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Faculty of Business Economics

Master of Management

Master's thesis

Campus Diepenbeek and the further steps to becoming an innovation district

Ivonne Martinez Valdes

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

SUPERVISOR :

Prof. dr. Jean-Pierre SEGERS



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Summary

Currently, Campus Diepenbeek is part of an innovation ecosystem involving several players. In collaboration with LRM, POM Limburg, capital investors, higher education institutions, and companies, Campus Diepenbeek has deployed a development plan for 2030. However, the development of innovation districts has not been set yet. The current Campus Diepenbeek and its facilities host several main elements of innovation districts. The analysis of these elements and further planning is highly relevant for the development of Campus Diepenbeek and the network of knowledge that can be created from it.

This thesis aims to understand what elements of the innovation district campus Diepenbeek is already applying and the possible changes that can be made over time to become an innovation district. Further, the analysis of Campus Diepenbeek as a case study and the elements that are not currently present. Finally, recommendations for policymakers, investors, and the government are deployed with the intention to provide recommendations that would help Campus Diepenbeek to become an innovation district are shown. This thesis aims to enrich the knowledge of innovation districts and the further steps that should be made to develop Campus Diepenbeek.

The methodology used in this thesis is based on qualitative research design via interviews with key stakeholders of Campus Diepenbeek and other personalities that have experience in geographies of innovation. The section of interviewees includes members of the triple Helix (Government, Industry, and Academia). The interview guide was developed based on the research questions and the literature review. The type of questions asked was open-ended, allowing the interviewees to elaborate answers based on their experience and perspectives, describing processes, and social and economic phenomena, which helped to enrich the thesis research.

Three categories of findings are included in the thesis. First, the current elements of campus Diepenbeek are similar to the elements of other study cases of innovation districts. Second, elements of Campus Diepenbeek that are different than in other innovation districts. Third, elements present in other innovation districts that are not yet present in Campus Diepenbeek. Therefore, suggestions and future considerations for stakeholders and policymakers are elaborated based on this information. From the elements that are similar to other innovation districts, several general themes were found. First, ten general themes were found in the current composition of Campus Diepenbeek, such as regional development, participation of academia, knowledge generation, innovation, Infrastructure development, entrepreneurship, cross-collaboration, and network creation.

It is important to highlight several aspects of these themes as more relevant to the development of Campus Diepenbeek. First, the participation of a higher education institution, UHasselt, as an anchor institution. From the establishment of this university, other universities and research institutes were placed on the same campus, increasing the network of innovation and knowledge generation. Second, in recent years, the creation of a general management led by POM Limburg has been important for the creation of a common goal in Campus Diepenbeek and a direction for projects that involve several stakeholders of the campus. Third, the development of a master plan for 2030, Limburg DC, has as a major goal to attract more innovative and international companies to the area, increasing the job opportunities for the alumni and strengthening the cross-collaboration with other campuses of the region such as Energy Vile in Genk, and two main hospitals, ZOL and Jessa. Fourth, Entrepreneurial events that link innovative projects, companies, and young entrepreneurs have increased in recent years. These events supported by the Flemish government and hosted by anchor institutions such as UHasselt, have a big impact on the entrepreneurial development in Belgium.

From the literature review, it is known that innovation districts can vary in shape and size. Therefore, it was expected to find different characteristics of campus Diepenbeek as a geography of innovation that perhaps are not seen in other current geographies. Initially, Diepenbeek is situated in the region of Limburg, which is situated in the middle of an important region of innovative development. In the North, the city of Eindhoven hosts the largest tech company in Europe. In the East, research universities in Liege and Aachen bring to the region knowledge and innovation. In the West, there are Ghent and Leuven, two cities where the oldest universities of Belgium are situated. Zooming in, Campus Diepenbeek is located in the middle of three main cities where other campuses are situated. Campus Diepenbeek is 6.5 km from Corda Campus, a high-tech innovative campus where national and international companies and start-ups are situated; two main hospitals are situated six and fifteen kilometers around. Additionally, the municipality of Diepenbeek hosts living facilities for the students of Campus Diepenbeek.

Although Limburg does not have the typical big city structure of other innovation districts, the development of a European innovation district in Limburg is a possibility. Proximity to other innovative areas allows Campus Diepenbeek to contribute to the innovative ecosystem of the region. Lastly, the circular construction and the transformation of existing buildings allow Campus Diepenbeek to make better use of the space. These elements contribute to the development of an innovation district and leverage the network of knowledge in the area.

Findings related to the future development of Campus Diepenbeek are (1) Walkability infrastructure between buildings. (2) The attraction of international talent not only for academic purposes but also for collaboration with innovative companies in Campus Diepenbeek. The attraction of international talent not only increases the knowledge network but also strengthens the current network between Campus Diepenbeek and the neighboring countries. (3) The attraction of an anchor company related to healthcare or Bioscience is still under debate by several stakeholders. However, the inclusion of a big anchor company could generate more employment opportunities for the region. Further research on these aspects should be done in the future by analyzing quantitative data.

By understanding the case of Campus Diepenbeek and the current elements of innovation districts that this campus has, policymakers, current members and investors can take better information-based decisions related to the future and the economic development of Campus Diepenbeek. Additionally, stakeholders and policymakers can understand from this thesis that rather than being considered a separate element of an ecosystem, Campus Diepenbeek should switch to a more collaborative approach with other geographies of innovation in the region.

As a practical implication, this thesis does not intend to generalize the elements of innovation districts but rather enrich the existing knowledge in the field by describing Campus Diepenbeek as a case study of possible future candidates of innovation districts in Europe. The existing literature about innovation districts is still under development, therefore, it is highly relevant to contribute to the generation of knowledge in this field so further investigation can be developed.

The selection of the interviews for this thesis was carefully considered, to enrich as much as possible this case study. However, it is from the awareness of the researcher that a quantitative approach should be performed in the future to complement this exploratory research about innovation districts and their early development in Belgium.

The limitation of this thesis relies on socio-cultural aspects of Belgium such as language barriers and cultural differences with other neighboring countries that have a more open perspective to internationalization. Additionally, innovation openness in society should be a topic of investigation in the future since this aspect plays a key role in the development of

innovation districts and the interconnections with other members of the quintuple helix. The study's findings may have practical implications for policymakers, industry leaders, and academic institutions regarding the development of collaborative innovation processes, further investigation is encouraged.

Table of Content

Acknowledgments	1
Summary	1
Table of Content	4
Chapter 1: Introduction	8
Chapter 2: Literature Review	13
Innovation and its Definition.....	13
Precursors of Geographies of Innovation.....	13
Definition of Innovation Districts.....	19
Why Innovation Districts Matter.....	22
Innovation Districts in The United States:	22
Three Prior Study Cases in Europe.....	23
From the Mining Industry to Business Development in Belgium.....	27
Innovation History in Belgium.....	29
The Role of Universities in the Development of Innovation in Belgium	29
The Role of Entrepreneurs from High Education Institutions as Catalyzers in the Innovation Districts:.....	30

Policymakers are a Key Factor in Creating Sustainable Innovation Districts.	30
Campus Diepenbeek as a Case Study	31
Limburg DC:	34
Chapter 3: Research Design	37
Methodology.....	37
Data Analysis.....	38
Chapter 4: Results	40
The Current Organization of Campus Diepenbeek	40
Network:.....	42
Cross-collaboration:	44
Infrastructure:	44
Employment:	45
Academia:.....	46
Knowledge Development:.....	47
Entrepreneurship:.....	47
Participation of The Government:	47
Innovation:.....	47
The Attraction of Big Companies to Campus Diepenbeek:.....	48
Master Plan of Limburg DC:.....	49

Chapter 5: Discussion	50
Development of Limburg DC:.....	51
Changes in The Industry:	51
Network:.....	52
Cross-collaboration:	52
Stakeholders:	53
Infrastructure:	53
Sustainability:	54
Employment:	55
Innovation:.....	57
Entrepreneurship:.....	57
Academia:.....	58
Participation of The Government:	59
Attraction of a big player:	59
Limburg:.....	60
Chapter 6: Conclusions	63
Theoretical Implications.....	63
Managerial Implications: Recommendations:	64
Limitations and Suggestions for Further Research.....	66

Bibliography	67
Appendices	73

Chapter 1: Introduction

Innovation has been defined by several recognized economists and theorists throughout history. (P. F. Drucker, 1985) referred to innovation as "the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth" (p.5). In further years, (P. Drucker, 2015), defined innovation as "the act that ends resources with a new capacity to create wealth" (p.7).

Additionally, (Porter, 1990) emphasizes the key role of innovation for firms as a means to achieve competitive advantage. Following the path of Michael Porter, several authors have delved into the impact of innovation on industries. (Simmie J., 2004) concludes that "innovation is a key driver of competitiveness and productivity" (p. 1). Similarly, (Tidd J. & Bessant J., 2005) highlighted that competitiveness is a driver of change, leading to a pressing need for innovation to remain profitable and gain an edge over competitors. From these perspectives, it is clear that innovation plays a key role in companies and market developments.

It is well known that globalization and the way we spread knowledge had changed drastically over time, leading to an exponential increment of developments and applications of innovation. "Global challenges and changes in the structure of knowledge production, have led to diverse innovations, and recognizing and classifying such innovations is more complex, fragmented, and geographically dispersed than ever before" (Edwards-Schachter, 2018).

Several studies have emphasized the relevance of knowledge as a driving element in the economy. "Knowledge has increasingly become an important means for value creation. Knowledge has become a vital commodity to countries, businesses, and individuals in the twenty-first century - the age of the knowledge-based economies" (Kefela, 2010, p. 160). During the last century, the speed of knowledge sharing has increased through the internet. Knowledge has been crucial in the development of areas such as healthcare, agriculture, and technology. Several countries have engaged in multi-party agreements to enhance knowledge sharing as a tool for economic growth and societal development (OECD, 1998).

Additionally, research has shown that the generation of knowledge from within and outside the firm is the steps tone for innovation in multiple industries. " A central focus for R&D, innovation is the successful exploitation of ideas to create a new, useful offering of product or service" (Armbrecht et al., 2001). From the perspective of firms, knowledge has been recognized as an important asset by multiple companies all over the world, leading to the creation of additional departments within the firm to manage the new knowledge. Therefore, research and Development departments rely on knowledge to generate new knowledge and its spillovers.

During the last 30 years, entrepreneurship and innovation have played an important role in the development of several industries and the economy of the world. Now a days, innovation plays a core element in multiple industries such as telecommunication, health, and construction. Following the research of Edwards-Schachter (2018), "Innovation is considered as both the process and outcome of creating or inventing something new and valuable that produces broader effects in the economy and technological advances" (p. 2). J. Schumpeter (1934) placed entrepreneurs as innovators and highlight their contributions to the economy. Additionally, (P. Drucker, 2015) defined entrepreneurs as "responsible of innovate and manage innovation" (P.8). J. Schumpeter (1934) refers to entrepreneurs as important actors in the irregular innovation process. In their book "Innovation and Entrepreneurship", Tidd and Bessant (2007) understand both concepts as vessels of change. Additionally, (Tidd J. & Bessant J., 2005) determine several factors that influence not only the creation of startups but also innovation. These factors are environment, support from institutions, technologies, and market access. From these perspectives, innovation, and entrepreneurship have a close relationship and are both important to the success and development of the economy.

However, entrepreneurship by itself is not sustainable in the long term. (Coad & Srhoj, 2023) concluded that Entrepreneur Ecosystems (EE) cannot be considered the main generators of outputs in the economy. Additionally, the outcome of entrepreneurs is not constant meaning that to generate growth over time, High Growth Firms and other players are needed.

In the 21st century, research and development have become a more integrated building block not only for companies but also for universities and the government. This phenomenon has been studied by several academics. Knowledge sharing and management play an important role in R&D (Ambrecht et al., 2001). Consequently, it is crucial to leverage the relevance of cross-collaboration for academia, industry, and government in order to develop new technologies.

Cross-collaboration and the sharing of knowledge have become the new currency. In his work *The Discipline of Innovation*, Drucker determines several sources of innovation. One of them is knowledge. "To become effective, innovation of this sort usually demands not one kind of knowledge but many" (P. F. Drucker, 1985). It is well known that sources of knowledge are as varied as we can imagine, including universities, suppliers, consumers, and employees. Several authors have emphasized the importance of a varied network of knowledge supply. "Firms with long-term network relationships to a multitude of external and diverse customers and suppliers would learn more because of the higher degree of diversity of their partners" (Fagerberg et al., 2013).

Globalization and an increase in mobility of talent from country to country have created a diffusion of knowledge, allowing big and small companies to acquire this asset more rapidly

and more and in a more varied way. This phenomenon has then encouraged innovation and entrepreneurship from the private and public sectors. Additionally, "SMEs are becoming increasingly important pillars of the economies of the major trading partners" (Acs et al., 2001). The collaboration between small and big companies is no longer an exception but a rule, leading to cross-collaboration and interdependency of industries and several fields of study.

Several authors have studied the origin of innovation. For instance, "innovation is the key driver of competitiveness and productivity." (Simmie J., 2004). (Carlino & Kerr, 2014) dedicated research to find the links between innovation and agglomeration, concluding that agglomeration plays a positive effect on innovation, especially for the technology industry and science. In their research, they emphasize the effects of agglomeration on spillovers and R&D (Carlino & Kerr, 2014). From the literature, it can be deduced that there is a tendency to agglomeration by companies, startups, research institutes and academia to facilitate innovation.

Throughout history, humankind has developed civilization to evolve, agglomerating around resources. This phenomenon has been extended to more modern resources such as knowledge. During the 21st century, firms agglomerate geographically to pursue new knowledge. Agglomeration and sharing of knowledge increased the chances to generate wealth, creating a knowledge-based economy (Carlino & Kerr, 2014). Additionally, innovation has followed a pattern of agglomeration and concentration over time (Carlino & Kerr, 2014). Literature around agglomeration shows that firms, research institutes, as well as societies, get access to resources by agglomerating around them.

Several terms for agglomeration are known such as cluster, parks, districts, and hubs, all of these being geographies of innovation. Researchers in the field have referred to geographies of innovation as "the spatial clustering of innovative activity and the advantages conferred by co-location" (Feldman, 2016). But where is this phenomenon coming from? Due to globalization and natural clustering by firms and organizations, geographies of innovation have emerged.

Multiple authors have given different names to describe the clustering of companies and institutions gathered in a specific area that share some facilities and knowledge from the same industry. (Feldman, 2016) emphasized the benefits of proximity location such as "lower search costs through localized knowledge spillovers and provide access to external scale and scope economies." (p. 2). Additionally (Clark et al., 2010) conclude that geographies of innovation are characterized by a high density of small firms and high rates of patents. Equally important, (Feldman, 2016) conclude that the combination of technological infrastructure from firms, universities, and business services enhances product innovation. Finally, (Simmie J., 2004)

emphasizes that productivity is achieved by innovation, and innovation is delivered within geographies of innovation.

Examples of geographies of innovation can be seen mostly in China and The United States, such as Silicon Valley and the high-tech cluster in Beijing (World Intellectual Property Organization (WIPO, 2022)). From the analysis, we can see an increment in the number of clusters to 123 out of the top 100 clusters if WIPO 2022. From the same analysis, it is highlighted that the number of venture capital deals raised during the pandemic of Covid-19 of 46% from 2020 to 2021. This increment upraised also in 2022 in the field of science and innovation (World Intellectual Property Organization (WIPO, 2022)).

Globalization has influenced not only the integration of technology and science in our lives but also the way we agglomerate as a society. The first modern cluster wave in the United States started developing around 50 years ago when innovation and technology activities took place outside suburban areas to protect knowledge. "The trend is to nurture living, breathing communities rather than sterile compounds of research silos" (Katz & Wagner, 2014).

Due to changes in the way cities are interconnected, the mobility of human talent is more present and more common. Another term that has come into popularity is innovation districts. (Katz & Wagner, 2014) described this phenomenon as "suburban corridors of spatially isolated corporate campuses, accessible only by car, with little emphasis on the quality of life or on integrating work, housing, and recreation" (p.1). These geographies of innovation are playing an increasing role in society and the development of new knowledge.

Following this trend, "innovation districts focus extensively on creating a dynamic physical realm that strengthens proximity and knowledge spillovers" (Katz & Wagner, 2014). The introduction of the relevance of innovation districts and what they bring to the economy and society is serving as a stepstone for the development of more innovation districts around the world. "Innovation districts represent a radical departure from traditional economic development" (Katz & Wagner, 2014). From this perspective, we can understand innovation districts as a new way of innovation clustering not only for companies but integrating living facilities that allow us to exchange knowledge and innovate. This new way of glomeration aligned with the new generation of appreciation between work and life. By bringing together facilities where leisure, work, and living are together. After the increasing success of innovation districts in the United States, other countries such as China and Sweden start applying this concept to create more competitiveness and increase wealth in the region. Pioneers studying this concept have emphasized the relevance of understanding the composition and main aspects of innovation districts.

Investors and governments have taken into consideration the previous studies to ensure sustainable geographies of innovation. The European Commission has developed several recommendations for policymakers to enlighten good practices for the creation of innovation districts. However, less attention has been paid to existing geographies of innovation that have the potential to become innovation districts. Additionally, small attention has been set on the main differences between American and European geographies of innovation, giving the illusion that innovation districts look the same in size and composition in any environment.

In order to extend the knowledge of innovation districts, this thesis dissertation focuses on a case from Belgium, in particular, Limburg. This area has overcome 3 major financial crises, naming 1) the closure of the coal mines in several places of Belgium, 2) the closure of Phillips in the city of Hasselt, and 3) finally the closure of the car manufacture Ford in Genk, raising the unemployment in the area. Since then, the federal government has deployed action plans to fight against unemployment.

The location of Belgium in Europe gives it a competitive advantage. Surrounded by 2 European leaders in innovation and technology, Belgium shares with them not only a strategic position but also the talent and resources to develop and leverage current geographies of innovation. Additionally, entrepreneurship and cross-collaboration between neighboring countries have shown a positive increment in startups and innovation developments. Further analysis of national policies should be done to leverage the outcome of this collaboration.

Studies from the European Commission have shown a slightly under-average development for Belgium in this aspect, therefore, the promotion of entrepreneurship has been on top of the agenda for the Belgian government (European Commission. & Joint Research Centre., 2020) Several programs and institutions have been created to leverage entrepreneurship in the area including the development of geographies of innovation where entrepreneurs can create value.

This thesis aims to enrich the knowledge of geographies of innovation and to enlighten the economic development that geographies of innovation bring to Limburg. The work is divided into 6 main sections. The first section introduces some concepts around innovation and geographies of innovation, In the second section the methodology of the thesis is described, followed by the research design, and in section four, the results of interviews with experts about geographies of innovation and the development of Campus Diepenbeek is shown. After, an analysis of the findings and ultimately, conclusions and limitations are explained.

Chapter 2: Literature Review

Innovation and its Definition

P. Nijkamp 2016 highlighted the term *agglomeration* as a "spatial-economic advantage related to a geographic concentration of economic activities" (p. 5). From the literature, it can be inferred that the nature of economic activity is to gather in a determined place to use resources optimally to generate wealth. Several benefits can be highlighted from spatial agglomeration, such as a decrease in communication costs and economies of scope (P. Nijkamp 2016). Benefits related to innovation have been discussed by several authors. Carlino and Kerr (2014) related spatial agglomeration with the generation of spillovers between firms located within the same geography of innovation.

In *Geographic Sources of Innovation*, Feldman and Florida (1994) explored the innovation concept and conclude that spatial concentration of specific resources was a natural phenomenon followed by firms to develop innovation activities. In the same analysis, four major components (industrial R&D, University R&D, firms in related industries, and business-service providers) were highlighted as the main factors to develop innovation. Years later, in *Geography of Innovation*, M. Feldman (2016) defined the geography of innovation as a "spatial clustering of innovative activity, and the advantages conferred by co-location" (p.1). It is also mentioned that geographies of innovation do not focus on the individual participation of firms but on the larger context and interactions between the elements. *Geography of Innovation*, M. Feldman (2016).

Precursors of Geographies of Innovation

Many authors have referred to different ways of geographies of innovation. One of the initial models of geographies of innovation was Industrial Districts. The term *Industrial Districts* came a long time ago since Alfred Marshall (1890) highlighted not only the causes but also the relevance of these geographic areas for the growth of the economy. The industrial district model of Marshall was based on sharing specialized knowledge and resources between firms from similar industries.

However, the Marshallian model has been debated by several authors in the economy field arguing that globalization and immigration have severely impacted the way industrial districts behave (De Marchi & Grandinetti, 2014). According to (Marshall, 1890) the main characteristics of an industrial district are being in a specific territory, containing a population of firms from a determined business area, and a web of relationships between these firms. However, the 20th century brought a more technological environment for firms, forcing firms to create more

interconnected and diverse relationships. One example of this phenomenon is mentioned by De Marchi & Grandinetti, (2014) who analyzed Marshallian industrial districts in Italy and their changes throughout time. (Galan-Muros et al., 2021) complemented the literature by highlighting that the precursors of geographies of innovation such as industrial districts have a "lack of innovative and knowledge-based organizations that enhance collaborative innovation" (p.16).

With a complementary and more modern and integrative perspective, P. Nijkamp (2016) defined the concept of a *resourceful region* as a "functionally and spatially demarcated geographical area which combines its assets (skills, physical resources, technology, social capital, institutional support systems, geographical connectivity, etc.) to maximize its capabilities to achieve accelerated economic progress and a more sustainable socio-economic performance" (p. 3). This new approach to geographies of innovation describes the main change in regional development. Firms have switched to a more open collaboration with firms from other industries, allowing a new integrating policy to emerge (Nijkamp, 2016)

The concept of an innovation ecosystem has been studied by several authors. (Granstrand & Holgersson, 2020) defines the innovation ecosystem as "the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors" (p.3). The reference to the innovation ecosystem term emphasizes the interaction and collaboration between the members bringing a more systemic concept rather than a set of elements that allow an increment of productivity of a firm. In their work *Innovation Ecosystems*, Granstrand and Holgersson (2020) presented some business cases of innovation ecosystems, giving a clear overview of how firms from the electronic industries interact in the ecosystem of innovation as rivals and complementors.

M.P. Feldman (2016) also highlights the relevance for researchers to analyze institutions and actors of the geography of innovation not individually but, to consider the larger context. This complementing approach allows innovation ecosystems to be seen and appreciated as the geographic location where institutions from the 3 axes (Government, Academia, and Industry) are welcome to collaborate to create innovation.

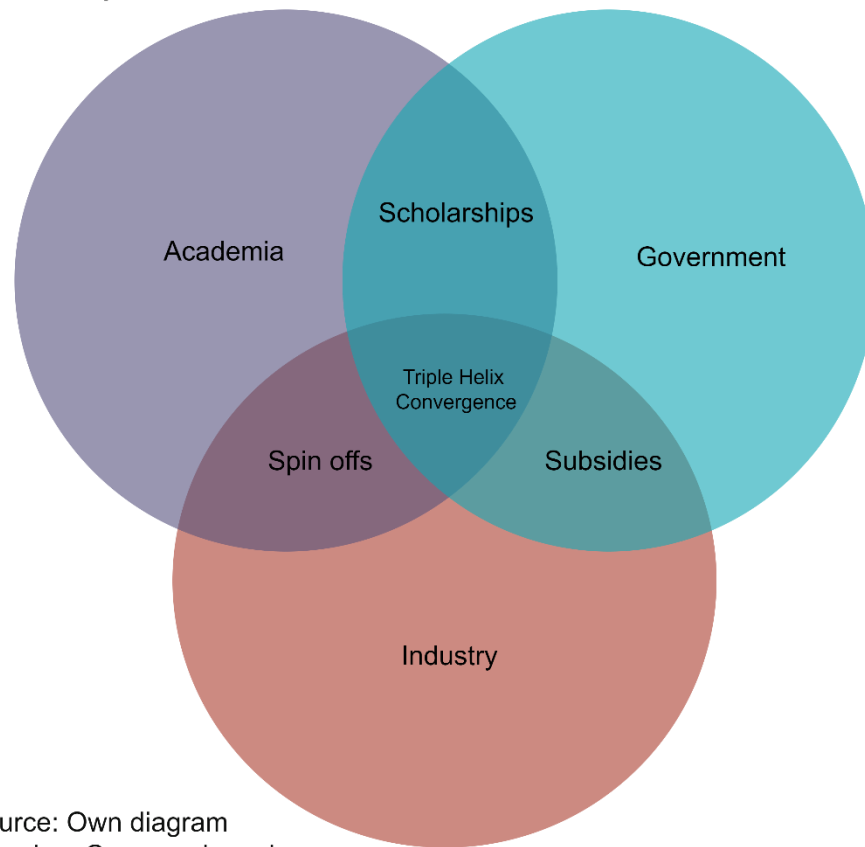
Even though innovation has been related to the technological industry, several authors have extended the concept to other industries such as science, telecommunications, and alimentary industries. A more recent article (Galan-Muros et al., 2021) added different models of the geography of innovation naming Science Parks, Technology Parks, and Innovation Districts. The term innovation has been developed over the years based on numerous studies. As can be appreciated, innovation is not a term applicable only to technology but to other fields of study such as medicine and economics.

A term related to geographies of innovation is open innovation. This is a term that has gained popularity among small, medium, and international companies. This phenomenon, in contrast with traditional innovation, is focused on "opening up the innovation process" (Huizingh, 2011, p. 2). Open innovation has been defined by several recognized authors. One of the most recent definitions is the one given by Henry Chesbrough and Adrienne Crowther, (2006), describing a model "where companies recognize that not all good ideas will come from inside the organization and not all good ideas created within the organization can be successfully marketed internally" (p.1). Literature about open innovation is extensive and concludes that it is indeed an increasing tendency for companies to switch to this model rather than staying in closed innovation. The reasons behind this forced change are a competitive advantage and the generation of new knowledge that open innovation allows. Contrary to closed innovation, open innovation promises a sustainable way of innovation. Open innovation is enhanced by the geographical proximity of companies, knowledge sources such as universities, and R&D development (Feldman & Florida, 1994).

Another phenomenon related to open innovation and proximity is the model of the Triple Helix. This term was first introduced in 2000 by Etzkowitz and Leydesdorff, placing the collaboration between government, academia, and industry as part of an ecosystem of innovation. It must be noticed that the element of the Helix evolves over time. Other authors add the societal involvement in terms of lifestyle, culture, and values (Carayannis & David F. J. Campbell, 2010) Supporting the last author, Galan-Muros argued that geographies of innovation often develop interactions between Government, Academia, Industry, and Society, creating a quadruple Helix (Galan-Muros et al., 2021). The involvement of external factors such as climate change caught the attention of investors and society, forcing them to include this matter in the development of geographies of innovation. The Quintuple helix model explains the inclusion of social ecology into innovation and geographies (Carayannis et al., 2012).

As common characteristics, geographies of innovation are planned spaces with a high density of innovative and knowledge-based actors, all managed by an organization or consortium of organizations (Galan-Muros et al., 2021). The main actors are members of the three main axes of the helix model. The evolution of innovation districts and the involvement of helixes in them is a matter of cultural awareness and the natural evolution of geographies of innovation over time. The addition of knowledge in several layers of development creates the evolution of helix or axes in the development of knowledge-based geographies of innovation (Carayannis & David F. J. Campbell, 2010).

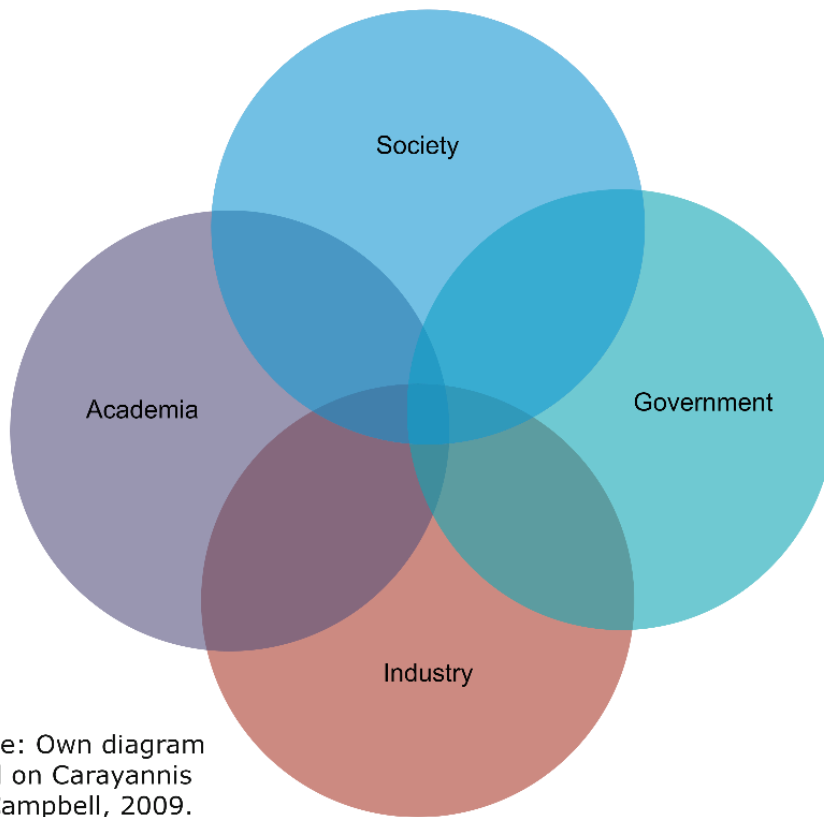
Figure 1. Triple Helix Model



Source: Own diagram based on Carayannis and Campbell, 2009.

More complete models of helixes have been developed over time. For instance, Quadruple Helix includes the societal participation into the ecosystem (Carayannis & David F. J. Campbell, 2010).

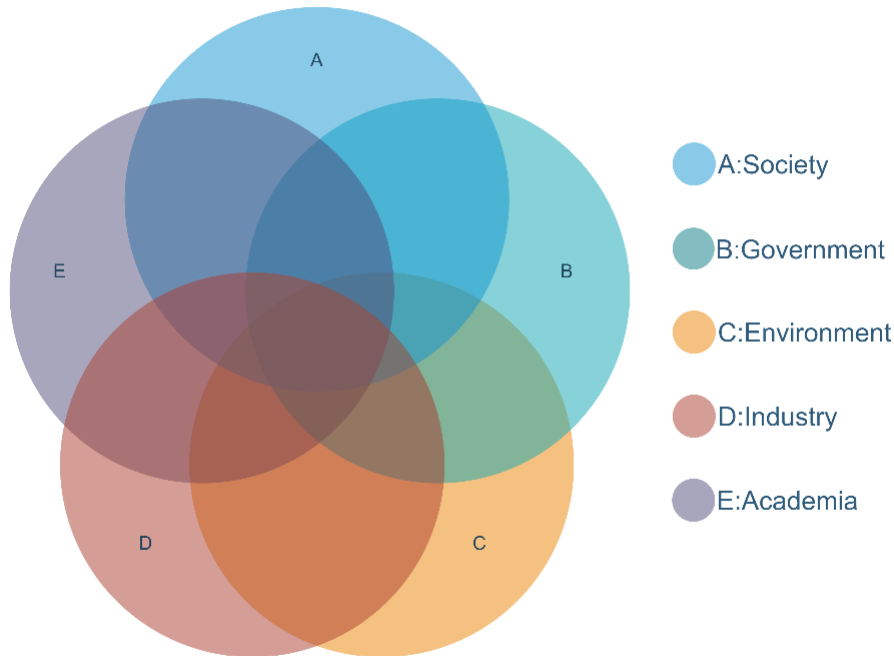
Figure 2. Quadruple Helix Model



Source: Own diagram based on Carayannis and Campbell, 2009.

Lastly the quintuple helix model adds the environmental element to the ecosystem (Carayannis & David F. J. Campbell, 2010). By this, the quintuple helix model makes all parties not only aware of the relevance of sustainability development but empowering them to create synergy with the other elements of the ecosystem to develop sustainability.

Figure 3. Quintuple Helix Model



Source: Own diagram based on Carayannis and Campbell, 2009.

For this research, the triple helix model will be considered the base of Campus Diepenbeek as a geography of innovation, keeping the quadruple and quintuple helix for further development over time.

In based-place innovation ecosystems, Rissola and Monardo 2019, analyzed three main cases of innovation ecosystems in the United States of America, revealing some models of innovation districts. Moreover, Rissola and Haberleithner, 2020 analyzed several cases of the geography of innovation from Europe and America, concluding that every location is unique and cannot be compared to one another. It is evident that geographies of innovation are characterized by a unique combination of entities from the quadruple axis, giving each location a set of non-replicable characteristics that firms from a specific location can exploit and contribute to.

The study of geographies of innovation encouraged the creation of related terms. According to Christopherson, a *resilient region* achieve economic sustainability over time by making adaptations to the economic environment (Christopherson et al., 2010). Complementary, Christopherson et al., (2010) highlighted some no-exclusive factors that help to build resilient regions. Among them can be modern productive infrastructure; a skilled innovative and entrepreneurial workforce; a supportive financial system; a diversified economic base.

Definition of Innovation Districts

The most recent geography of innovation term is *Innovation District*. Katz and Wagner (2014) defined an innovation district as "Geographic areas where leading-edge anchor institutions and companies cluster and connect with start-ups, business incubators, and accelerators. They are also physically compact, transit-accessible, and technically wired and offer mixed-use housing, office, and retail" (Katz and Wagner, 2014, p.1).

Several authors refer to *clusters* as innovation districts. The Brookings Institution uses the term indistinctively since they define it as "geographic concentrations of interconnected businesses, suppliers, and associated institutions. They can contain anchor institutions, small firms, start-ups, business incubators, and accelerators" (Baily & Montalbano, 2017, p.1). Furthermore, (Porter, 1998) defined cluster as "geographic concentrations of interconnected companies and institutions in a particular field". (p.1) For the purpose of this thesis, it will be taken the term innovation districts since the focus is on innovation.

According to Katz and Wagner (2014), it is highlighted that innovation districts contain "economic, physical, and networking assets" (p.2). The combination of these three types of assets in combination with innovative management can create an innovation ecosystem. Katz and Wagner (2014). Examples of economic assets can be institutions, firms, and organizations. As physical assets are mentioned buildings, common spaces, and infrastructure. The networking assets are represented by relationships, interactions, and exchanges between the actors (Katz & Wagner, 2014). From the analysis of Katz and Wegner 2014, and in line with the thought of Rissola and Haberleithner, 2020, it can be highlighted that even though the geographic composition of their three main aspects is a key characteristic of innovation districts, each geography of innovation has its combination of economic, physical, and networking assets, bringing to each location unique set of opportunities ad developments.

Going further with the definition of innovation districts, the main objective is the "intentional effort to create new products, technologies, and market solutions through the convergence of disparate sectors and specializations" (Katz and Wagner,2014, p.2). The interaction between these 3 types of assets brings regional development and interaction in ways that industrial parks and other previous models could not provide.

As mentioned before, the combination of assets creates the ideal conditions for clustering, however, only when actors pursue innovation, synergy is created, and geographies of innovation become meaningful not only for companies and clients but for the community where they are located. The analysis of several innovation districts and their composition has brought to the conclusion that even though innovation districts can differ in form and main industry,

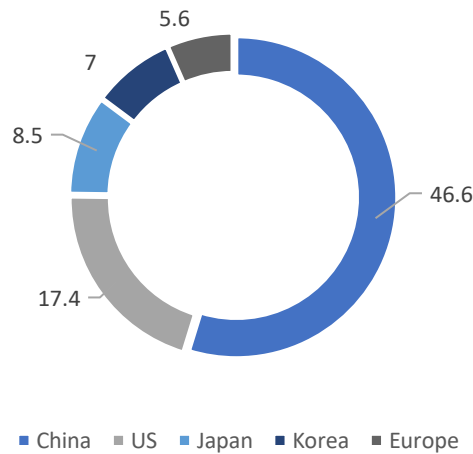
they all share the interaction between actors within the shared geography (Katz & Wagner, 2014).

Another important aspect of an innovation district is the variety of assets that every district possesses. According to Katz and Wagner (2014), there are 3 general models of innovation districts named *anchor plus*, *re-imagined urban areas*, and *urbanized science parks*. From these 3 innovation districts models, the *anchor plus model* is defined by Katz and Wagner (2014) as a geography of innovation "where large-scale mixed-use development is centered around major anchor institutions and a rich base of related firms, entrepreneurs and spin-off companies involved in the commercialization" (p.2). The anchor plus model of innovation districts are typically started by "anchor companies and institutions, advanced research institutions, advanced medical campuses, venture capital companies, management, and research campuses, major real estate developers, major and local governments, incubators and social networking institutions" (p.3). This list is not exclusive but rather exemplifies the main actors that an innovation district may have to create synergy and respond to a common goal.

According to Clark et al., 2010, the reason why anchor institutions models are more famous and innovatively developed is the intensity of patent development. From this perspective, it can be assumed that anchor institutions play an important role in the development of new knowledge and patents for countries. According to WIPO (2023), Europe has the 5.6% of the world's patent applications, being China and the USA leader's world's leaders in this aspect. It is not a surprise that the major concentration of innovation districts in the world are located in countries such as the USA and China, where the concentration of patents application is higher. The following figure explains graphically the data:

Figure 4. Graph of Patent Application Percentage Allocation

World patents application in percentage



Data retrieved from WIPO Statistics Database, February 2023

The second model of innovation districts proposed by Katz and Wagner (2014) is the *re-imagined urban areas*. These pre-existing urban areas, mainly warehouses, start a process of transformation in terms of structure and allocation of resources to attract innovation (Katz & Wagner, 2014). The goal is to transform the geography to make room for companies from other industries. The efforts are combined with the participation of research institutions and anchor companies (Katz and Wagner (2014)). An up-to-date example of an innovation district of Boston and Cambridge, in the United States. In their analysis, (Rissola et al., 2019) examined the innovation ecosystem actors in this particular area. Higher education institutions such as Boston University and MIT play the role of anchor institutions.

The last model of innovation districts refers to *urbanized science parks*. This model is characterized by semi-isolated science and technology areas that build a long-term development plan to attract a more dense activity to the area (Katz & Wagner, 2014). Cases of this model can be found mainly in the United States, led by anchor institutions such as the University of Virginia Research Park in Charlottesville and the University of Arizona Tech Park in Tucson (Katz & Wagner, 2014).

It has been mentioned before that innovation districts are characterized by the interaction between the 3 main types of assets. Matching with the definition of innovation district from Katz and Wagner (2014), innovation districts require a centric management institution that helps to allocate assets and liabilities to generate strategic growth in a realistic and customized way. This approach is not only the main characteristic of an innovation district but also is

relevant to emphasize that given the complexity of an innovation district, without core management, innovation districts will come to be a mere geographic area with a high concentration of firms.

From the literature, geographies of innovation evolve over the years in terms of collaboration and open innovation. In the past, technological and science parks brought some of the most significant innovation developments. Despite the positive effects of industrial parks and the development of isolated clusters focused on innovation, innovation districts “help address three of the main challenges of our time: sluggish growth, national austerity, and local fiscal challenges, rising social inequality, and extensive sprawl and continued environmental degradation”. (Katz & Wagner, 2014).

Why Innovation Districts Matter

As it has been mentioned before, due to social and economic factors, industrial districts and technological parks have decreased in popularity and migrated to more resilient regions where assets are used in more integrated and sustainable ways. Katz and Wagner (2014) showed a clear example of this shift in The United States. Places such as Silicon Valley brought innovation and large development to the region. However, in recent years, open innovation and mutual collaboration have put the eyes of investors in other locations all around the world.

It is well-known that geographies of innovation have brought economic and social development not only to the more proximate area but to several industries all around the world. According to Wagner (2019), innovation districts benefit the surrounding with an increment of job positions, a raise in the entrepreneurship degree, and help to decrease poverty and social inequality in the area.

Along the same line, innovation districts have the potential to mitigate the slowdown of productivity over time and the diffusion of knowledge in an economy by increasing collaboration between firms and universities. (Baily & Montalbano, 2017). Moreover, (Carlino & Kerr, 2014) identified some advantages of clustering such as sharing of common assets, an increment of matches between high-skill workers and job opportunities, and an incremented spread of tacit knowledge between the participants.

Innovation Districts in The United States:

Several academic articles highlighted the innovation district trend in The United States. The Brookings Institute named in their report some of the most remarkable innovation districts host cities such as Detroit, Houston, and Chicago. It is evident that rather than limit the list to some strategic cities in The United States, the trend is to invite more and more participants to the

game. From existing innovation districts, Katz and Wagner (2014) gathered the main strategies followed by experts to develop innovation districts. Among the strategies are to “build a collaborative leadership, network, set a vision of growth, pursue talent and technology, enhance access to capital, and promote inclusive growth” (p.14). It is important to consider that the list is not exclusive and future research should include a quantitative analysis of these strategies to understand in depth the impact of each institution inside the innovation district it belongs to.

Three Prior Study Cases in Europe

Even though the American trend of innovation districts has permed to other parts of the world, little attention has been put in Europe. In this century, innovation districts in Europe started developing, primarily influenced by Western trends. One of the most significant examples of this phenomenon is the self-proclaimed innovation district in Barcelona (Barcelona 2000, as cited in Morrison, 2017). To transform Barcelona into a "knowledge city and a reference in technological innovation in Europe", 22@Barcelona became one of the most significant projects in the geographies of the innovation field (Barcelo & Oliva, 2002, as cited in Morrison 2017, p.2),

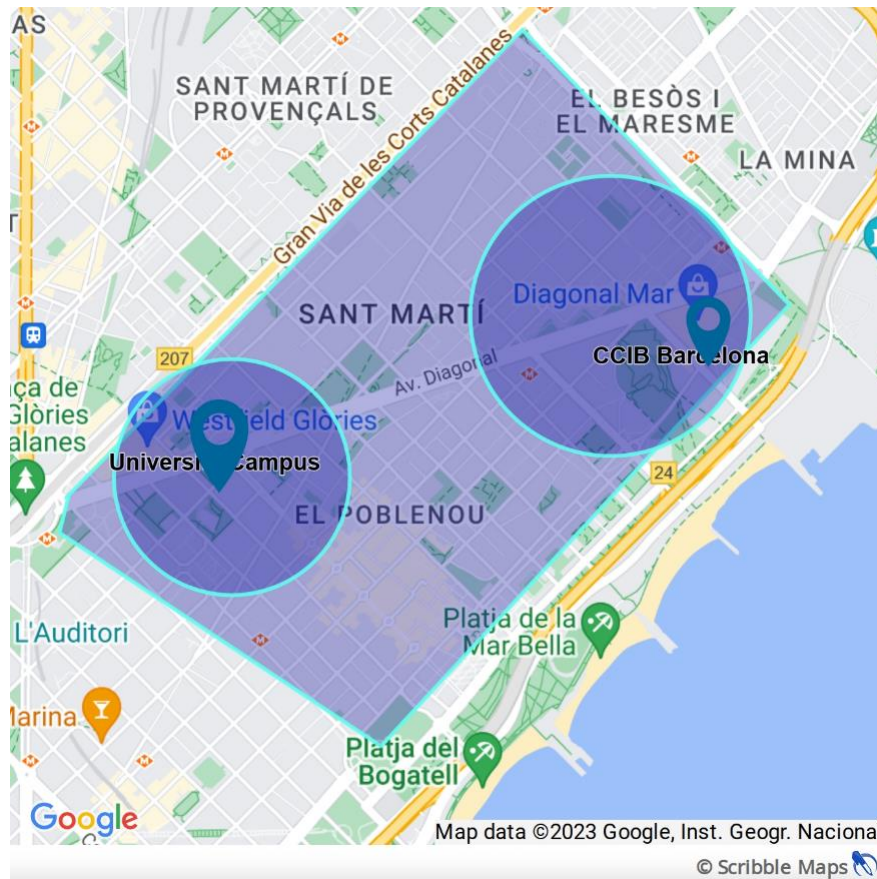
The city of Barcelona has 4 main spots of innovation naming Barcelona Activa Technology Park, Barcelona Science Park, Polytechnic University of Catalonia Park, and 22@ Innovation District (Galan-Muros et al., 2021). 22@ Barcelona is framed by 200 hectares of built space, where more than 1,500 firms perform their innovations and technological activities (Monardo, 2019). Anchor Institutions such as the Pompeu Fabra University and the company Cisco Systems are placed in the region (*Sh Barcelona*, 2021).

Additionally, (Morisson, 2017) highlighted the urban planning of 22@ Barcelona with 4 main goals: “to foster the development of new activities through zoning laws, to create diversity, to encourage density, and to generate a good quality of life” (p. 5). Moreover, the city council and main actors of the district are actively involved in the planning and development of innovation projects, creating a unified administration of the innovation district. The focus of 22@ Barcelona is on startups and incubators, hence, every year are organized several international fairs with technology and startups as the main topics (Galan-Muros et al., 2021).

22@ Barcelona is one of the main examples of innovation districts outside the United States. In the research of Monardo (2019), it is highlighted that the innovation district in the region of *Pobleneu*, Spain was planned according to Barcelona's city traditional development and design. Part of this development includes the transport accessibility of the innovation district via bus, metro, and train (Sagredo, 2020, as cited in Galan-Muros et al., 2021). This is a clear

example of a *re-imagined urban area* brought by The Brookings Institute where industrial and residential areas are transformed to attract innovation and a dense network.

Figure 5. Map of 22@ Barcelona, in Spain.

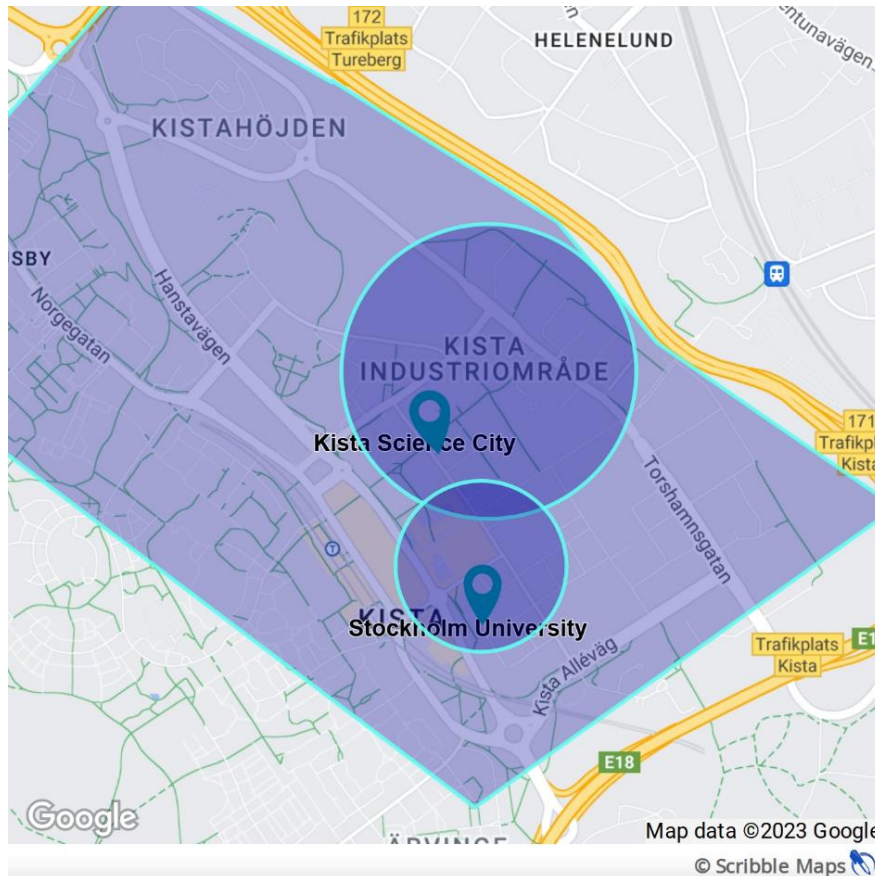


The second example of innovation districts in Europe is in Stockholm, Sweden. In research from (Galan-Muros et al., 2021), the Kista, Science City was originally planned as a residential and commercial area. When companies such as SRA and IBM, the opportunity to emerge as a geography of innovation becomes clear (Galan-Muros et al., 2021). Nowadays, Kista Science Park is constituted by more than 1000 companies and leading institutions such as The University of Stockholm and The Royal Institute of Technology. Additionally, private, and collaborative research centers as well as incubators are in the area. Furthermore, the management of this geography of innovation is performed by Kista Science City AB (KSCAB) which oversees the development of the region of Kista, Stockholm (Kista Science City AB), and the Electrum Foundation, conformed by representatives from the city, companies, nonprofit organizations and the universities. (Galan-Muros et al., 2021).

The main industry of Kista Campus is Pharmaceutical; however, it is also a house of projects from other industries such as digitalization and sustainable innovation (Galan-Muros et al.,

2021). This geography of innovation is connected by two main European roads (metro and train options). The geography also includes green areas, restaurants, shops, hotels recreational spaces, and public transportation facilities (KI Science Park, 2023).

Figure 6. Map of Kista Campus in Sweden



A third example of the geography of innovation is Corda Campus, in Hasselt. Even though the Corda campus has not been recognized as an innovation district, it fulfills several characteristics of this new phenomenon of agglomeration and innovation. Corda Campus is in Hasselt, Limburg. As an initiative of LRM Group – an investment company in the region of Limburg focused on projects with high economic growth and sustainable industry- the Corda campus was created as a technology campus for businesses and start-ups (LRM Group, 2023). Corda Campus is the house of 250 companies, networking organizations, incubators, startups, and public institutions, which create a rich knowledge and innovation network within the 9 buildings. (Corda Campus, 2023). Additionally, Corda Campus has green pathways, connections with public transport, and daily life amenities such as restaurants, cafes, banks, and service places (Corda Campus, 2023).

Figure 7. Map of Corda Campus, in Belgium

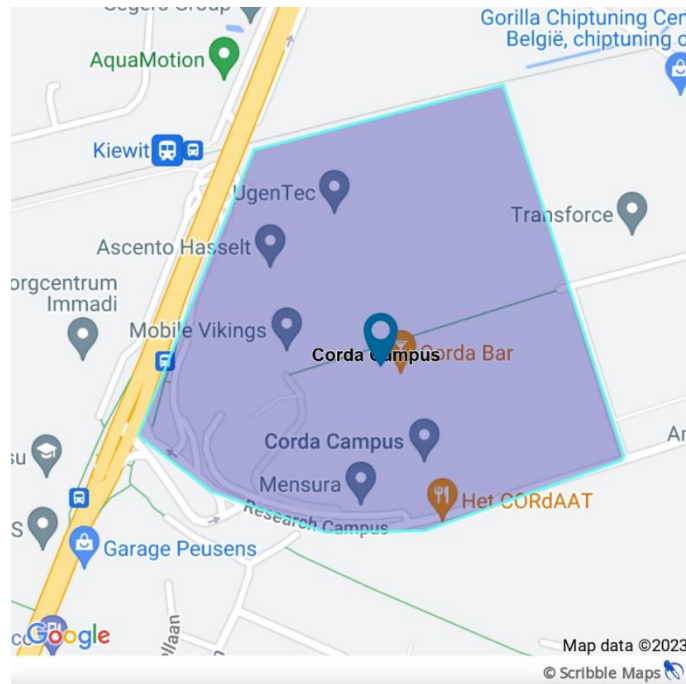
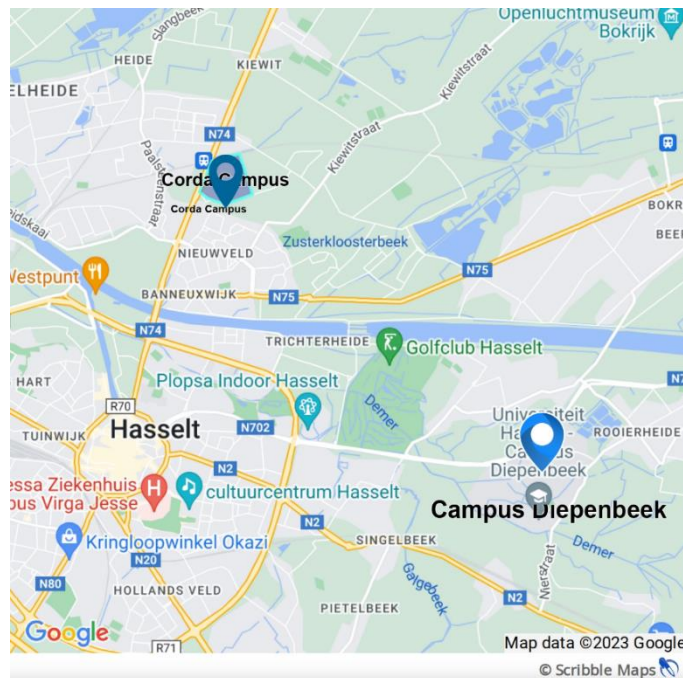


Figure 7.1. Map of Corda Campus, next to Hasselt and Diepenbeek, Belgium



According to the regional Innovation Index (WIPO, 2022), Belgium occupies the number sixteen in this rank, being Sweden number 2 and Spain number eighteen. This data illustrates

the development of each example of innovation districts and its impact on the overall innovation performance.

From the business cases in Spain, Sweden, and Belgium, the geographical space of these innovation districts can be very different in shape and size. However, we can observe that collaboration and structured planning are tacit characteristics of the three innovation districts. From Barcelona @22, Kista campus, and Corda campus examples, the innovation-based development is sustained by a set of aligned policies, ruled by common governance. The main common characteristic found in *Exploring the Concept of Geographies of Innovation* by (Galan-Muros et al., 2021) is a high density and high variety of actors, which collaborate in shared infrastructures. The literature review is hence sustained by Barcelona, Stockholm, and Hasselt business cases.

From the Mining Industry to Business Development in Belgium

According to Belin (2018), Belgium is well known for being the first country in Europe after the UK to engage with the industrial revolution. Since 1815 Belgium received a heavy industry approach under the rule of William I. In 1892, more than 80% of companies in Belgium were heavy industries. After 1917, the coal industry start being exploited in Limburg. This industrial exploitation in the region brought to Belgium a big economic development. However, the coal exploitation didn't last long. Parallel to the coal crisis of 1955-1958, the Flemish government made considerable changes that attract foreign investment to the region, allowing Limburg to diversify in other industries (Buyst, 2009).

Finally, in 1992, the last seven coal mines in Limburg were closed and acquired by the company LRM. Since then, the coal mines complex has been transformed to deliver more value than before (LRM, 2022). This transition was possible partly due to the creation of government institutions such as the Flanders Investment and Trade Agency. After 1960, the Finance sector in Belgium increased considerably, allowing Belgium to gain financial trust from abroad, and consequently attracting investors. The transition from heavy industry to a more diverse welcoming environment for industries, allowed Belgium to start a new era of innovation and development.

This new reallocation of resources and geography allowed the region of Flanders to diversify into other industries where technology and science lead the path of development and growth. Ex-mine sites were not the only attempts of the Belgian government to invest in science and technology. In 1991 the Flanders Investment and Trade Agency was founded as an independent agency by the government of Flanders. According to the website of the same institution, the purpose of this agency is to attract foreign companies and investment to the

region at the same time that they assist Flanders-based firms (Flanders Investment & Trade, 2023a).

Two main industries were developed in Flanders in the 1950s with the arrival of Ford and Phillips Electronics to Flanders. Product of bilateral agreements between the Flemish Government and foreign investment for the region, Philips Electronics, the electrical equipment manufacturer opened in Belgium in 1954. With several manufacturer points in Flanders, Philips brought an increase in job positions and prosperity to the region. (De Tijd, 2002).

Due to globalization and the re-location of manufacturing plants to countries with lower wages than in Europe, Phillips closed 25 factories all over the world, also affecting Belgium in 2002 (De Tijd, 2002). One of the main manufacturing centers, located in Hasselt was closed, bringing a loss of 1,100m jobs to the region (Eurofound, 2003). The affected areas were mainly located in Limburg, however, this major closure affected also the area of Brussels, East Flanders, West Flanders, and Flemish Brabant (Eurofound, 2003).

A second major event in Limburg was the closure of the assembly site in Genk, Limburg. Ford, the automotive company, settled in Genk, Belgium in 1962. Together with other car brands, the automotive industry generated 26,000 in the period 1992-2001. By 2002, Belgium was one of the highest producers of cars in Europe with most of the production exported. (Eurofound, 2003).

Due to strategic changes in the company, in 2003 the assembly plant of Ford in Genk cut off 3,000 jobs (a third of the total number of employees from the assembly plant), creating a considerable negative impact on the economy of the region (Eurofound, 2003). In addition to this direct loss, other supply chain and distribution companies were affected by the major decision of Ford. (Eurofound, 2003). A definitive closure of Ford in 2014 causes an even major loss of 4,300 jobs in Limburg, and approximately of indirect 11,800 jobs in the region (Reuters, 2014)

The imminent job crisis in Limburg caused not only an increase in the available labor force for other companies but also an urgent problem to solve for the regional government. Additionally, companies from several industries realized it was more important than ever to diversify and invest in innovation. Again, the transition from the industrial to the innovative era was palpable.

These two major events of closure in the region forced the local and federal governments to look for other long-term investments that were able to bring job opportunities as well as development for the region. In collaboration with investment companies, the Flemish government worked on the reallocation of resources from heavy industry to knowledge-based

innovative companies, opening the path to technology development, investment of foreign companies, and a new era of social and economic development for Belgium.

LRM is a venture capital company that invests in real estate and transforms mining sites into projects with a climate and mobility approach (LRM, 2022). According to LRM 2022, examples of this transformation are Walterscheid, Winterslag, and Houthalen-Helchteren. Walterscheid has been transformed into the actual *Thor Park*, which is the house of the EnergyVille Science Park, incubators, research institutions such as KU Leuven and IMEC, 250 researchers, and start-up companies (THOR PARK, 2023)

Innovation History in Belgium

The role of the government in the development of innovative and sustainable projects in Belgium has been present for several decades. (Province of Limburg, 2022) In the case of Limburg, regional and European funds have had strong participation in the area to create a "smarter, more innovative, more sustainable, more enterprising and better connected Limburg". (Province of Limburg, 2022, p.1).

The development of Corda Campus is one example of the recent clustering of innovation in Flanders. As part of the LRM group, Corda Campus was created to motivate companies and startups in the technology industry to gather and collaborate (LRM Group, 2023). This example has served as a milestone in the innovative path of Limburg, attracting more foreign investment and developing an innovation culture.

The Role of Universities in the Development of Innovation in Belgium

We have seen that the presence of anchor institutions such as universities are a key element of innovation districts. An important observation of Chelait (2020), is that Belgium has experienced a considerable increase in the number of patents owned by universities in the period 2000-2016. This development has been encouraged by the Flemish Government, via several governmental institutions. Therefore, it can be inferred that the role of universities in the field of innovation and IP has become more important for the innovation process over the years.

Even though Belgium is encouraging the number of patents owned by universities and the result, it has led to an increase in cross-border ownership, collaboration with other institutions and companies inside the country that can exploit these patents is crucial to the development of new technology. The region of Flanders had a historical background of innovation development. Even though governmental institutions encouraged foreign investment in the zone, still there is much more it can be done to leverage innovation. Innovation Districts have

become a vanguardist way for governments to gather research institutions and worldwide companies dedicated to research and development.

From the analysis of Cheliout (2020), the main sectors Belgium is focusing attention to develop patents are Special Machines, Biotechnology, and Pharmaceuticals. Even though it is emphasized that there is still a long way Belgium should run to reach the main competitors of innovation in Europe, the development of the mentioned three main areas matches with the objective of development of innovation by the Belgian Government.

The Role of Entrepreneurs from High Education Institutions as Catalyzers in the Innovation Districts:

Several benefits from entrepreneurship have been founded within the literature. Segers (2018) highlighted the role of students-entrepreneurs within regional entrepreneurial ecosystems, concluding that their contribution has a positive impact on the regional economy. Therefore, universities that play the role of anchor institutions within innovation districts allow students and startups to have access to a denser network and resources (physical, technological, and knowledge).

The report of the OECD between 2010-14 and 2015-19 about entrepreneurship shows that Belgium remains above average (+1.6 points) in the Total early-stage Entrepreneurship Activity rate-TEA). However, in the same study, it was compared the percentage of the Belgian entrepreneurial population that feels prepared with knowledge and skills to start a business with other countries of Europe (OECD, 2022). From this analysis, the Belgian entrepreneurial population stayed under average in the EU. From this perspective, the role of university and higher education programs that include entrepreneurial skills and knowledge is highly relevant.

Policymakers are a Key Factor in Creating Sustainable Innovation Districts.

Several federal programs have been elaborated to increase the innovation and entrepreneurial rate in Belgium. This country is part of the recent innovation policies by the European Commission, The Eco-Innovation program strives to promote the reduction of the bad impact on the environment and the use of resources in a more efficient manner (European Commission, 2022). Several programs such as the previously mentioned have been developed in order to promote innovation and the organic growth of geographies of innovation.

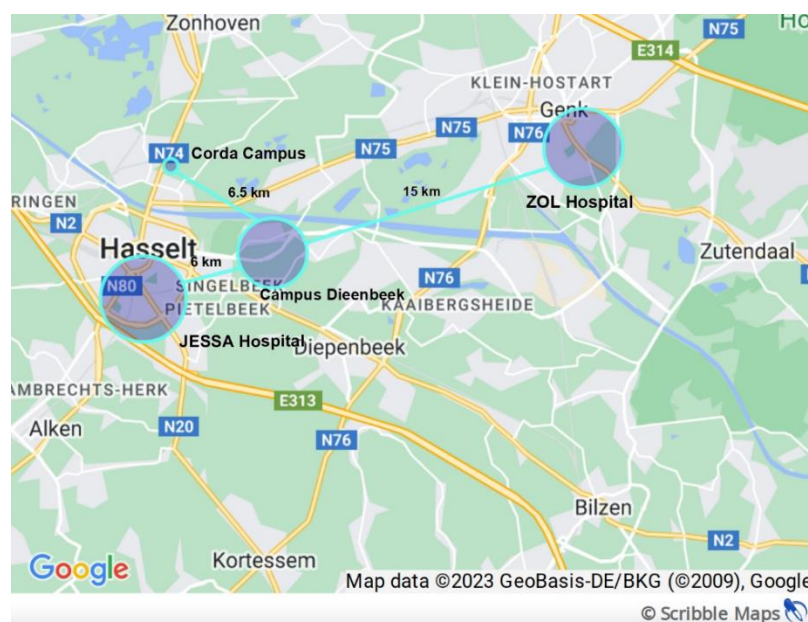
The government of Flanders has been aware of the relevance of entrepreneurs in the development of innovation and its role in the innovation ecosystem. As part of the policy priorities 2021-2024 of the Government of Flanders, including infrastructure for research and

development testing for the use of academia and companies. (Flemish Government Department EWI, 2022). Additionally, since 2016 the Government of Flanders has endeavored on a cluster policy, which is intended to “unlock untapped economic potential and to increase the competitiveness of Flemish companies through active and sustainable cooperation between actors” (Flemish Government Department EWI, 2022, p. 78). From these initiatives’ s examples, the participation of the government and the creation of policies that help to develop regions are more than needed. The participation of the local and federal governments as part of the helix is crucial for the development of geographies of innovation.

Campus Diepenbeek as a Case Study

Diepenbeek is situated in the region of Limburg, which is situated in the middle of an important region of innovative development. In the North, the city of Eindhoven hosts the largest tech company in Europe. In the East, the research universities in Liege and Aachen bring to the region knowledge and innovation. To the West, there are Ghent and Leuven, two cities where the oldest universities of Belgium are situated. Zooming in, Campus Diepenbeek is located in the middle of three main cities where other campuses are situated. Campus Diepenbeek is 6.5 km from Corda Campus, a high-tech innovative campus where national and international companies and start-ups are situated; two main hospitals are situated six and fifteen kilometers around. These elements brought to the region the ingredients needed to generate an innovative ecosystem where anchor institutions lead the path in collaboration with companies and the government.

Figure 8. Map of Hasselt-Diepenbeek-Genk



In Limburg, civic demands on education in 1971 led to the creation of Hasselt University. Cross-collaboration and the rapid popularity of the faculties added speed to the creation of the biomedical science program in collaboration with Maastricht University in 2001. Years later in 2005, holding the Faculty of Applied Economics and Science, this campus changed its name to UHasselt (UHasselt, 2022).

The focus on innovation and research, lead progressively to the current ten faculties and nine research institutes from UHasselt. (UHasselt, 2022). With an international policy, UHasselt is committed to creating synergies with international institutions and contributing to local and global challenges (UHasselt, 2022).

Currently, Diepenbeek has 3 campuses. The Health Campus, The *Bouw Campus* referring to the Construction Campus in Dutch, and the Education Campus (POM Limburg, 2022a). As part of the triple helix, several universities are on the Education Campus such as UHasselt, the University College Leuven Limburg (UCCL) campus Diepenbeek, PXL Hogeschool, and, the KU Leuven Faculty of Industrial Sciences. These education institutions share not only the facilities and buildings but also several education programs allowing students to get joint diplomas (KU Leuven Campus Diepenbeek, 2023). This is an example of cross-collaboration between higher education institutions.

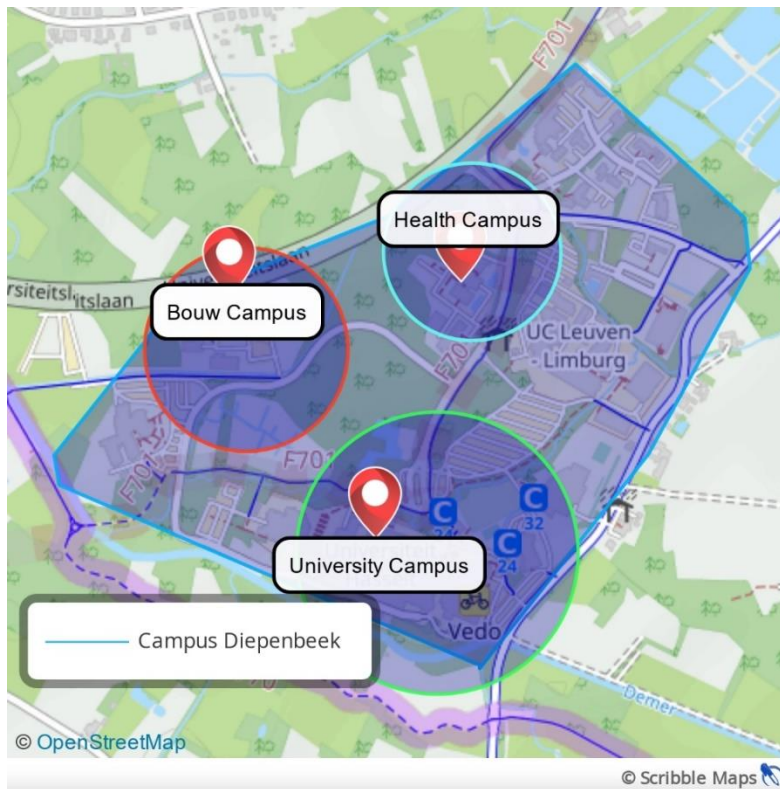
The third campus of this geography of innovation is Health Campus. This project started as an initiative between POM Limburg and UHasselt to promote the collaboration between the elements of the triple helix (Health Campus, 2023). With the mission of “becoming a leading care lab for the Euregio” (p.1), Health Campus attracts ad supports companies and research institutes to work in collaboration with startups and students from the science sector. (Health Campus, 2023). Currently, Health Campus works in association with the BioVille Center of Health & Care, PXL Hogeschool, and UCCL Limburg. (Health Campus, 2023). The collaboration with BioVille has acquired more relevance for Health Campus since it intends to combine technology and health (BioVille, 2023).

The construction of the Bouw Campus in 2018 brought a high-quality learning tool for students from the Architecture and Engineering Faculties of Campus Diepenbeek. Additionally, the Limburg Construction Confederation and the Construction Academy have their main offices in this building. (Mathieu Gijbels, 2023) allowing cross-participation between the construction industry, Academia, and Government. As the director of the Confederation Bouw Limburg, Chris Slaets mentioned, the purpose of this building is to create closed collaboration with members of the triple helix from campus Diepenbeek. (Embuild Limburg, 2022)

The construction of this building has principles of efficiency, innovation, and sustainability (Embuild Limburg, 2022), matching the purpose of geographies of innovation. More

development of the building area is already in planning to provide accommodation for new developments for and from the sectors (POM Limburg, 2022b).

Figure 9. A map of the three main campuses in the Diepenbeek area.



Additionally, economic, and geographic factors lead to clustering in the area where UHasselt is situated. Several companies are situated in this geography, thanks to the collaboration of the members of Campus Diepenbeek and LRM, the next list of institutions, universities and companies are currently part of Campus Diepenbeek:

Academia:

- UHasselt
- PXL
- KU Leuven
- UCCL

Research Institutions:

- IMO IMOMEC
- Bouw Campus (UHasselt)→ Embuild Limburg (non-profit organization)

- Health Campus
- BioVille
- Limtec + (Learning Center)

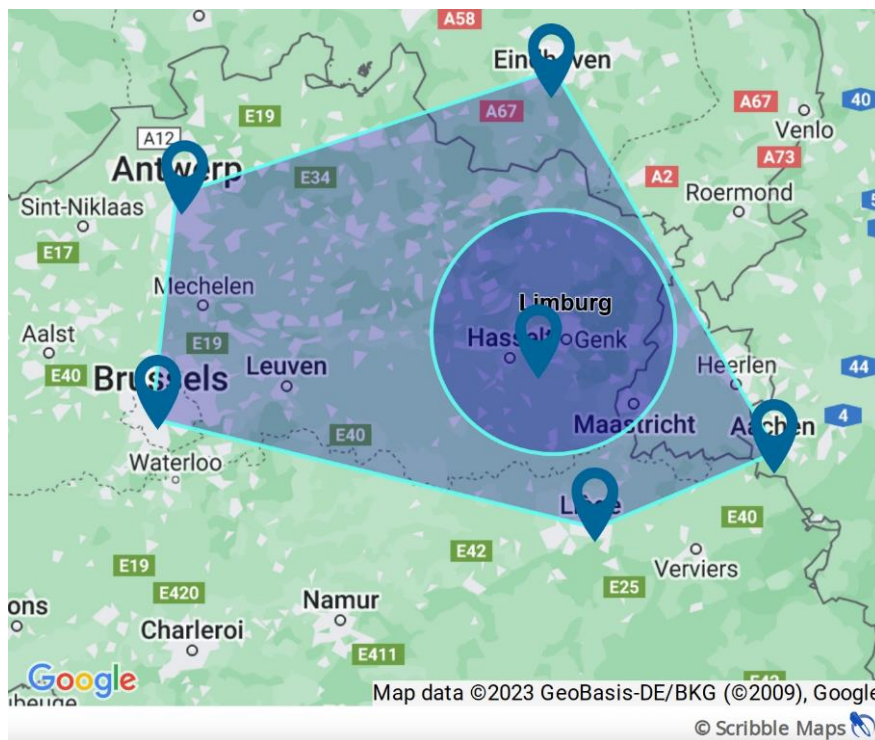
Companies:

- Entelec Control Systems (Software company)
- Apitope International (Pharmaceutical company)
- FOx Biosystems (Biotechnology company)
- QCare Medical Services (Medical center)
- Biostrand (Biotechnology company)
- InnoSer Belgie NV (Research and product development)
- DoseVue N.V. (Research and product development)

Limburg DC:

The development of the area of Limburg is not a mere coincidence. De area of Limburg is situated in the middle of a strong economic and logistic triangle. Several authors have referred to this zone as the Flemish Diamond. Van Meeteren et al., (2016) refer to this zone including the cities of Antwerp, Brussels, and Charleroi as the *ABC-Axis*. Additionally, the development of other surrounding cities such as Liege, Antwerp, Aachen in Germany, and Eindhoven in the Netherlands, have positioned Limburg in the center of a very important area of development. The list of geographies of innovation in Belgium that contribute to the development of the country is extensive, including Leuven and Ghent, where Science Universities highly contribute to the patent application rate of Belgium.

Figure 10. Map of Limburg as the center of the Flemish Diamond



Capron and Cincera, (1999) argued that policymakers should focus on “strengthening of the knowledge base, the design and the implementation of S&T policy and the enhancement of the knowledge distribution power” (p.6). Since then, attention in Limburg has been set. As part of the innovation plan of the Government of Flanders, and in collaboration with POM Limburg, LRM, and participants of the triple helix, what it is today, Campus Diepenbeek would transform into Limburg DC. This innovation and architectural project is planned to be released in 2030 (POM Limburg, 2022a).

From Katz and Wagner (2014), the geography of innovation model of anchor plus fits with the model of geography of innovation of campus Diepenbeek. From the previous analysis, UHasselt under the name of *Transnational University Limburg* set in 2001 a second campus in Diepenbeek, with a focus on science and medicine. (UHasselt, 2022). This campus served as an anchor institution for the geography of innovation.

Part of the architecture of Limburg DC is a delimitation of 3 sub-campuses, where academia, the health sector, and the construction industry are highly involved. The Health Campus building is already planning to be a 40 meters vertical building where offices, meeting rooms, and research laboratories will be available (POM Limburg, 2022a). Additionally, *Bouw Campus*, has a mission to be “more than just a transformation of construction. It reflects the ideas of future builders, rooted in the present and using the best available technology available”.

(Embuild Limburg, 2022, p.1). With this mission, Bouw Campus is currently developing a construction laboratory where students from civil engineers and architecture students can have access to it (Embuild Limburg, 2022).

Several innovation districts have included the attraction of skilled workers from other regions and countries to a specific area (Wagner, 2019). The construction sector in Belgium has experienced a shortage of construction workers. Given this problem, the construction industry and the Flemish government encourage the construction of the *Bouw Lab* which will be used as a Research and Development building where small companies that want to innovate in the construction industry can have access to facilities and knowledge. (Embuild Limburg, 2022).

As part of Limburg DC, the Bouw Campus is intended to create synergies between academic and business research not only from the construction industry but taking a more open perspective. (Embuild Limburg, 2022). One element that other innovation districts around the world do not share with Limburg DC is the compaction and sustainable building, allowing to maximize the use of geographical areas without the need for massive land expansion. Vertical building is a core element of the architectural plan from Limburg DC. (POM Limburg, 2022a). Contrary to the American model of innovation districts, the constitution of main European cities is characterized by small portions of land, interconnected by highways and most importantly, based on circular construction.

Additionally, parking spaces and green areas are also considered in the planning of the new campus (POM Limburg, 2022a). These new and revitalized elements will allow Limburg DC to become a highly walkable, livable, and networked geography of innovation.

It has been mentioned that transport connection by several means is a core element of innovation districts (Katz & Wagner, 2014). Limburg DC 2030 plan has also considered this core element; however, more elements should be added. This thesis aims to analyze the development of the existing elements of Campus Diepenbeek and the addition of new ones that Limburg DC needs to become an Innovation District.

From the literature review, this thesis shows the relevance of innovation for society and the economy. The natural development of geographies of innovation is based on the principle of sharing resources. Innovation districts are an evolution of geographies of innovation that help to cover certain needs in society such as the sharing of knowledge and technology. Multiple study cases in the world have brought different perspectives about innovation districts and their development in varied geographies. Still, research about potential innovation districts is still missing. Therefore, the research purpose of this thesis is to contribute to the topic by analyzing the case study of Campus Diepenbeek as a future innovation district.

Chapter 3: Research Design

Methodology

This thesis applies a qualitative research design to understand in depth the degree of integration of Campus Diepenbeek as a geography of innovation and the key elements that are still needed to be developed to achieve high integration between the members of the triple helix. The study aims to understand what elements of the innovation district model Campus Diepenbeek is already applying and the possible changes that can be made over time to become an innovation district. For that reason, the analysis of Campus Diepenbeek as a case study is relevant. Yin 2009, in his work *Case Study Research*, highlights the situations when a case study approach is more suitable. For instance "to contribute to our knowledge of individual, group, organizational, social, political and related phenomena" (Yin, 2009,p. 4).

The exploration of Campus Diepenbeek as a case study is intended to understand a social and economic phenomenon in the area of Limburg, Belgium. Yin (2009) explained 3 main conditions that must be considered when choosing the research method. Since 1) the research question is influenced by how the historical development of Limburg affects the current situation, 2) this thesis does not require to control behavior but rather to understand it and 3) it is focused on past events, the case study method fits with this thesis.

To understand more in-depth, the primary data collection was via interviews performed by the researcher with key stakeholders of Campus Diepenbeek and other personalities that have experience in geographies of innovation. The interviewed selection included members of the triple helix (Government, Industry, and Academia). The interviewees were carefully selected taking into consideration that the type of information needed is not completely from the public domain and required certain expertise in the field of innovation and geographies of innovation. For that, the criteria used to select interviewees was that the individual must be an employee or relevant decision-making member from one or several members of Campus Diepenbeek.

Additionally, external members of Campus Diepenbeek were accepted since they had relevant knowledge about the composition of geographies of innovation. Lastly, members that were not directly involved but are part of the network of geographies of innovation were selected. The complete list of interviewees can be found in Appendix 1 of this thesis. Eight semi-structured interviews were conducted. The choice of different roles between interviewees was to compare their answers around specific topics and see if there are similar and/or different opinions.

The method chosen over other data collection methods relies on the aim to gather contextual, explanatory information about social and economic structures that need deep understanding

and analysis. Additionally, this method allowed the interviewer to ask further questions based on interviewees' answers and extend the knowledge depth. The interview guide was developed based on the research questions and the literature review. The type of questions asked was open-ended, allowing the interviewees to elaborate answers based on their experience and perspectives, describing processes, and social and economic phenomena. A descriptive list of the interviewees can be found in Appendix 2.

The semi-structured interviews were conducted in person and remotely, depending on the participants' preferences and accessibility. Each interview was expected to last between 60 to 90 minutes and was audio-recorded and transcribed verbatim with the use of the software Otter.ai. It is important to note that the researcher was aware of the qualitative approach does not produce results that can be generalized, however, the information provided more in-depth knowledge about a specific economic phenomenon. This method is supported and used by other investigations in the field.

Data Analysis

The analysis of the data consisted of several steps. After interviewing the participants and transcribing the interviews with software, a thematic analysis was made in order to find major themes around innovation district and the main characteristics of Campus Diepenbeek as a geography of innovation coding methodology was performed. Further, a framework analysis of the open-ended questions led to the creation of codes. The coding process was based on the deductive method however, the inclusion of some new codes was performed because of the relevance of the information for this thesis. The process of coding was revised multiple times to discharge codes that were not relevant or were captured more than one time. In total twelve themes including areas of study such as infrastructure, governance model, network, entrepreneurship, academia, government, and industry. Eighty codes were registered and gathered according to each theme.

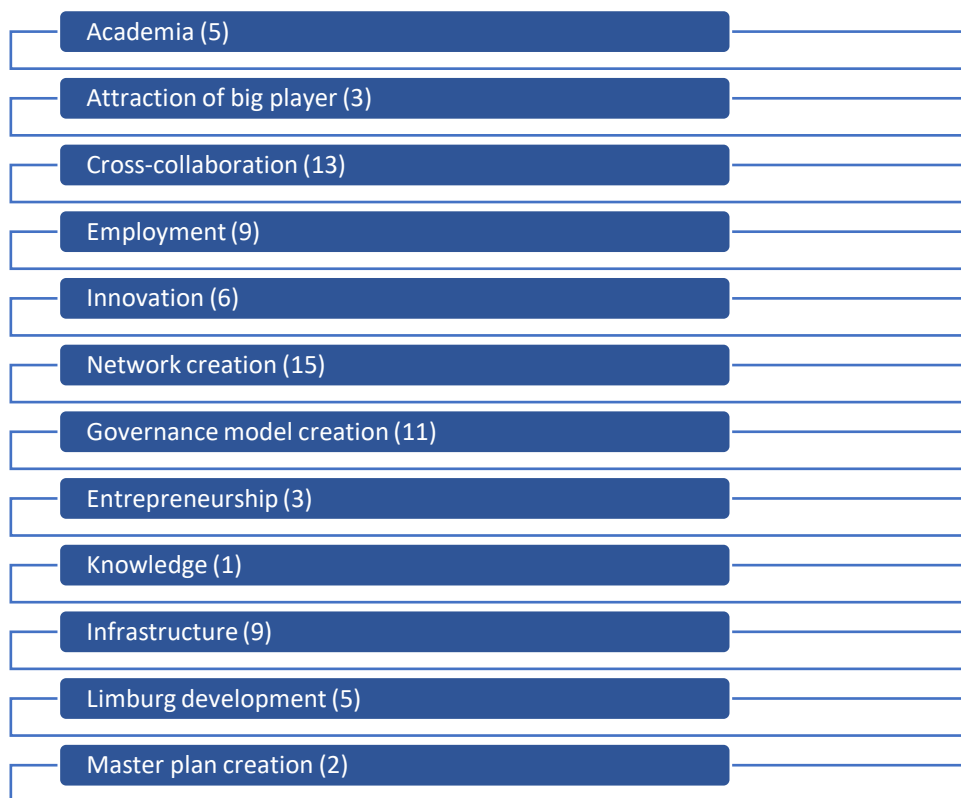
Then, the construction of the codes was based on the interviewee's answers and the grounded theory of the literature review, giving importance to the topic and its relationship with other topics. For that reason, the constitution of the codes has several keywords. The codes were compared between interviewees in order to find similarities and differences. Additionally, several codes were similar between respondents, giving consistency to the research process. It is important to mention that some new codes were not able to match other interviewees' answers, however, the information gathered from them was relevant for the research. To analyze the data, the Excel software was used to organize the data.

A criterion as *positive* or *negative* was given to analyze the impact that specific code has on the geography of innovation. Additionally, a criterion of the *current situation* and *future*

situation were assigned to analyze the current situation of Campus Diepenbeek and the changes that should be considered in the development of this geography of innovation. After that, a numeric value was given to each topic based on the number of interviewees that talked about the topic and the perspective, positive or negative, that they perceived. This number allowed to quantify the relevance of each topic and highlight the most relevant topics and elements for the members of Campus Diepenbeek. It is important to mention that the axial coding method was applied, allowing to establish relationships between codes.

After the process of coding and classification of the data, axial trees were made to represent the information obtained and the relationship between themes and codes. These diagrams allowed to quantify the relevance of certain themes or codes for the thesis and the comparison of answers between interviewees.

Figure 11. List of themes and number of codes in brackets per theme.



Chapter 4: Results

The Current Organization of Campus Diepenbeek

To determine if Campus Diepenbeek can become an innovation district, it is relevant to understand its current organization of it. The information gathered from the interviews covered several general themes such as governance model, investment, infrastructure entrepreneurship, innovation, sustainability, and cross-collaboration. The list is not limited but rather extensive.

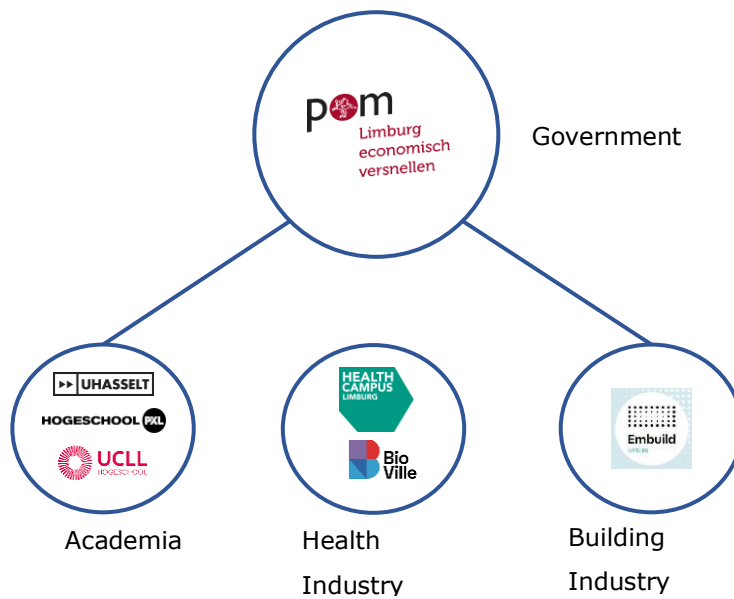
From the literature review, it is known that innovation districts can vary in shape and size. Therefore, it was expected to find different characteristics of campus Diepenbeek as a geography of innovation that perhaps are not seen in other current geographies. Additionally, similar characteristics were found in the data obtained from the interviews, allowing for future analysis and recommendations. The study's findings may have practical implications for policymakers, industry leaders, and academic institutions regarding the development of collaborative innovation processes.

As a first topic, the current organization of campus Diepenbeek was sketched. The governance model of Limburg DC is not defined yet; however, the current composition of the Board of Managers of Campus Diepenbeek is built by representatives of the province of Limburg, the city of Diepenbeek, Bouw Campus, the Health Campus, and the 3 higher education institutions such as Hasselt University, PXL University of Applied Sciences and the University College Leuven-Limburg (UCLL). The board of management meets regularly to analyze the development of the area and the so-called Science Park. Additionally, POM Limburg can be considered head of that board, by being the gate to European funding for the province. The participation of POM Limburg, the *Limburg economisch versnellen*, is crucial for the development of Campus Diepenbeek since it allows Campus Diepenbeek to have access to provincial funding and to connect to several innovation players in the province. At a federal level, the investors in this project are represented by LRM (a venture capital and private equity in Limburg). This company invests in profitable business in Limburg allowing Campus Diepenbeek to develop societal and profitable projects.

The creation of the Science Park as a company allows the Health Campus and the Bouw Campus to delineate their share in the property within Campus Diepenbeek. The meetings of the board of managers are purposed to determine the joint plan of the members in terms of infrastructure and development of their land in Campus Diepenbeek. In the current governance model, there is a board of managers led by POM Limburg. This board of managers gathered in order to discuss infrastructure and common areas development. Within the board,

academia, government, Health Campus, and *Bouw Campus* are represented, and frequent meetings are arranged to discuss infrastructure and collaboration matters. The graphical representation of the current board of management is shown in the next figure, where government, academia, and 2 main industries are represented.

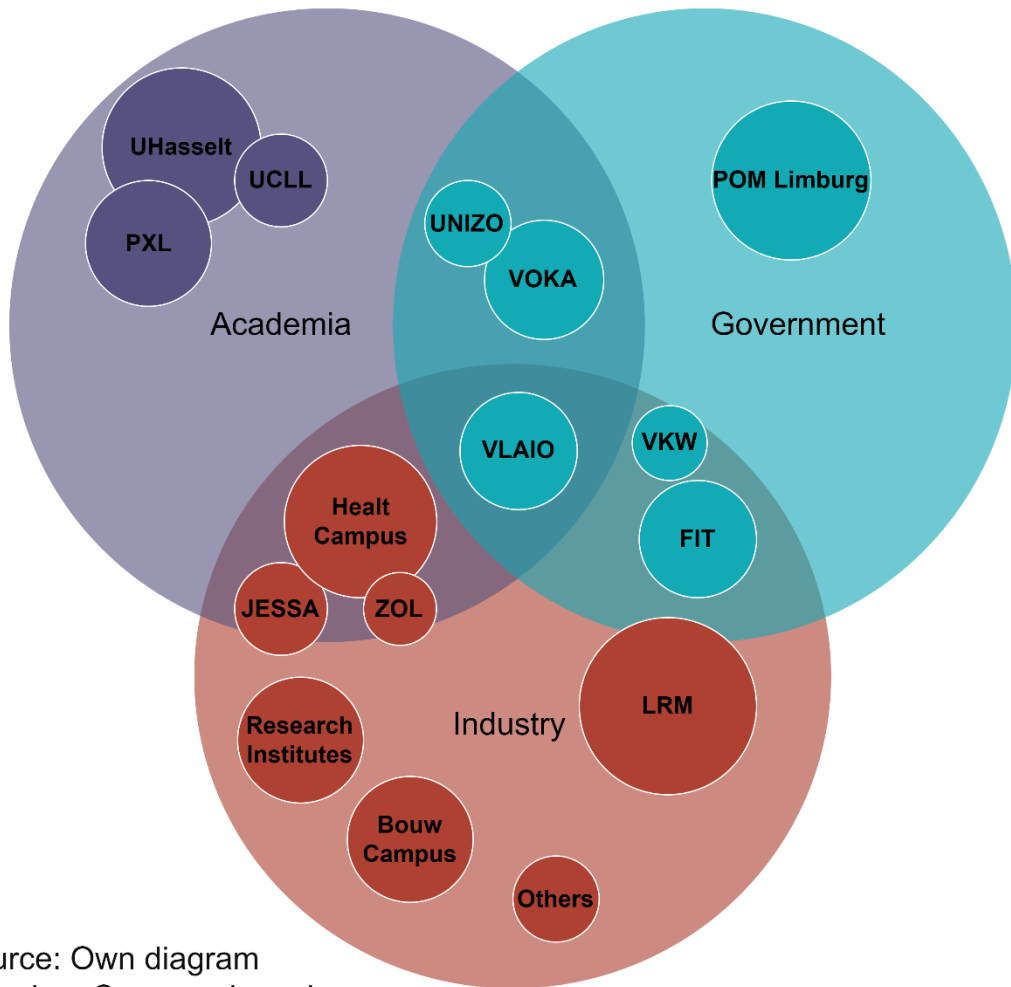
Figure 12. Illustration of the current board of Managers from Campus Diepenbeek.



Source: Own diagram based on interviews with stakeholders, 2023.

From the creation of themes, it has been found that some received more relevance than others. In the next diagram, it is graphically shown the representation of the themes. An explanation of each of them is then deployed.

Figure 13. Triple Helix Model of Camus Diepenbeek



Source: Own diagram based on Carayannis and Campbell, 2009.

Network:

The theme of *Network* was the biggest of the list, with thirteen codes. Codes oriented as current positive aspects of Campus Diepenbeek were found. Additionally, several opportunity areas were pointed out by the interviewees. On the positive aspect, Embuild Limburg saw an opportunity in Campus Diepenbeek, since in contrast with other Building campuses in Belgium, Campus Diepenbeek allows Bouw Campus to connect construction companies with experts in the field to receive orientation in specific projects. Additionally, the connection with universities in Campus Diepenbeek allows them to be in touch with new ideas and possible collaboration with entrepreneurs.

From the academia, it was found a positive collaboration between the University and the companies within Campus Diepenbeek. From the Academia point of view, it is relevant to have companies in the vicinity.

"But I can name several of these companies remote or close by, indeed, whether they are in our vicinity is a practical advantage...It helps to be in the vicinity" (P. Pauwels, personal communication, March 22, 2023).

From the Health Campus point of view, connection not only within Campus Diepenbeek but also abroad are relevant in other to position Health Campus in the eyes of high science and research. Even though networking with the hospitals in the area such as ZOL in Genk and Jessa in Hasselt, provincial, regional, and international networking is important for Health Campus in order to generate more research and development.

"We have to develop the campus on three spear points. One of them is networking. If we only keep networking, between Hasselt and Genk, we will not make it. I mean, regional networking is important, and campus networking is important. But also Flemish networking and international network" (R. Buckinx, personal communication, March 27, 2023).

A special remark about international networking was made by Health Campus. Currently, they are extending their international network with other science parks and associations to generate and spread more research. The intention is to transform Health Campus in the starting point of science for researchers by increasing the network.

"We have a memorandum of understanding now with Osaka bio headquarters and we're looking for new partnerships. We are part of the International Association of science parks in Innovation Areas IASP.... if you want to do something in healthcare and life sciences, you can come to the campus, ask and use us as connecting help to network..."(R. Buckinx, personal communication, March 27, 2023).

It was found that investors and sponsors are sending pilot offices to Campus Diepenbeek. This is a strategy that in the future is expected to attract more companies in the industry to the region. Finally, a positive connection between geographical proximity, sharing of facilities, and attraction of talent was found related to the theme of network.

Cross-collaboration:

Cross-collaboration is one of the richest themes among the 3 main areas of Campus Diepenbeek. Different connections were found and analyzed. First, Academia plays an important role in the network within campus Diepenbeek, being present in 75% of the codes related to cross-collaboration. Some compositions of codes are shown below to illustrate the current relationship of collaboration held by Academia with other members of Campus Diepenbeek:

- Academia + companies (positive).
- Academia + companies + government (positive, and still in development).
- Academia + companies + government + decision making (positive, and still in development).
- Academia + Health Campus (positive).

Second, the strength of Campus Diepenbeek in terms of collaboration was leveraged by Health Campus. For instance, their close relationship with the Data Science Institute allowed them to motivate companies to work with the university via Health Campus and attract them to the vicinity.

"We saw that with the role of the Data Science Institute and interaction with professors of the Data Science Institute, that's what got them here"
(R. Buckinx, personal communication, March 27, 2023).

Third, cross-collaboration between Bouw Campus and the rest of the members of campus Diepenbeek is still under development.

Infrastructure:

Not surprisingly, in the infrastructure theme, several codes were developed. Sustainability, circular building, sharing of facilities, walkability, and development of facilities were the main topics related to infrastructure. From the current land organization, there is a physical delimitation of property divided by the several landowners in Campus Diepenbeek. It was found that in the past, organization and meetings between the owners were not held, allowing every owner to build and modify freely. Currently, meetings between stakeholders are organized to determine how they will build and develop Campus Diepenbeek.

"There are discussions going on. How? How are we going to do that? These are quite technical discussions because I think everybody agrees that the

infrastructure on the campus is important..." (R. Buckinx, personal communication, March 27, 2023).

It was found to be the main positive aspect of infrastructure development, the sharing of facilities between academia, research institutes, and the biomedical sector.

"Especially for life sciences, a lot of the facilities that are needed are incredibly expensive for a starter to pay for. You can share or make use of university facilities to do your research, and of course tap into the knowledge that's there at the university, the technical knowledge, and the academic knowledge" (R. Buckinx, personal communication, March 27, 2023).

For the development of campus Diepenbeek, several codes were developed. First, sustainability is on the agenda of all three main axes of Campus Diepenbeek. By keeping sustainability as a core element in the development of the campus, several principles such as circular construction, the inclusion of green areas, energy neutral buildings are considered for the project Limburg DC.

"The green areas of the campus will be used to give room back to the creek so the creek can overflow if and without any problems. We want to have these beautiful green zones in the campus that are not accessible at this point. You can't go walk there" (R. Buckinx, personal communication, March 27, 2023).

Second, it was found that housing development in the area was also covered, however, no positive responses in the middle long term were achieved.

Employment:

The theme of employment included several codes such as proximity, internationality, current problem, and universities. It was found that academia and the industries within campus have a good connection, being translated into job opportunities for students and a talented workforce for companies.

"We have a good research collaboration with companies say like, we might need an internship student okay, then we get branch through to the internship coordinator...if we've 100 internships, maybe five leads to a research opportunity 5% per year. But more than 20% lead to a job offer" (P. Pauwels, personal communication, March 22, 2023).

From the industry perspective, the relationship with academia is positive as well since they find fresh talent from the three main higher studies institutions in Campus Diepenbeek.

"We have a lot of guys from PXL, software engineers" (J. Nelissen, personal communication, April 5th, 2023).

However, the positive impact needs still to be developed since the number of talented fresh students is not enough to cover the industries' s needs. This phenomenon was found in four interviewees. This phenomenon is complemented by the current situation of a language barrier for international students and strict language regulation from the region. It was found that the number of both international students and international professors is not increasing as in other neighboring countries due to this legislation in the province.

"We only have around 15% of international professors... The reason is that we have very strict Dutch legislation on the language of our courses. Our international students are only 15%...The foreign people have to be able to speak Dutch in five years" (B. Vanhuesden, personal communication, April 14, 2023).

Academia:

Under the label of academia, several findings were made. First, the development of the Health campus was a strategic decision to develop science in the area. From the interview with the manager of Health Campus, Roeland Buckinx, the detailed history outline was deployed, where several strategic decisions were made to develop Health Campus. From the start of the training program of Biomedical sciences in 1999, to the development of research institutes in Campus Diepenbeek, and the creation of a Science Park under the name of Health Campus, all these were strategic steps to promote Research and Development in the area. Second, the deliberate choice of the development of a Health Campus in Diepenbeek is related to the relationship with UHasselt and several research institutes. Third, the strategic proximity with 2 of the biggest and most important hospitals in the area *Jessa Ziekenhuis* (in Dutch) in Hasselt and ZOL in Genk make Health Campus a strategic research point for both hospitals. (R. Buckinx, personal communication, March 27, 2023). Academia also plays an important role in the region by attracting international students, especially PhD students to the region.

"We have fifty, close to fifty percent of our PhD students is foreigner. But the vast majority then goes in the international arena", (P. Pauwels, personal communication, March 22, 2023).

Knowledge Development:

From the interview with Prof. Pieter Pauwels, in terms of content creation, UHasselt as an anchor institution delivers programs that allow research and development on campus. This knowledge from academic programs is then used by students and Ph.D. professors to create more content and potentially be used with a company for commercial purposes.

Entrepreneurship:

In the entrepreneurship part, it was found a considerable difference between Corda Campus and Campus Diepenbeek. The cross-collaboration between entrepreneurs, startups, and companies in Corda Campus is highly encouraged and facilitated via events by the general management of this high-technology campus and synergy between small, medium, and big companies. Entrepreneurship is an integrated practice in Corda Campus. Conversely, on campus Diepenbeek, entrepreneurship is encouraged only by one member of the quadruple helix, being the academic and the societal part. Entrepreneurship is encouraged by the involvement of students and the opening of events for the public around startups.

“But now there is a bit of a counter evolution that we now have a very a much better interaction between people here in the school who know about entrepreneurship” (*P. Pauwels, personal communication, March 22, 2023.*)

Participation of The Government:

Only two codes related to the participation of the local and regional government were found, indicating a weak connection between Campus Diepenbeek and the government at the municipal level. However, the collaboration with POM Limburg has been crucial in the development of Campus Diepenbeek and other campuses in Limburg.

Innovation:

Under the theme of innovation, several findings were made from Bouw Campus and Health Campus. From the construction industry, a deep understanding of a recent phenomenon was explained and divided into several points. First, construction is highly related to other industries such as technology, energy, and water. Therefore, the well-maintenance and increase of a network for the construction industry players is crucial. Second, due to changes in the construction industry, main actors such as architecture firms and contractors had to innovate in the way they relate and increase their network and access to new knowledge. For that reason, a strategic point in Limburg was set up in Bouw Campus to attract players in the

construction industry to a physical location in Campus Diepenbeek. Third, construction companies do not have the resources and time to innovate, therefore Embuild Limburg plays a key role and brings to them consultancy in terms of innovation.

"...This type of working, it's, it's exceptional....construction companies, they have like, a really low margin...So they have a different type of work so they need others to tell them okay, you need to do innovation. You need to invest in innovation because they don't have the practice or the time or the money to do that. So, we need to involve them" (G. Kerckhofd, personal communication, April 20th, 2023).

Fourth, innovation as the mission of Bouw Campus allows Embuild Limburg to bring innovation to the construction industry and increase the network of companies interested in building more efficiently.

Innovation is highly related to the research and development that is happening in Health Campus and BioVille. Additionally, a portfolio of innovative projects is being developed in Health Campus to attract more companies interested in science and development. Their purpose is to increase the network and promote innovation within companies. Now several governmental funds such as VLAIO encourage companies in Limburg to invest in research and development. Concerns about the number and size of companies in Limburg that apply to this fund are raised.

"Our delimiting economy is apparently around 13% of the Flemish economy. But the Limburg economy only gets around 6% of the subsidies. So we're missing a lot of money...The difficulty here in the region seems to be that we have a lot of SMEs and few large companies that can afford to have or they need to be innovative" (B. Vanheusden, personal communication, April 12th, 2023).

The Attraction of Big Companies to Campus Diepenbeek:

The code *Attraction of Big Player* appeared multiple times among research and development and industry topics. A controversy was found between interviewees. From the Health Campus point of view, the core activity of the campus is research and development, with the help of small manufacturing. However, the addition of a big company within the campus seems not viable for Campus Diepenbeek since this might require bigger facilities that are not currently developed on campus. However, the construction of a network between the Health Campus and other research institutes, startups, and hospitals is a core activity for Health Campus.

From the perspective of a company specializing in high tech for the medical sector, the establishment of a *big player* is crucial to attracting more employees with high skills to the area. The current struggle of this company compared with other branches in Belgium is the concentration of talent and resources in other provinces but Limburg, making it difficult for the office located in Campus Diepenbeek to attract talented engineers.

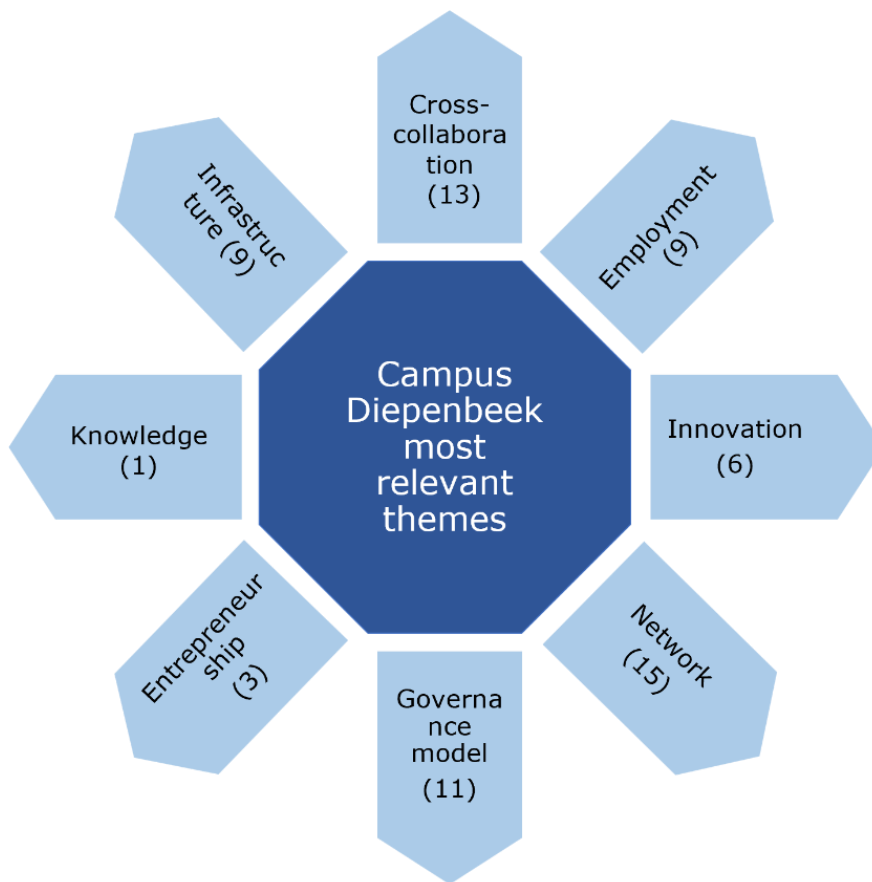
Master Plan of Limburg DC:

The creation of a master plan of development for Campus Diepenbeek is the current major project between stakeholders. The participation and involvement of decisions of members of Campus Diepenbeek is crucial for the success of this project. From the interview with Britta Mulleners, Strategic Manager of POM Limburg, the development of Campus Diepenbeek started in 2016 with the creation of a master plan.

“Between 2016 and 2018, the province of Limburg began with the development of a master plan, with an important focus on the balance between expansion of the campus and ecological protection of the Demer area” (B. Mulleners, personal communication, (B. Mulleners, personal communication, March 27th, 2023).

In the next diagram, it can be visually represented the major themes mentioned by the interviewees. Some of them had more relevance than others, allowing us to understand certain phenomena.

Figure 14. Relevance of current themes of Campus Diepenbeek



Source: Own diagram based on interviews with stakeholders, 2023.

As can be appreciated several major themes were mentioned in the exploratory interviews, providing important information about economic and innovative development for further years. In the next section, the analysis of the themes and codes will be shown. In the next session, a discussion of the main findings will be deployed, allowing me to link the literature review with the findings of this master thesis.

Chapter 5: Discussion

The purpose of this thesis is to understand the geographical and economic aspects of Campus Diepenbeek that position it as a future innovation district. From the Qualitative interviews performed, the research question was answered. Additionally, other aspects were found, enriching this study and enlightening future research.

Several economic and social aspects have influenced the development of Limburg, Flanders. The government of Flanders in Belgium has established a long-term goal that beds for the development of innovation, science, and technology in the region (Flanders Investment & Trade, 2023b). Additionally, POM Limburg has deployed an aligned development plan for Campus Diepenbeek (POM Limburg, 2022a). Several actions and coalitions between stakeholders have been created to pursue this goal. During this development, several aspects have acquired relevance. The analysis of this phenomenon is deployed in this chapter.

Development of Limburg DC:

The main purpose of innovation districts is the development of innovation and new knowledge (Katz & Wagner, 2014). Additionally, The increase in companies will also create more possible work opportunities not only for students but also for skilled engineers, scientists, and business experts (Galan-Muros et al., 2021). By concentrating companies, universities, research institutes, and living facilities, innovation districts are transforming the way science and technology campuses are being developed. Strategic movements from the main orchestrators of Campus Diepenbeek to become Limburg DC are already being placed in motion, such as the attraction of pilot offices of medium companies inside the campus. With this strategy, it is expected to increase the concentration of companies on the campus, bringing more professionals in several domains to the area, which will mean more economic activity for the vicinity.

Changes in The Industry:

Changes in some industries have influenced the development of Campus Diepenbeek. Therefore, stakeholders proactively analyzed these changes and generated strategies that fit with the challenges. Certainly, the attraction of innovation entities such as Embuild Limburg to campus Diepenbeek is not a coincidence. POM Limburg in coordination with the local government looks for changes in the industry and to attract innovative companies to the region. Goele Kerckhofs, Innovation advisor of Embuild Limburg refers to how the construction industry has been through change and how these impacts on the way they cooperate.

“Eight years ago, we had a transformation of the construction industry. Constructors are changing, contractors are changing everything in the chain needs to change. So also architects and engineering, engineering offices, contractors, the way how do you think, research institutions, they all need to change. So, we need to cooperate more” (G. Kerckhofs, personal communication March 20th, 2023).

Network:

Spatial proximity as a vehicle of network creation has been analyzed in previous research (Galan-Muros et al., 2021). Spatial proximity has been shown as a crucial advantage for the 3 main campuses in Campus Diepenbeek. Benefits such as cross-collaboration between companies and Ph.D. researchers, organization of events about innovative projects, and employment of fresh students are only some of the benefits that campus Diepenbeek is currently giving to their members.

"We don't believe in competition. We only believe in ecosystem partners. And sometimes Yeah, it could be a competitor and sometimes it could be a subcontractor. The market field is big enough. I think when your market field is big enough that you don't have real competition, you will have cooperation and in an ecosystem system away" (J. Nelissen, personal communication, April 5th, 2023).

Cross-collaboration:

Results related to cross-collaboration were positive. Overall, there is a positive cross-collaboration between academia, industry, and government. Each of the campuses is currently engaged in cross-collaborative projects. These projects involved not only members of Campus Diepenbeek but also innovative partners outside the Limburg region and abroad. Participation of Bouw Campus in the development of joint projects is still under development. More involvement of the Bouw Campus is needed to leverage the participation of society and academia in the building industry. From the Academia part, collaboration with Health Campus is getting stronger. However, collaboration with entrepreneurship is still under development. Currently, several events to promote entrepreneurship among students are being held by UHasselt, and entrepreneurship courses are included in the course material of the Science Faculty.

Currently, there is cross-collaboration with companies and entrepreneurs outside Campus Diepenbeek. The increase in networks created bridges between industries that would enhance the collaboration with Campus Diepenbeek. This would mean that the triple helix collaboration, developed by Etzkowitz (2000) and later analyzed by Carayannis and Campbell (2010) is met. The natural evolution of the helixes leads to the involvement of society, and, in the future, the creation of mutual agreements related to sustainability. However, in the results, the involvement of society appeared not to be strong. Therefore, cross-collaboration is still under development and stakeholders should take action in order to strengthen the bonds between them and keep collaborating to achieve mutual goals.

Stakeholders:

The results related to the participation of stakeholders lead to a general conclusion that the creation of a general management involving all stakeholders of Campus Diepenbeek is needed. Since the involvement of POM Limburg, Campus Diepenbeek has been transformed into a multiplayer campus rather than hosting multiple players sharing vicinity.

One of the strongest stakeholders of Camus Diepenbeek is the Data Science Institute, which attracts talented scientists and also encourages other research institutes and companies to collaborate with them. Additionally, the official establishment of a Health Campus increases the participation of the stakeholders in the decision-making, by leveraging the relevance of their participation. The results showed that the collaboration from the municipality is not very relevant, however, provincial participation plays a big role since they bring access to federal funds that allow Campus Diepenbeek and other geographies of innovation to develop.

The analysis of the participation of stakeholders in Campus Diepenbeek brings the conclusion that 1) more participation of the local and regional government is needed, 2) stakeholders should participate more in the planning and development process of the campus and 3) a leader is needed to set the vision of the future.

Infrastructure:

By the creation of the entity of Science Park, several stakeholders of Campus Diepenbeek can coordinate the development of the infrastructure of the Campus. Even though the ownership of Campus Diepenbeek is currently split between the different entities, the organization, and planning of facilities is now centralized under this new entity. From the Academia perspective, this is a big step since historically, only the 3 main higher education institutions were sustaining periodic meetings however, the development of common infrastructure was not part of these meetings.

It is important to highlight that discussions of how the public areas will be modified are still in process, and the planning for 2030 for Limburg DC is still under development. However, big investments are being made for the construction of more buildings where innovation and cross-collaboration will be pursued. Additionally, proximity and the share of facilities are important aspects of research and development, allowing researchers and companies to create joint projects in Campus Diepenbeek. This is a competitive advantage for Campus Diepenbeek

The development of housing areas is a relevant aspect of innovation districts. Recently, POM Limburg announced the acquisition of the parking area from Campus Diepenbeek, where student accommodations were developed for the planning of Limburg DC 2030. Additionally,

the city center of Diepenbeek is 3.1 km from the campus, allowing students to have accommodation inside and outside the campus. The development of facilities for students is intended to attract more Pd.D. Student.

A comparison with Corda Campus has been made and the feeling of a livable campus. Where you have amenities such as restaurants and bars. These amenities create an atmosphere of not only business or research but an actual campus.

" No individual elements, but the connection will be important for the feeling of a campus. Three important structures form the symbolic backbone of the campus: namely the 'Collector' from east to west, the 'Boulevard' from north to south, and the natural paths along the watercourse. Together they provide a high level of experience and an environment where it is pleasant to stay. The structure, together with the infrastructure (public transportation, but also a restaurant, parking, and meeting rooms) will make this area a vivid campus. Indeed, a campus of the future is not only for working, doing business, or studying, it is also a place to meet, to play sports, to relax, ..." (B. Mulleners, personal communication, March 27th, 2023).

The connection of elements and buildings within Campus Diepenbeek is in development however, the sense of campus was highlighted in the investigation. The development of the right infrastructure and the combination within the campus will give a sense of connection and liability, attracting not only more companies and talent to the region but also providing the infrastructure where the creation of a network rich in knowledge can be created.

Sustainability:

In terms of sustainability, UHasselt, as an anchor institution, has set this goal in the agenda for upcoming years. With the creation of planning in terms of sustainability within the buildings UHasselt is leading the further steps to develop sustainable measures and practices for the campus.

"Three years ago, we started with a steering group on sustainability. And they made the sustainability plan specifically for the university, buildings, catering, energy consumption, and waste" (P. Pauwels, personal communication, March 22nd, 2023).

"We aim for them to be energy neutral, at least energy positive as possible"
(B. Vanheusden, personal communication, April 12th, 2023).

For the upcoming years, the project Limburg DC includes sustainability, and the care of green areas are part of the project. By analyzing the building print in Campus Diepenbeek, the goal is to protect the green areas while increasing the walkability of the campus.

The various sub-campus are connected by car-free roads...The available space is used in the best possible way, doing more with less space. Specifically, this means building upwards as much as possible, and on existing foundations wherever possible. This is also important because of the ecological protection of the Demer area." (B. Mulleners, personal communication, March 27th, 2023).

From the research, it is clear that sustainability is on the individual agenda of all stakeholders. However, common projects related to sustainability are not on the agenda of Campus Diepenbeek as a whole. It is therefore relevant for the stakeholders to develop a sustainability plan that includes the participation of all stakeholders.

Employment:

It is well known that geographies of innovation increase job offers in the region (Katz & Wagner, 2014). Innovation districts in Europe have brought an increase in employment opportunities not only for professionals but for the community around them. A general view of the lack of a talented workforce in Limburg has remained for the last five years. Industries such as construction, science, medicine, and technology are only a few examples of this phenomenon. The growing concentration of companies and talent in other regions such as Antwerp and Brussels, makes it even harder for Limburg to attract people to the East part of Flanders.

However, several programs to attract talent to Limburg with the participation of the government, higher education institutions, and companies have been developed. An example of this happens in the construction industry, with the creation of activities for kids in the fifth and sixth grades related to construction.

What we're doing now is working with focus FIRST LEGO League. It's like children in the fifth and sixth grade, and the first and second high school. They're, encouraged to work with the FIRST LEGO and they get an assignment...After ten weeks, they get a godfather of construction from a construction company, who goes and sees how it is working" (G. Kerckhofs, personal communication March 20th, 2023).

From this example, it is shown that collaboration with the community and governmental institutions is crucial to find new talent for the construction industry in the early stages.

Additionally, Embuild Limburg is currently developing a network of employment for the construction industry in Limburg.

Employment was also influenced by the availability of young talent from universities in the geographic area. Companies get in touch with academia when they are looking for an internship or a researcher for the company. At the same time, University plays the role of connector for researchers who want to do internships. The Proximity between companies and academia plays an important role when companies are looking for researchers and young talent in the area. Even though this does not solve completely the problem of some companies, the proximity to universities is important because they have access to a young workforce.

*'We have a lot of guys from being PXL and also University of software engineers''
(J. Nelissen, personal communication, April 5th, 2023).*

From the interview with the Director of Corda Campus, Raf Degens, an insight into the relationship between big companies, startups, and employment within the high-tech innovative campus was found. It was found that startups are a growing source of talent attraction for the campus, increasing the network of professionals in the area. Additionally, within Corda Campus, medium and big companies now see startups as unique partners. The strength of this relationship has been incentivized by the direction of Corda Campus, by developing a strategy to build facilities that attract young talent to Corda Campus and organizing events where networking between, small, medium, and big companies, startups and entrepreneurs are motivated.

A second phenomenon linked the attraction of talent to Limburg with the development of facilities in the region. The founder of NBS Cleaning rooms with sites in Munsterbilzen, Limburg expressed his concerns about attracting engineers.

"There is a mind shift, ten years or fifteen years ago and now young engineers want to go to fitness every day...We feel there in the new generation, there was a shift" (J. Nelissen, personal communication, April 5th, 2023).

Due to lifestyle changes, young talent is paying special attention to a balance between work and life. The availability of facilities to perform daily activities such as gyms, restaurants, shopping areas, and residences now play a crucial role in the selection of the workplace for many employees. Innovation districts help companies not only to attract talented workforce but also to provide the facilities for the development of life balance. Meaning that innovation districts are places where people can not only work but enjoy and live.

Innovation:

Drucker (2015) highlighted the relevance of innovation in the development of changing environments. In terms of innovation, UHasselt in collaboration with Heath Campus, Bioville, and the research institutes of science, enhance innovation and development of knowledge. Several ways of collaboration and co-development are nurtured in Camus Diepenbeek. This is translated into active projects on innovation.

"We need to invest in innovation, and transformation. So we can, everybody needs to jump on this innovation train... It's not only the construction but also the environment needs to be innovative." (G. Kerckhofs, personal communication March 20th, 2023).

Currently, the Flemish government's participation of the government deploys several economic plans to leverage innovation in the region. One of the main strategies is the creation of *clusters* (Flanders Investment & Trade, 2023). Even though innovation appeared in the research as a positive current aspect of Campus Diepenbeek, more focus should be put on it. The World Innovation Index 2022 placed Belgium at number twenty-six in the innovation rank. Compared to past years, Belgium has gone down in rank from twenty-two to twenty-six. However, a positive relationship between innovation and development was found in the same study, positioning Belgium as an innovation leader with performance according to expected (World Intellectual Property Organization (WIPO), 2022).

It is also important to highlight that the same response was not given for open innovation. Therefore, attention to open innovation is still an underdeveloped area. Further investigation into this matter should be carried out to understand the reasons and causes of this phenomenon.

Entrepreneurship:

Entrepreneurship and innovation are terms that are interrelated with each other (John Bessant & Joe Tidd, 2007). The nearest case of entrepreneurship attraction in the region is Corda Campus. In the first years of Corda Campus, the relationship between startups and big companies was hierarchical, meaning that medium and big companies would invest in startups and take them into account for joint projects until they develop economic stability. However, in recent years, this relationship has changed. Startups have been able to attract talented people to develop innovative ideas and projects. Positions in big companies are now equally attractive as working for a startup. This phenomenon has forced medium and big companies to reflect on their talent acquisition procedures and corporative culture.

This phenomenon within Corda Campus shows the relevance of startups and entrepreneurs in an innovation district. In comparison with Corda Campus, Campus Diepenbeek has a different but equally important approach to entrepreneurship. The strategy consists in (1) preparing researchers for the outside world by including entrepreneurial courses and (2) encouraging researchers to become entrepreneurs and/or collaborate with startups in order to understand more in-depth how entrepreneurs work.

"It's in the two elements, training our own people to think about, okay, Could I could I go to market with this? But also, yeah, getting to understand better entrepreneurs and what their needs are making a business plan, things like that. I mean, scientists" (B. Vanheusden, personal communication, April 12th, 2023).

Several actions plan and projects are held in Campus Diepenbeek to promote entrepreneurship. An example of this is *Pitch Please*, the collaborative initiative of UHasselt, PXL, UCLL, and LUCA as higher educational institutions, the agency of Flanders Innovation and Entrepreneurship (VLAIO), and the municipalities of Hasselt and Genk that looks to encourage and support entrepreneurial activities (Pitch Please, 2023). Yet, more development in this area should be encouraged in order to increase knowledge sharing and innovative ideas on the campus via entrepreneurial activities.

Academia:

Hasselt has played a crucial role in innovation by developing the knowledge available in biomedical science and other faculties. Additionally, the creation of a research institute allows Campus Diepenbeek to attract highly talented researchers to the area and develop innovation (UHasselt, 2018). The collaboration between UHasselt and Health campus, in coordination with research institutes in Campus Diepenbeek, has created a geography of innovation for Limburg.

One of the unexpected findings from academia is related to the language barrier and international talent. The attraction of international professors to UHasselt has been on the agenda for many years. However due to Flemish regulations in education, the courses must be given in the local language, (Dutch,) forcing Master and Ph.D. professors to either learn the language within 5 years after they are hired. Additionally, the government has switched to a more variable financing professor, meaning that the yearly budget can be different from one year to another.

"We are so controlled and outdated for everything that we can become the slowest partner in the game. If a venture capitalist or a province firm or the

market evolves, that even before we moved, we are already too late” (P. Pauwels, personal communication, March 22nd, 2023).

The attraction of international students and talent is one of the most tangible results of innovation districts. However, language barriers and government regulations can undermine the attraction of people from abroad. Even though UHasselt has successfully doubled the number of Ph.D. students in recent years (Bernard Vanheusden et al., n.d.), the difference in the number of national students is a matter of worry.

Regulations on the language are part of a big concern from the government and the society in Flanders that a current situation in the neighboring country The Netherlands happens as well in Belgium. The number of international students and professionals is raising considerably in Dutch universities, causing also housing problems and over-capacity universities. A middle point between these opposite situations should be met by policymakers to increase internationality but also take special care with the balance in the economy, population, job opportunities, and globalization. UHasselt as an anchor institution plays a big role in Campus Diepenbeek, However, external regulations and processes may slow innovation within the institution.

Participation of The Government:

From the interview with one of the stakeholders, an important aspect related to the participation of the government appeared. Innovation and development in Limburg are historically linked with the participation and support of the Provincial Government. The Deputy of Economy and Chairman of POM Limburg plays an important role in the development and attraction of companies to Campus Diepenbeek, however, concerns in the election of future leaders have been raised since the support of the authorities is crucial for the development of Campus Diepenbeek and other geographies of innovation in Limburg. Decentralized and impersonal support for this project and its implications of it should be analyzed in further research.

From this perspective, it can be highlighted the relevance of the participation of governmental institutions in the development of Campus Diepenbeek. Access to resources and network are some of the benefits, however, the underlying benefit is the long-term support that innovative projects can have despite changes in the administration of the government

Attraction of a big player:

There is an existing debate between stakeholders and decision-makers around a big company such as Phillips or Ford should be brought to Limburg to concentrate more research and

development and technology in the region. Discussions about whether Campus Diepenbeek or Limburg DC in the future can host or not a big company, for instance in pharma or healthcare, have been present during meetings of the general management.

The attraction of SMEs to Campus Diepenbeek is needed to increase the network of knowledge and enhance job opportunities. However, big players are needed to bring the negotiations of Campus Diepenbeek investments to a long-term project for Limburg. One of the main observations by the interviewee was that for Limburg DC to succeed in terms of increasing employment and R&D, the attraction of a big international company must be set in the area. This perspective is contrary to other interviewees, highlighting their skepticism around the establishment of big companies.

Limburg has faced several massive closures in the last thirty years; therefore, investors and the community are divided in opinion about the attraction of a new big player to the region. It is well known that innovation districts vary in shape, size, and components. Hence, an established composition cannot be drawn to determine the success of a certain innovation district. Empirical research should be performed to evaluate the real impact of big companies as anchor institutions in innovation districts.

Limburg:

The regional development of Limburg has been increasing over the years. With the closure of the coal mines, followed by Phillips and Ford, big waves of unemployment appeared in Limburg. Since then, authorities and stakeholders have been looking to reactivate the economy of the region. Due to globalization and internationalization, geographies of innovation have become more popular between countries as a sustainable way to bring innovation and technology to the region. Several real cases have been used as models for future geographies of innovation. From science to high-tech parks, medicine, and logistics hubs, each of them has contributed to the development of the region. Corda Campus, situated in the old facilities of Phillips in Hasselt, was developed by LRM to bring high-tech companies to the region. Six core values were the pillars to develop Corda Campus as an innovation and technology center in Limburg.

"In collaboration with LRM, we show these six core values when we set up the core canvas. It was deliberate, we want to work on innovation and technology"
(R. Degens, personal communication, March 27th, 2023).

From this case, planification and vision of the geography of innovation is a good practice in order to set the direction of development. Additionally, Corda Campus has a big perspective on geographies of innovation.

"I believe, especially when you want to attract international people. It's not just about talking about this campus or the university campus. You have to talk about the full system. They look at Europe. They look at Central Europe. (R. Degens, personal communication, March 27th, 2023).

From this perspective, even though campuses are confined to a specific area, members of the geographies of innovation cannot miss the whole picture and the possible connections outside the boundaries of their campuses. A more extended vision of geography is needed to support the sustainable development of the areas and a richer network.

Diepenbeek, situated in the middle of the so-called *Euro Triangle* between Liege, Eindhoven, and Germany, is a strategic geographical point where the network of these three main geographies of innovation converged, giving Campus Diepenbeek a strategic advantage that investors and stakeholders must leverage.

Several industries are situated in the vicinity of Campus Diepenbeek. Investment in the area has been made considering the strategic relevance of Limburg and the potential development of the area. The construction of a network especially in healthcare and science has been developed.

"...We make connections when we make choices for campus do we make we also look make connections or look at other sites close by like college campus to see over there in Genk 50 in terms of energy Ville, yeah, or to the hospital's needs, but also energy fill. So, everything on green renewable energy is done over there. It is held at Corda Campus. And so that's a bit saying a division. And also, a reason why in Diepenbeek, we focus on health. And then also on construction" (B. Vanheusden, personal communication, April 12th, 2023).

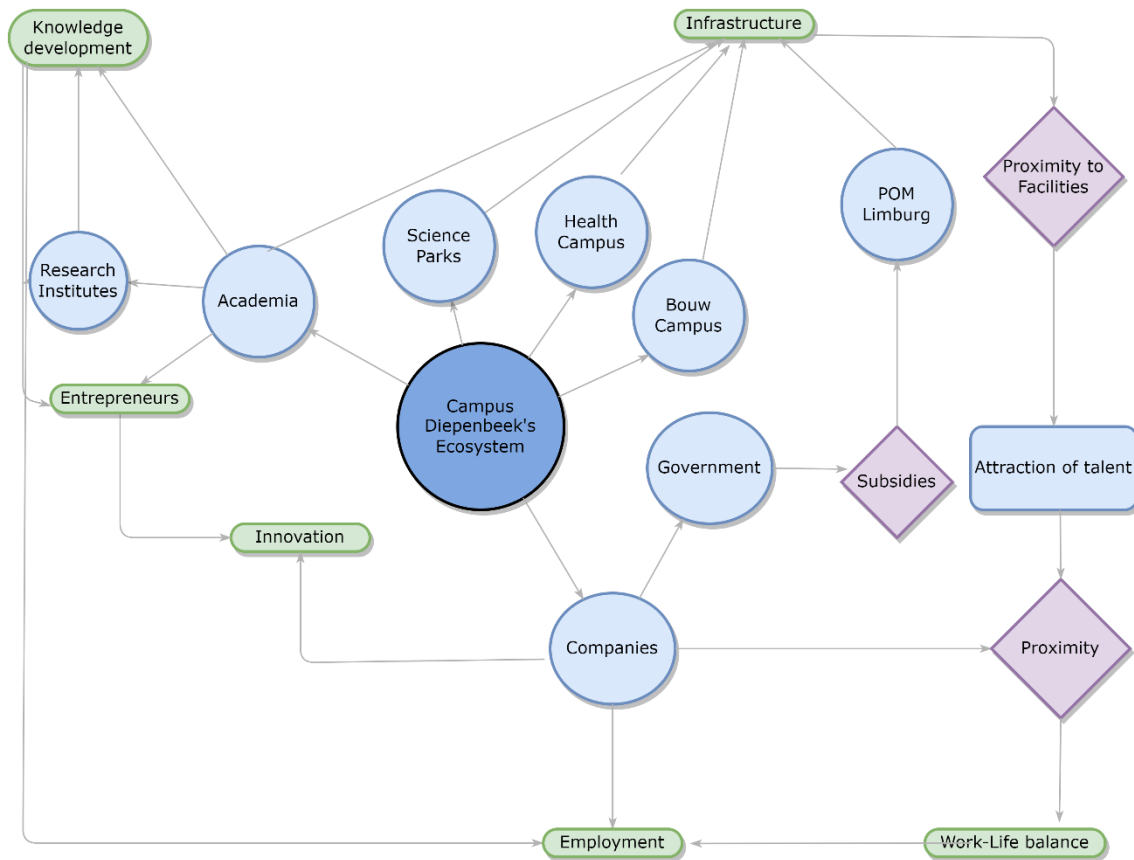
The area of Genk-Hasselt-Diepenbeek is developing several campuses, covering several industries. For instance, there are 2 main hospitals in the area, calling ZOL in Genk and Jessa in Hasselt. It is complemented by the research institute in Bioscience at UHasselt. Additionally, there is a logistics hub in Genk which attracts job opportunities for the area. Additionally, Corda Campus offers a home for IT innovative companies. Additionally, changes in the construction industry have forced decision-makers and big players in the industry to adapt to new challenges and embrace new ways of cooperation.

"Eight years ago, we had a transformation of the construction industry. Constructors are changing, contractors are changing everything in the chain needs to change. So also, architects and engineering, engineering offices, contractors, the way how do you think, research institutions, they all need to

change. So, we need to cooperate more” (G. Kerckhofs, personal communication March 20th, 2023).

In order to illustrate the analysis performed in the results of this thesis, the next diagram is shown. Campus Diepenbeek’s ecosystem is represented and its main elements such as universities, Health Campus, Bouw Campus, the government, and companies. Additionally, the phenomenon related to each element of the ecosystem is represented, creating linkages between elements and phenomena. Lastly, moderators such as proximity and subsidies are included to represent variables that might influence the ecosystem. The diagram is extensive, and the addition of elements might be needed in the future considering that the analysis of this thesis dissertation looks to understand a phenomenon rather than control it.

Figure 15. Campus Diepenbeek’s Ecosystem and its Connections



Source: Own diagram based on interviews with stakeholders, 2023.

Chapter 6: Conclusions

Resources and knowledge sharing have been the main reason for agglomeration in cities and large regions, creating a network of combined efforts between the members of the network. Innovation districts in concrete are an evolution of geographies of innovations, to integrate science and technology development in cities, allowing them to merge with elements such as housing facilities, entertainment, corporate offices, higher education institutions, and government offices into the city or the vicinity of it. This new model allows people to gather in a place not only to work but also to enjoy doing sports, networking, and living.

Innovation districts in Europe are increasing in popularity. Some countries such as Sweden and Spain have developed recognized innovation districts to attract talent and develop the economy. The purpose of this thesis is to enrich the knowledge of innovation districts and the further steps that should be made to develop Campus Diepenbeek.

For this qualitative research thesis, several interviews were conducted with members of the triple helix of Campus Diepenbeek to answer the research question. Open-ended questions were carefully elaborated, allowing the interviewees to elaborate answers based on their experience and perspectives, describing processes, and social and economic phenomena, which helped to enrich the thesis research.

Three categories of findings were developed. First, the current elements of campus Diepenbeek are similar to other study cases of innovation districts. Second, some elements of Campus are different than in other innovation districts. Third, elements present in other innovation districts that are not yet present in Campus Diepenbeek. Lastly, suggestions and future considerations for stakeholders and policymakers were elaborated based on this information.

Theoretical Implications

Contrary to other case studies, Limburg hosts a growing number of geographies of innovation clustered by sectors. This formal agglomeration of hubs and their interconnections create a vast network of geographies of innovation in the region of Limburg and cross-border with neighboring countries. This development of style (market forces driven) is similar to the Kendall Square study case mentioned by Katz and Wegner, 2014. Campus Diepenbeek has a similar growth. Since the creation of the faculty of biomedical sciences, the growth in this sector is evident, attracting research institutes and, more recently, the official creation of the Health Campus.

In addition, another finding of this thesis is the most recent recognition of Campus Diepenbeek as a suburban geography with geographical and economic characteristics worth of being exploited for the benefit of the economy and society. This first step, mentioned by Katz and Wegner, 2014 is important since it brings the needed recognition to the geography of innovation. This recognition focuses the attention of stakeholders, government, and policymakers on the development and success of the innovation district. From this recognition, policies, an increase in the development budget, and strategic plans are created.

One of the main findings of this thesis is the weak participation of society in innovation, especially in entrepreneurial activities. Similarly to (Rodríguez-Pose, 1999), it was found that certain societies are more innovation prone or averse. In this case, even though the Belgian government has invested in the diffusion of knowledge and innovation activities, the participation of society still holds a traditional perspective on academic innovation rather than entrepreneurial innovations. One of the reasons why Belgian society might be innovation averse is the strict social filter in terms of language and cultural diversity. Even though Belgium is a country with 3 official languages and hosts a considerable number of nationality diversity, the social barrier to integration is still high. This might influence the degree of acceptance of other nationalities to innovate not only in science and technology but also in entrepreneurship. Yet, further investigation would be developed to determine if there is a direct relationship between innovation-averse societies and rigid regulations in terms of language and cultural barriers.

Managerial Implications: Recommendations:

Knowledge clusters are the result of the development of clusters and geographical areas (Carayannis & Campbell, 2009, p. 3). A closer development of the relationship and collaboration between the members of the triple Helix is needed to achieve higher development and a denser network of knowledge and innovation. The development of events that bring together stakeholders, entrepreneurs, young talent, and scientists is needed. Hence, it is recommended that a closer collaboration between academia, industry, and the government in order to create novel knowledge and promote innovation.

An unexpected consequence of the development of collaboration between the helixes involved in the growth of the Entrepreneurial Ecosystem (EE). Coad & Srhoj, (2023) concluded that there is no region with zero entrepreneurial development. However, entrepreneurship ecosystems are not linked to a specific industry (Coad & Srhoj, 2023). Therefore, the main difference between innovation districts and entrepreneurial ecosystems is the lack of a sectorial approach. In line with the research, High Growth Firms (HGF) at a regional level are more common than at a firm level (Coad & Srhoj, 2023). This can explain why sustained success is positively influenced by collaboration with other firms from the same industry rather than

solitary development. From this perspective, the future attraction of an HGF should be considered by the government of Flanders and the stakeholders involved in Campus Diepenbeek.

Additionally, innovation districts share a characteristic with Sectorial System Innovations (SSI). According to Breschi & Malerba (1997), SSI's are linked to a specific sector, allowing to gather firms, experts, entrepreneurs, and universities in the same place to develop a specific area. Examples of this development can be found in geographies of innovation from different countries. From this perspective, Campus Diepenbeek is already aligned with sectorial development, with health care and biomedical sciences as the strengths of Campus Diepenbeek. It is still, a strong recommendation of this thesis to develop a plan to promote a sustainable development of this area.

Even though Belgium is smaller in size than other countries that have developed innovation districts, such as 22@ Barcelona and other examples in the North of Europe, it is needed a big perspective where Limburg is seen as a region full of potential for innovation districts. Belgium is geographically situated in the middle of two major countries that are leading innovation. The natural proximity to these countries creates more opportunities for entrepreneurship and innovation to be developed. Therefore, it is crucial that joint efforts between stakeholders of Camus Diepenbeek create master planning and projects focused on exploiting this competitive advantage to strengthen innovation and entrepreneurship in Limburg.

Several researchers have emphasized the relevance of high-performance firms within ecosystems to create sustainable growth rather than *trendy* clusters. A fully entrepreneurial ecosystem cannot persist over time without creating a network with high-growth firms (Coad & Srhoj, 2023). Therefore, the role of innovation systems is to gather and connect entrepreneurs with high-growth firms, research institutes, venture capital investors, and policymakers. The task of policymakers and stakeholders in this regard is to nurture relationships with performance firms in order to create 1) cross-collaboration and 2) a future agreement for the attraction and or construction of facilities for these high-performance firms.

"Gazelles are found to be outstanding job creators. They create all or a large share of new net jobs" (Henrekson & Johansson, 2010, p. 227). This increment of job availability in the area may invite other startups and young firms to the area, increasing the density of the network in a short time. From the Report of the European Commission 2020, the share of HGEs is lower than the European average (European Commission, 2020). However, the linkages among SME innovation are greater than average. This means that innovative networks in Belgium are stronger among SMEs. As a recommendation in the employment part, the attraction and/or development of high growth enterprises (HGEs) within Campus Diepenbeek can increasingly attract talent in a short period.

In contrast, the culture of entrepreneurship is relatively small compared with other members of Europe, meaning that even though the access to loans for entrepreneurs via venture capital is high, the tendency to innovate via Belgian society is still low. (European Commission & Joint Research Centre., 2020) Changes in the policies regarding promotion and entrepreneurial material at universities should be created to overcome this aspect.

Limitations and Suggestions for Further Research

The time constraint was a limitation of this study since the case study was analyzed in a specific point in time. Future investigation of Campus Diepenbeek should be performed in order to analyze and compare the different stages of development.

The limitation of this thesis relies on socio-cultural aspects of Belgium such as language barriers and cultural differences with other neighboring countries that have a more open perspective to internationalization. Additionally, innovation openness in society should be a topic of investigation in the future since this aspect plays a key role in the development of innovation districts and the interconnections with other members of the quintuple helix.

More research related to societal innovation-prone and innovation averse should be performed since the role of society and its attitude toward innovation can be relevant to innovation districts' development. (Rodriguez-Pose, 1999) highlighted the impact of elements such as immigration law, workforce regulations, skilled labor shortage, and the degree of openness of local and regional society in the innovation process.

Even though academia and companies do cross-collaboration, a thin line between a consultancy firm and the help of academia for research should be kept in mind since universities claim more recognition for the knowledge obtained, and companies want good specific deliverables by academia. More research must be done on this theme.

The planning for 2030 and the development of Limburg DC is currently undergoing. The researcher is aware that changes in this planning and its development will appear in the future. By this, the future development of Limburg DC might not be included in this research. Further investigation in the future will be needed in order to determine what characteristics of innovation districts are in Campus Diepenbeek at that moment and which one needs more development to become an innovation district.

The study's findings may have practical implications for policymakers, industry leaders, and academic institutions regarding the development of collaborative innovation processes, further investigation is encouraged.

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Appendices

Appendix 1. List of interviewers for this thesis

Interviewee Nickname	Company	Position	Interview date
B.M.	POM Limburg	Strategic Manager	27/03/2023
J.N.	Cleanroom Technology & SmartLog	CEO/Founder	05/04/2023
P.P.	UHasselt	Dean of Faculty of International business	22/03/2023
B.V.	UHasselt	Rector	12/4/2023
R.B.	Health Campus	Manager	27/03/2023
G.K.	Embuild Limburg	Advisor Transformatie Bouw	20/03/2023
T.V.E	Fox Biosystems	Chief Executive Officer	18/03/2023
R.D.	Corde Campus	Director	27/03/2023

Appendix 2. Questionnaires interviews

For UHasselt:

1. Open innovation and collaboration with companies are key elements of innovation districts. Is UHasselt currently engaging cross border collaboration with other universities and research institutes?
2. Additionally, spillovers are a more common way of revenue for universities and companies. What would be the role of UHasselt in Limburg DC around this topic?
3. As Innovation cultivator, what is the role of UHasselt with companies and entrepreneurs?

- a. -How is the relationship with them?
 - b. -What projects are ongoing to incentive innovation by entrepreneurs?
 - c. Are joint projects hosted by UHasselt?
4. The support from UHasselt to POM Limburg in order to create a joint master plan has been set. With what specific actions does UHasselt have done that? Or will do?
5. Entrepreneurship are leading to a less hierarchical organization of talent. What modifications can be done by the administration of Limburg DC to integrate students?
6. Social networking assets such as integration if international and local students is key part of innovation districts. What actions are held by UHasselt in order to promote networking spaces that include local and international students as well as professors and researchers?
7. What events does UHasselt hold in collaboration with companies and research institutions from Diepenbeek campus to promote networking and pool of talent?
8. What programs in collaboration with the municipality of Diepenbeek are held to attract international students and workforce?
9. What is the perspective of the board of deans related with a creation of a governance model for Limburg DC.
10. Is it in the agenda of UHasselt to create a in a governance mode with other members of Limburg DC?
11. Attraction of workforce is one of the core effects of innovation districts. At the moment UHasselt faces a more than double students from 2010 (2,895) to 2020 96,4500. However, the numbers of professors, especially foreigners is not increasing. What is the current plan of UHasselt to attract more talented professors?
12. What would be the main issues to create a general management of Limburg DC?
13. From your perspective, what is still needed to become an Innovation District.

For POM Limburg:

Limburg DC:

1. When did Limburg DC started to be planned?
2. What stakeholders are involved in the new Limburg DC?
3. What members are involved in the decision making of Limburg DC?
4. Is a Governance model planned for the whole campus?

Crosspollination:

5. To what degree cross-pollination will be implemented between healthcare, construction, and academia?

6. What events would be generated to promote R&D between the 3 campuses?

Infrastructure:

7. From your experience, what other elements campus Diepenbeek should have in terms of infrastructure and networking to reach a feeling of campus?
8. Housing areas around innovation districts are common characteristics of innovation districts. Is there a plan for housing included in Limburg DC 2030?
9. Is there a current collaboration with the local government to develop infrastructure and facilities?

Innovation:

10. Open innovation is a key characteristic of innovation districts. In what ways does Limburg DC is planning to motivate this element?
11. What institutions are involved? (Example of SAKr=turbo project THINK3 between POL, Health campus, and UHasselt). –in this case who are the main orchestrators?

Sustainability:

12. Reduction of carbon emissions is one of the core missions of innovation districts around the world. How does Limburg DC contribute to reducing carbon emissions?

Entrepreneurship:

13. What would Limburg DC do to support entrepreneurs and startups in the region?

Workforce:

14. The attraction of the workforce is one of the core effects of innovation districts. What will be the contribution of Limburg DC to attract a more talented workforce to fulfill the several layers of services?

For Bouw Campus:

Partnership within Campus Diepenbeek:

1. Bouw Campus claims to have a close collaboration between government and higher education institutions, does this contact enables to create a common agenda of projects?
2. What projects in common does the Bouw Campus have with the other stake holders of campus Diepenbeek? (UHasselt/construction companies)/Limtec
3. How does Bouw Campus collaborate with UHasselt and the government?
4. What partnerships with companies are currently held to bring innovation to the construction industry?
5. Does the projects are developed in collaboration with the other partners or is it more like individual projects?
6. What type of changes should Bouw Campus do in order o become a more integrated member of the Innovation District?

Academia:

7. What type of collaborative projects does Bouw Campus has with UHasselt?
 - a. Are the decisions taken collaboratively or independently?

Infrastructure:

8. Infrastructure and common areas are key to open innovation. What improvements should Campus Diepenbeek have in order to boost the interaction between the Bouw Campus and the rest of the ecosystem?

Resources:

9. Does Bouw Campus have complete freedom of allocation of resources for projects?
10. Does Bouw Campus act a s a facilitator of resources and subsidies for companies and startups?

Startups and entrepreneurs:

11. Does Bouw Campus have current or future projects with Startups of the industry?

The future:

12. What other companies and key partners from the building industry does Bouw Campus would like to have in Limburg DC?

Employment:

13. How does Bouw Campus is contributing to attract new and capable talent to Limburg?
14. Is Bouw Campus currently working with international talent?

For BioVille:

1. What is the current role of Bio Ville in Campus Diepenbeek? (aside facilities)
2. What other partnerships from Diepenbeek campus does BioVille has?
3. What type of collaborative projects does BioVille has with UHasselt?
4. Are the decisions taken collaboratively or independently?
5. What is the vision of Bio Ville in terms of collaboration with the members of the campus?
6. What type of changes should Bio Ville do in order to become a more integrated member of the Innovation District?
7. What amenities are still missing in Campus Diepenbeek that Bio Ville needs to leverage the impact of Bio Ville in the community?
8. What partners (companies, institutions) would Bio Vile like to have in Campus Diepenbeek?
9. How many startups is Bio Ville working now? (NOTE: LSU -Limburg Startup-incubator is in Corda Campus).

10. How is BioVille attracting international and local talent?
11. Does BioVille have full independence of the financial budget for future projects?

For Health Campus:

Members of Health Campus:

1. From the current companies that are at Health Campus, is there any cross collaboration between them?
 - a. How does Health Campus encourage these partnerships?

Finance:

2. Does Health Campus have full independence of the financial budget for future projects?
3. How does Health Campus budget is allocated in terms of cross collaborative projects?
4. Does Health campus have a specific agenda and budget with other members of Campus Diepenbeek?

Workforce:

5. Attraction of workforce is one of the core effects of innovation districts. What will be the contribution of Health Campus to attract more talented workforce to fulfill the several layers of services?
6. The attraction of international talent is considered a good indicator for Limburg, how does Health Campus is contributing to attract international talent?

Sustainability:

7. Sustainability in one of the main focus of several institutions in Campus Diepenbeek. How does Health Campus can contribute in this aspect in Limburg DC?
 - a. If any current project, explain.

Interaction with Campus Diepenbeek members:

8. How does Health Campus collaborate with other members of Campus Diepenbeek to create a community?
9. Is there a common organization now where members of Campus Diepenbeek discuss topics in common?

Universities:

10. Health Campus claims to have a close contact with higher education institutions. Does this contact enable to create a common agenda of projects?
 - a. If answer is yes, give examples.
11. Does Health Campus have collaborative projects with UHasselt? If so which ones?
12. Does Health care work along with entrepreneurs from UHasselt in the health sector?
 - a. If so, give an example of the most significant or the best collaboration has been done.

Infrastructure:

13. What amenities are still missing in Campus Diepenbeek that Health Campus needs in order to leverage the impact of Health campus in the community?

BioVille:

14. What other partnerships from Diepenbeek campus does BioVille have?
15. What type of changes should Bio Ville make in order o become a more integrated member of the Innovation District?
16. What partners (companies, institutions) would BioVille like to have in Campus Diepenbeek?

For the companies in the campus:

1. What projects in common does the company has with the other stake holders of campus Diepenbeek?
2. Infrastructure and common areas are key to open innovation. What improvements should Campus Diepenbeek have to do in order to boost the interaction between the company and the rest of the ecosystem?
3. Social networking assets are a key element of a successful innovation district. What is the company currently doing to enhance this aspect within the company and outside?
4. What partnerships are currently holding that bring innovation projects alive?
5. Do the projects are developed in collaboration with the other partners or is it more like individual projects?
6. In terms of workforce, what is the company currently doing to attract more talent, also from abroad?
7. How does the company imagine an efficient interaction between the industry, academia and government within Campus Diepenbeek?
8. Open innovation and collaboration with universities are key elements of innovation districts. Is the company currently engaging collaboration with universities and research institutes?
 - a. What about cross border collaboration?
9. Entrepreneurs and startups are leading to a less hierarchical organization of talent. How is the current organization of the company and how much does it has been influenced by less hierarchical companies?

For Corda Campus:

The start:

1. How did Corda Campus start?
 - i. When?

Finance:

2. Does Corda Campus have full independence of the financial budget (LRM controls it?)

Decision-making process:

3. How is the current administration of Corda Campus?
4. Did Corda Campus had planned in advanced a pool of companies and startups before the opening?

Collaboration within the buildings:

5. From the current companies that are at Corda Campus, is there any cross-collaboration between them?
6. How does Corda Campus encourage these partnerships?
7. How many seats can a company have on Corda Campus?
8. What are the criteria for accepting or inviting firms to Corda Campus?
9. How many international companies are in Corda Campus?

Benefits of being at Corda Campus:

1. Open spaces and intense collaboration are found in Corda Campus. What are the benefits that you see in that for companies?
1. And for startups?
2. Is there any downside of sharing working spaces with other companies?

Startups:

3. Does Corda Campus help startups to find financial support through the government?
4. Is there a current collaboration between start-ups and companies in Corda Campus?

International talent:

5. The attraction of international talent is considered a good indicator for Limburg's development; how does Corda Campus contribute to attracting international talent?
6. How do Corda Campus could benefit from the attraction of international talent by universities?

Collaboration with other elements of LRM:

7. How does Corda Campus connect the companies and start ups with other elements of LRM (EnergyVille)

The future:

8. As a project of LRM, Corda Campus was meant to be the business center of Limburg. What is the forecast for the number of companies for the next 5-10 years?
9. How could Corda Campus benefit from the development of an innovation District in Diepenbeek?
10. In your opinion, what is still needed in Campus Diepenbeek to leverage in terms of collaboration?
11. What connections would Corda Campus would like to have with Campus Diepenbeek?