakeholders and complexity of collaborations.

Also mentioned in section 5.2.2 was the combination of big data and open innovation practices. C5 ran a consortium of large companies to investigate to what extent big data can be used for open innovation practices. He found out that the concept of open innovation worked significantly better when the item for inbound and outbound practices is data. He also mentioned that this area is still largely ignored by academic researchers. To investigate this, I searched for "Open Innovation" AND "big data" combination. The search found two papers that investigated open innovation strategies in combination with big data analysis. Fortunato et al. (2017) mentions that concepts of open innovation and big data have been largely explored, but little research focused on the use of big data for open innovation activities. Moreover, Vecchio et al. (2017) explained that they did not find prior works that have provided a broad overview of the use of Big Data for open innovation strategies. Both papers tried to fill this gap in different ways. The point I want to make is that these concepts are under-researched. Therefore, researchers have many possibilities to investigate which open innovation practices work best with big data. One of the companies in the consortium of C5 or the Jheronimus Academy of Data Science (JADS) in Den Bosch can be used as a useful starting point.

In chapter 6, the thesis introduced the concepts of scalable efficiency and scalable learning. The scalable efficiency model defines work as a set of a set of routine, predictable, standardized and highly integrated tasks and over time these tasks should be executed most efficiently. This model is used throughout most institutions of the innovation ecosystems of Munich and Eindhoven (see section 6.2.1). Based on logic reasoning, the author claimed that scalable efficiency is the barrier for an entrepreneurial mindset, risk capital, community building and attracting talent. In contrast, scalable learning, work is defined around solving business problems, providing new services, and establishing new relationships. Via logic reasoning, the author argues that when using the scalable learning model as a basis for work, the entrepreneurial mindset in the innovation ecosystem of Eindhoven will improve over time. However, little research is done if this new definition of work improves entrepreneurial intentions of people. For example, Fernández-Pérez et al. (2017) findings show that entrepreneurship by university students is favored by the development of their emotional competencies. This is closely related the scalable learning model but does not precisely investigates it. Therefore, it would be interesting if to investigate if the transition from scalable efficiency to scalable learning improves entrepreneurial intentions.

Section 7.2 explained how the innovation ecosystem of Eindhoven could be further developed to an innovation ecosystem with a single message to the outside world as well as establishing a shared internal vision. The proposed process, in combination with scalable edges (6.3), can be seen as a new methodology for innovation ecosystem development. This sounds counter-intuitive because of the statement I made before about the evolution of innovation ecosystems; that there is

[1] source: https://www.simplypsychology.org/maslow.html

no 'guide' to build an innovation ecosystem because the ecosystem goes through many life cycles. Rabelo and Bernus (2015) made the same discovery as me. Based on their literature review they concluded that a successful innovation ecosystem is the result of a long evolution, and no single recipe suits all cases. Still, they attempted to systematize the building of innovation ecosystems. They proposed a holistic model to build innovation ecosystems incorporating the life cycle of it. For their future research, they intend to build a more formal model of the innovation ecosystem and the innovation process.
Gomes et al. (2015), who performed a systematic literature review on the innovation ecosystem construct from 1993 to 2016, found a literature stream where "the authors considered that entrepreneurs might build an innovation ecosystem rather than follow the leadership of a keystone firm" (Gomes et al., 2015, p.17). In this stream, led by Elizabeth Garnsey, Gomes et al. (2015) concluded that innovation ecosystem building is a key research area as well. So when combining the need of a more formal innovation ecosystem building approach Rabelo and Bernus (2015), the entrepreneurial side of it Gomes et al. (2015), and the information of M7 in section 7.2. I propose a formal, entrepreneurial and holistic methodology for innovation ecosystem building. The foundation of the proposed methodology is the effectuation method of Sarasvathy (2008). These two concepts have not yet been combined before. Therefore, it would be fascinating to do so. Future researchers can try to identify similarities and differences in approaches of innovation ecosystem builders (like M7) and entrepreneurs for building effective innovation ecosystems. Information from this master thesis can be used as a take-off point for other researchers who want to investigate this.