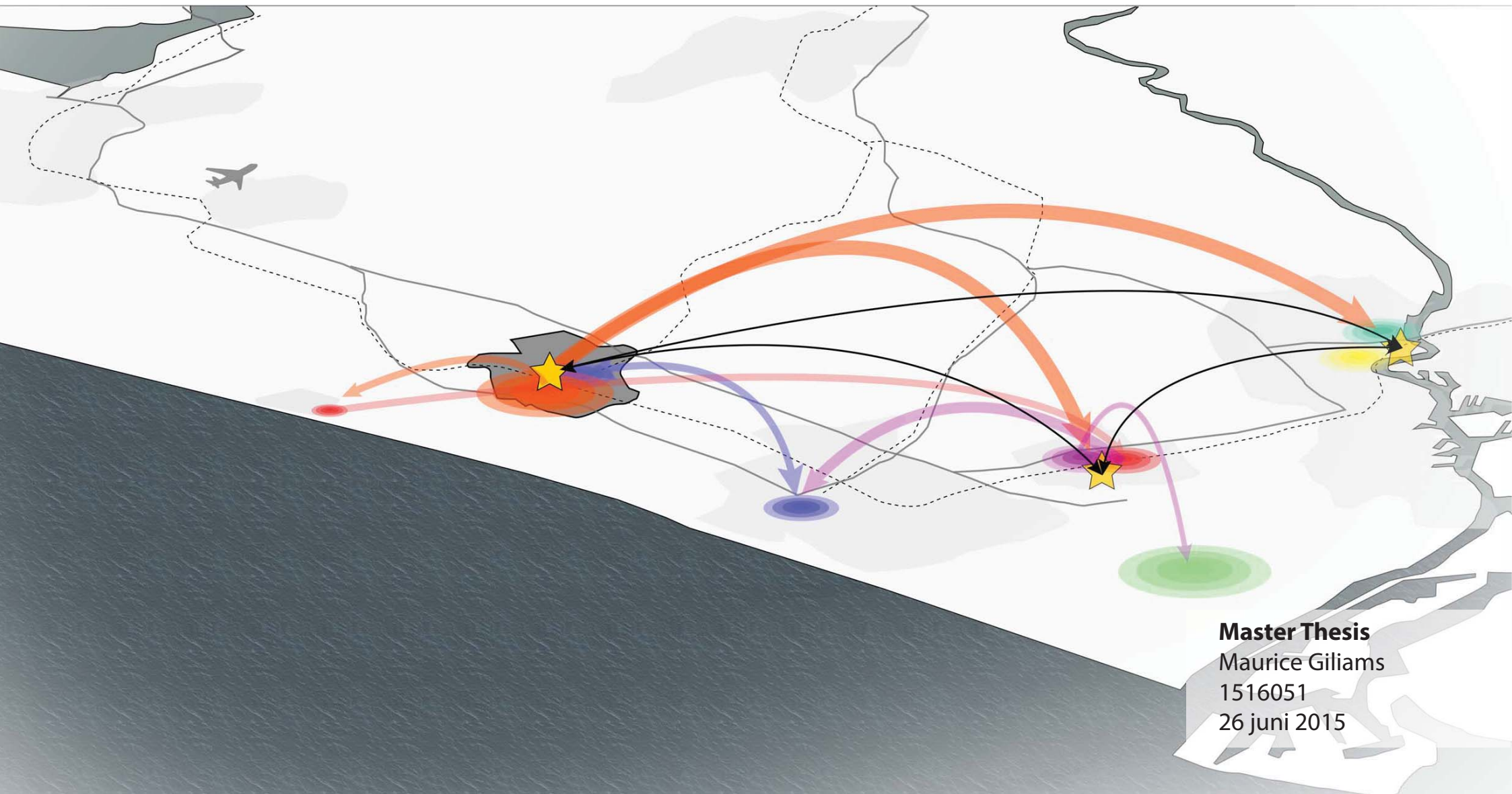# Leiden, pearl of the knowledge axis

Developing a masterplan for the Bio Science Park in Leiden to strengthen the knowledge axis in the south wing

Master Thesis
Maurice Giliams
1516051
26 juni 2015

Colophon

Title: Leiden, pearl of the knowledge axis

Subtitle: Developing a masterplan for the Bio Science Park in Leiden to strengthen the knowledge axis in the south wing

Maurice Giliams
mauricegiliams@gmail.com
1516051

MSc Thesis
Research Group: Regional governance, planning and design

26-06-2015

1st mentor: dr. Dominic Stead
                    D.Stead@tudelft.nl
                    Spatial Planning and Strategies (OTB)

2nd mentor: ir. Daan Zandbelt
                    D.D.Zandbelt@tudelft.nl
                    Urban Design, Van Eesteren

Delft University of Technology
Faculty of Archtecture and the Built Environment
Department of Urbanism

TUDelft

Technische Universiteit Delft

Preface

This Master thesis has been written in the framework of Urbanism. It is a describtion of my graduation project at the Faculty of Architecture and the Built Environment at the Delft University of Technology.

I would like to thank everyone who helped me during the process of this graduation project. First I would like to thank my mentors dr. Dominic Stead and ir. Daan Zandbelt for their guidance during the graduation project. They both teached me a lot and they really helped me during the process. I also want to thank my fellow Urbanism students who helped and motivated me during the graduation period.

Index

PART 1

Introduction

The national economy declined over the recent years due to the economic crisis. Also the provincial economy of South Holland was shrinking. The financial crisis of 2008 is noticeable in the province and had a major impact on the economy of South Holland.

In the last decades of the twentieth century, a shift from the industrial economy towards a more knowledge-based economy was made. This was possible by innovating information and communication technology which increased the mobility of people and simplified worldwide communication (Knight, 1995). The cities that are more innovative by generating new ideas and knowledge are more successful in the knowledge economy. Knowledge becomes a strategic tool to keep the economy running. Governments have developed strategies which are knowledge based. This is also the case for the province of South Holland.

Zuidvleugel
South Holland is part of the Randstad area, the area where most economic activity takes place. Therefore South Holland has a powerful economic base. The province of South Holland has the ambition to become one of the best sustainable, competitive and liveable European regions (Provincie Zuid Holland, 2012). The southern part of the Randstad is called the Zuidvleugel. According to the economic agenda of the Zuidvleugel, this region is nowadays sub top. The focus of the provincial policy of South Holland is therefore primarily on the implementation of the economic agenda of the Zuidvleugel. They want to strengthen the three economic pillars of the Zuidvleugel economy. The first pillar is the Mainport, which is the port of Rotterdam. The second pillar are the Greenports, the greenhouses in the Westland and the Bollenstreek. The third and last pillar is the knowledge axis.
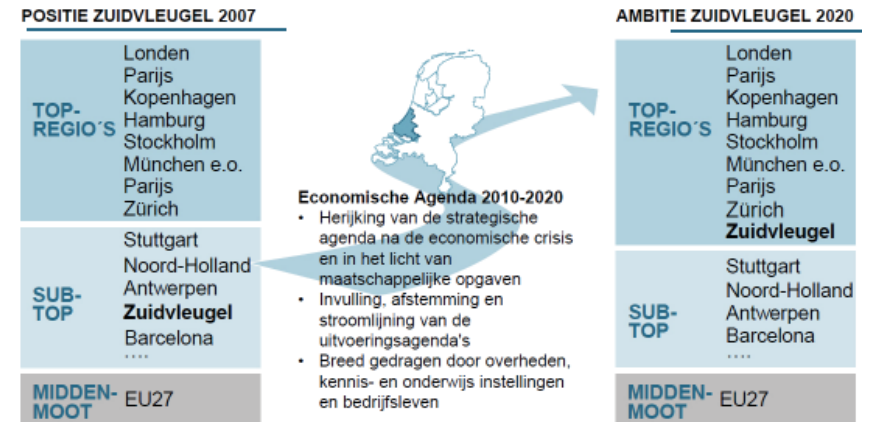

Figure 1: Competitive position of the Zuidvleugel compared to other regions and cities. (Economische Agenda Zuidvleugel 2010-2020)

Knowledge axis
The province of South Holland has a large amount of locations where knowledge companies and knowledge workers are concentrated near universities or other knowledge institutions. These locations together are called the knowledge axis. It can be seen as a corridor which mainly goes from Leiden to Den Haag, Delft and Rotterdam. The development of the knowledge axis, and more specifically of campuses is mainly creating conditions. Campuses are the breeding place for development of knowledge companies. Campuses have a favourable influence on the exchange of knowledge and the improvement of the innovating ability of companies on the campus. Other locations on the knowledge axis can benefit from them. The locations in the knowledge axis are connected to each other by economic activities. Knowledge generated in Delft can be used somewhere else. The spatial assignment near the knowledge axis arises from the high demands knowledge companies and institutions have for their business climate. They have specific quality demands for their business location.

The knowledge locations in the knowledge axis area are complementary to each other. They are mostly focusing on different sectors. Where Leiden is focusing on life-science, Delft is focusing on clean tech with their university of technology. Den Haag is more specialized in the security sector. Also relations between the different universities are part of this knowledge axis. The universities of Delft, Leiden and Rotterdam, together with the academic hospitals, are collaborating in the Medial Delta. Medical Delta is an initiative that stimulates the economic growth and provide healthcare solutions by developing, transferring and implementing knowledge in life-science and medical technology. This Medical Delta is an example how different knowledge clusters and their universities are working together to stimulate the economic growth. The relative large scale of the knowledge axis is needed to bring parties like entrepreneurs, companies, policy makers and financiers together. Larger cities are therefore important in the region. They are characterized by knowledge clusters with a specific specialization.

Figure 2: Spatial view of the knowledge axis concept. (made by author)

Problem field

Leiden

The knowledge axis exists of multiple cities in the Zuidvleugel of the Randstad. These cities should have a certain knowledge base in order to function in the knowledge economy. If the province wants to become a European top region in the knowledge economy, these cities needs to be developed.

Leiden is one of the cities in the knowledge axis. Leiden presents itself as an international oriented knowledge city which is widely known for its university, which is the oldest of the Netherlands. It doesn't only have the university but also situates other knowledge institutions and the Leiden Bio Science Park. The university area and the Leiden Bio Science Park are the knowledge clusters of Leiden.

Leiden wants to flaunt with its international knowledge in life science and historical culture in a city which is attractive for visitors. With the University of Leiden, the Leiden Bio Science Park and its historic centre it can attract the people it wants. But this is not enough! If Leiden wants to be a part of the knowledge axis, than the strengths it has nowadays needs to be improved. To achieve this the knowledge cluster of Leiden, the Leiden Bio Science Park, should be further developed into an attractive working environment for life science companies.

Figure 3: Naturalis located at Bio Science Park. A knowledge location in Leiden (Brochure Bio Science Park)

Aim

The main aim of the project is to develop a vision and masterplan done by research and develop key design interventions which are part of this masterplan. The aim is to develop a masterplan for the Leiden Bio Science Park making it more attractive for innovative life science companies and knowledge workers to settle in this area. By improving the Leiden Bio Science Park into a more attracting campus, the city of Leiden should play a more important role in the knowledge axis of the Zuidvleugel.

The design interventions are part of the masterplan and will give a better understanding how the Bio Science Park should work and look like in the future. The design goal is to make an attractive, visual good looking masterplan and elaboration of the designed interventions.

Relevance

The project is of social relevance because the development of the Leiden Bio Science Park may stimulate the economy of Leiden but also of the province. It attempts to create a more attractive knowledge location which will attract more and new life science companies and knowledge workers to the area. This life science sector is part of the top sector policy of the government. The development of the Bio Science Park will stimulate the creation of knowledge and innovation which will stimulate the economic growth, and therefore will improve the competitive position not only of Leiden but also of the province of South Holland.

This project is also of scientific value. There have a lot of studies been done about how to make knowledge locations economic successful but these studies don't tell how this works spatially. The studies tell what they are and how they emerge, but the spatial translations is often not being made. This project tries to make a spatial translation of the knowledge location theories.

Research questions

Main research question

The main research question which should be answered is:

In what way can a new masterplan help develop the knowledge cluster of Leiden towards the main innovative life science cluster?

Sub research questions
Theoretical questions
1- What is the knowledge axis?

2- What is a knowledge economy?

3- What are the characteristics of a city in the knowledge economy?

4- What spatial characteristics stimulate innovation for companies in the life science sector?

Analytical questions

5- How do we see the knowledge characteristics in the knowledge cluster of Leiden?

6- What are the strengths and weaknesses of this knowledge cluster?

Reference study Eindhoven

7- What development strategy is used for the High Tech Campus Eindhoven to create interaction between different innovative companies?

Design question

8- What spatial improvements needs to be made to develop Leiden Bio Science Park towards a innovative life-science knowledge cluster?

Methodology

To get an answer to the main research question, the sub research questions stated before need to be answered. For this, various methods are used. The sub research questions which are based on theory will be answered by a literature review in the theoretical framework.

Literature review
The literature review is the base for the theoretical framework. The theoretical framework will also be the base for further analysis. For this literature review different kinds of literature is used. This will be vary from academic literature to policy documents from the province and municipality. The review about the knowledge economy are mainly based on the theories and notions in the literature of Van Winden and Van Den Berg (2004), van Winden et al. (2007) and Florida (2002). For the research question about the stimulation of innovation literature from Bathelt et al. (2004) and Wolfe and Gertler (2004) is used.

Governmental documents
Not only academic or scientific literature will be used but also governmental documents. These documents are needed to get a better picture of what the knowledge axis is and how the province sees this knowledge axis pillar. These documents give a better understanding of what the plans of the government are, not only spatially but also economic plans which are important to understand the knowledge axis.

The theoretical framework will also function as the base for the analysis that needs to be done. Some sub research questions needs to be answered by analysis which emerged from the theory about the foundations of cities in the knowledge economy. The analysis will show how Leiden works in the knowledge economy. The foundations mentioned in the theoretical framework will be checked for Leiden and especially the Leiden Bio Science Park. Most analysis will be done by mapping. Mapping is a spatial tool to show information of the area.

Another part of the analysis is the SWOT analysis. This type of analysis will show the strengths, weaknesses, opportunities and threats of the location area. It will show to what extent the Leiden Bio Science Park meets the characteristics derived by literature.

Reference study Eindhoven
To figure out how interaction can be made possible on a science park or campus, a reference study needs to be done. Therefore a reference study of the High Tech Campus in Eindhoven is made. The goal of this reference study is to understand what kind of development strategies are used in this area to create interaction between the different innovative companies. The reference study can assist in the making of design decisions. Thereby it is important that the strategy used in the HTCE can't be directly copied into my project area, but it can work as a kind of inspiration.

Points of action
The analysis made for the Leiden Bio Science Park will tell what needs to be done for the location area. This is stated in the so called 'points of action'. Therefore a diagrammatic separation of the area is made. This 'points of action' will tell what the area is lacking and what needs to be done. It is the starting point for the vision of the area. The vision of the area is a further elaboration of the points of action. It will tell how the Leiden Bio Science Park should work in the future. There for the case study of the High Tech Campus Eindhoven and literature can be helpful. There will be a constant reflection towards the analysis and the theoretical framework.

Masterplan
The solutions to come to the vision will be presented in a masterplan. This will show what kind of tools and interventions are added to the area to create innovation by interaction between the life science companies and university. These interventions needs to be elaborated to show how this will work in the area.

At the end the project will be evalueated to the main research question and the aim for the Leiden Bio Science Park. Also a reflection towards the knowledge axis needs to be made. How does Leiden work as a knowledge city in the knowledge axis after the new masterplan for the Leiden Bio Science Park?
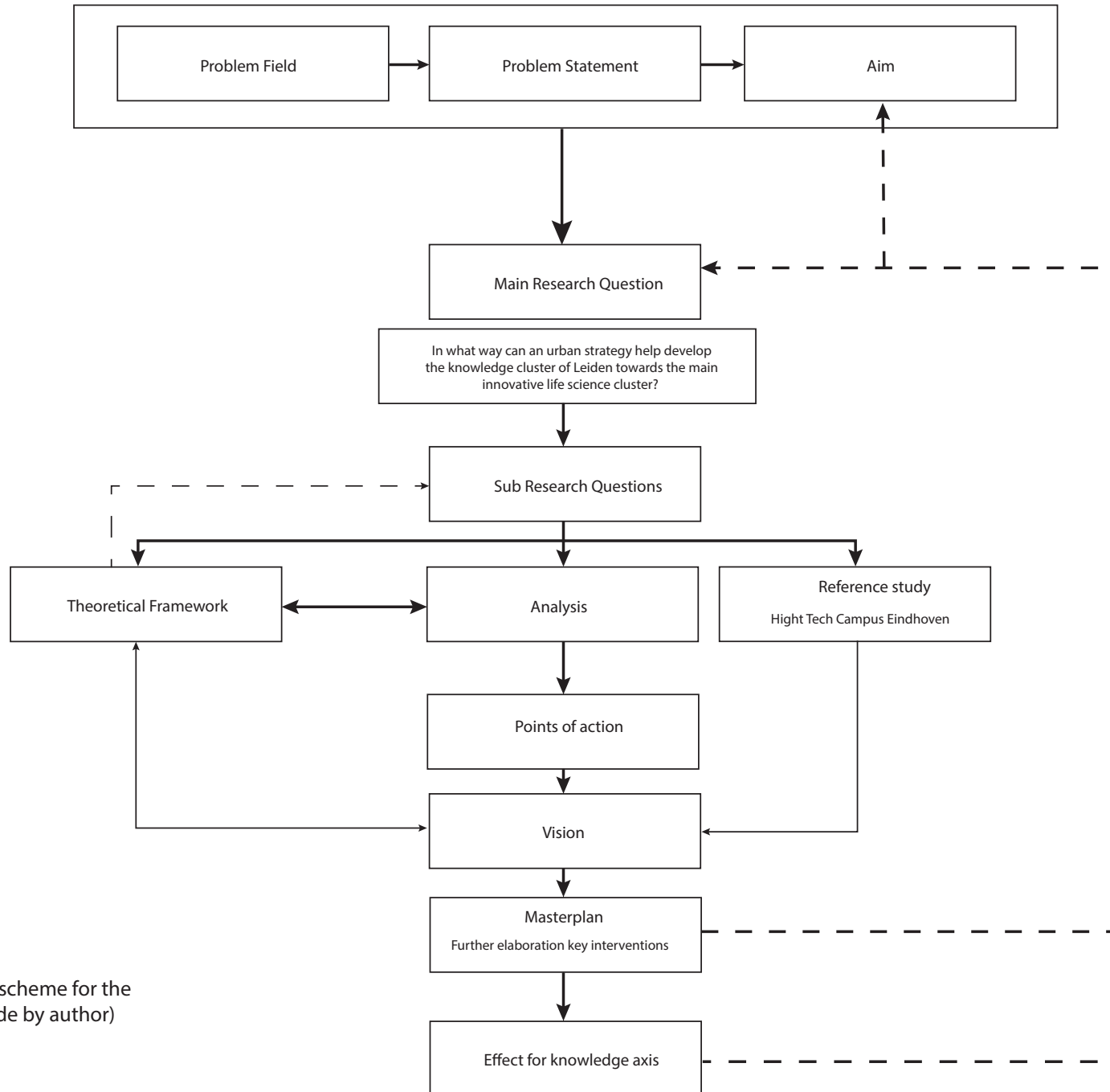
Figure 4: Methodology scheme for the graduation project. (made by author)

PART 2

Theoretical framework

This section is the theoretical framework which consist of a literature review to answer some sub-research questions. To get an answer to these questions it is necessary to explain some concepts and notions.

Knowledge economy

Over the last few years a lot of European countries shifted their economy towards a knowledge based economy. This shift towards the knowledge based economy is needed in order to match the growth of US and Asian countries. Also the Netherlands shifted towards the knowledge economy with the knowledge axis in South Holland as one of the examples. It is hard to say what a knowledge economy exactly is because there is not a single accepted definition of the knowledge economy. Van Winden et al. (2004) and Raspe (2014) describe the knowledge economy as an urban economy. Important actors in this knowledge economy are mostly universities and corporate research institutions. From this perspective we can say that the way how nations, regions and cities perform in the knowledge economy depends on the term of R&D and innovation. Cities or regions with good universities and research institutions will benefit from their ability to product knowledge. Due to the rapidly change in knowledge, Castells (2000) stated that no company can manage all disciplines. Therefore they need to engage in a strategic network. These companies should develop its own specialization so they can complement each other.

Cities are the places where knowledge is produced, processed, exchanged and marketed. Therefore they are the local point in the knowledge economy. Cities are best endowed with knowledge infrastructure with their universities and other educational institutions. Cities also houses mostly high educated people and are well connected with other cities. They are a place where knowledge is exchanged(Van Winden et al., 2004). The knowledge city concept may refer to the aspects of social, economic and cultural life of a city (Ergazakis et al., 2006).

For knowledge cities it is important that specialized companies and knowledge workers are attracted to the city. Baum et al. (2008) stated that people, rather than money, are the motor force of economic and social growth. Florida (2002) agrees with Baum. He argues that it is more important to attract knowledge workers, which are high educated people, to the city than knowledge companies.

Knowledge location

This production of knowledge and innovation takes place on a specific location. Such a location can be seen as a knowledge location. Carvalho (2013) defines a knowledge location as: "a planned area-based initiatives aimed at agglomerating knowledge-intensive activities in a designated area or city district. The concept of knowledge locations encompasses a number of manifestations such as science parks and quarters, technology hubs, knowledge campuses or creative factories and districts, with a deliberate element of planning and policy aimed at promoting that agglomeration". For the review for this project the science- and technology knowledge based locations are important.

Foundations of cities in the knowledge economy

We can describe seven characteristics of a city in the knowledge economy. These characteristics are also called foundations by Van Winden et al. (2004) and are also used by van Winden et al. (2007) and Malekzadeh et al. (2010). These seven foundations are the knowledge base, economic base, accessibility, quality of life, urban diversity, urban scale and social equity. Each of them will be briefly described.
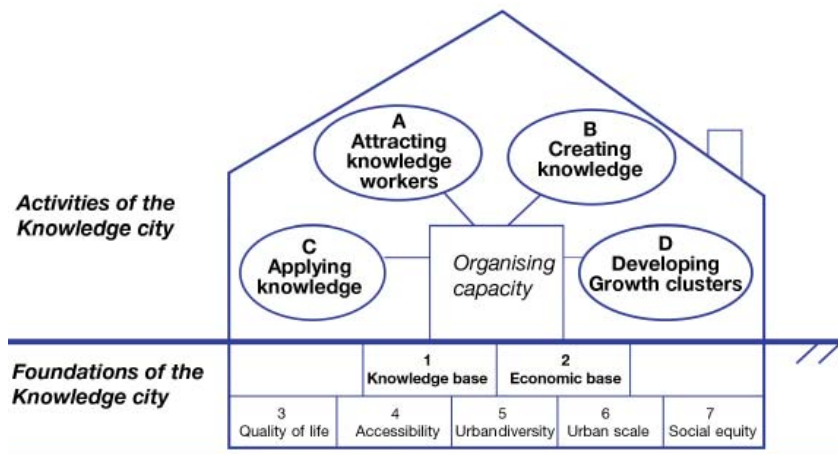

Figure 5: Assessing cities in the knowledge economy. (Van Winden & Van Den Berg, 2004)

Knowledge base
The knowledge base of a city can be seen as the universities, other education institutions, polytechnic and other public or private R&D activities in the urban region or city. Also the education level of the population is part of the knowledge base. For a city in the knowledge economy it is important to attract knowledge workers (Florida, 2002). These knowledge workers are high educated people. Matthiessen et al. (2002) find that a solid knowledge base is reflected in the economic life of a city. This is important for the urban economic growth and change.

Economic base
This foundation affects the starting position of the urban knowledge economy. It determines for a large part the economic possibilities and restrictions and the difficulties for an urban region. Another aspect is the degree of specialization of the city. Small and medium sized cities are mostly more specialized than the larger cities and metropolitan regions (Malekzadeh et al., 2010; van Winden et al., 2007). Jacobs (1969) stated in her urbanization economy theory that a diversified economy are better places for innovation.

Quality of life
The foundation quality of life is about attracting and retaining knowledge workers. It has a crucial importance in the knowledge city (Florida, 2002). Florida stated that talented people do not select a place to work based on salary but that a lot of other characteristics are determent. Creative people are more focused towards the city environment. They want to travel further for their job if needed. Therefore, good amenities are important for this group of people like an attractive build environment, high quality houses, attractive city parks and also good amenities like hospitals and schools.

Accessibility
The knowledge economy is a network economy. Therefore, accessibility is crucial for cities in the knowledge economy. Especially if a knowledge city wants to acquire, create, disseminate and use knowledge effectively for economic and social development (van Winden et al., 2007). International, regional and multimodal accessibility is therefore important for knowledge cities. They have to have good connections to international airports and good regional connections to other knowledge cities. Baum et al. (2007) stated the importance of the different levels of transportation. The different levels of

transportation should be closely connected with each other. Also local infrastructure to accommodate face-to-face contact is also important, this will be explained later on by the theory of Bathelt et al. (2004).

Urban diversity
Urban diversity is about promoting creativity. Urban diversity is a source of economic opportunities. The scale of cities and their diversity of inhabitants create the interactions that generate new ideas and foster innovation (Glaeser et al., 1995). Places that attract different groups of people have a low entry barrier for talent (Florida, 2000).

Scale
Scale is an important attraction factor for companies and knowledge workers. Van Winden gives three arguments why scale is important. First he mentioned that for companies in larger cities it is easier to find specialized staff. Secondly, the size of a city does matter in the attraction of knowledge workers. A larger metropolitan area will increase the variety of jobs. His third argument is that larger cities have more amenities that attract knowledge workers. Companies want to be located close by airports to have a good international connection.

Smaller cities located close by or in a larger metropolitan area can benefit from the scale advantage of that area. They can thereby play a role in the knowledge economy as well. This advantage of proximity is called agglomeration benefits or borrowed size (Meijers, 2014; Raspe, 2014).

Social equity
Social equity is a foundation that can be used for sustainable urban development. Therefore it is needed to reduce poverty and inequality to ensure the perceived urban safety by

the people. The perceived safety of a place is becoming an important location factor for companies and knowledge workers.
It is important to understand that the seven foundations do not have the same weight. The knowledge base and economic base can be seen as the fundaments. Cities with a small knowledge base and a weak economic base will find it very difficult to succeed in the knowledge economy.

Agglomeration power
There are different kind of knowledge cities if we look to the foundations described before. There is a diversion in metropolitan cities and non-metropolitan cities. The diversion can be made by looking into the size of labour market and cultural diversities. Metropolitan cities can be big cities like Munich but also smaller cities that are part of a polycentric urban system. The smaller cities can have advantage from larger cities located close by. The advantage of proximity is called by economist agglomeration benefits (Raspe, 2014).

Meijers (2014) stated that agglomeration power is possible in a group of cities which are combined in a network. The importance of agglomeration power but also thinking of how nearby cities and agglomerations can strengthen each other is a trend. Therefore connections between the cities in this network needs to be very good. Alonso(1973) explained that smaller cities or smaller metropolitan regions exhibit some of the characteristics of a larger city or region if it is near other population concentrations. The opportunities for interaction with people in other places or cities can be seen as the index for borrowed-size. The larger cities have more inhabitants than smaller cities and therefore more opportunities for interaction than smaller cities.

The smaller cities in a metropolitan network can be called knowledge pearls. They are located near major cities or be part of a polycentric metropolitan area. Their population may be low, while the number of opportunities for interaction is much higher. The smaller knowledge city can benefit from the major city's facilities like international airport, shops or cultural facilities to complement their own. It important that the smaller knowledge city is part of a metropolitan network so they can compensate their scale disadvantage (Van Winden et al., 2004; van Winden et al., 2007). Leuven near Brussels and Leiden in the Randstad can be seen as knowledge pearls.

Clusters
As mentioned before, cities are the place where knowledge is generated. Cities are becoming more and more popular as a knowledge location for companies and knowledge workers. Cities are the places for economic growth, hotspots of innovation and breeding place for entrepreneurship. Companies located in the knowledge locations can benefit from the cluster they form with each other. A cluster can be seen as a functionally defined group of firms and supporting institutions that are concentrated in a specific location (Wolfe et al., 2004).

Clusters can only be facilitated by building upon existing resources (Porter, 1998). They can't arises anywhere from scratch. For the cluster it is important to have the specialization of the cluster the same as the specialization of the knowledge and economic base. Marshall stated clusters as the product of traditional agglomeration economies. The firms located in the cluster benefit from the easy access to collective resources and labour market (Porter, 1998). A spatial environment with facilities for meetings and exchange of people, goods, information and capital is also called an interaction environment (Raspe, 2014). A cluster can be seen as such an interaction environment. Interaction environments exist in different scale levels and have a diverse reach. They can be local but can also cross borders. They distinguish strongly from other urban environments like living- or production environments. An interaction environment has strongly changing groups of users and specialized facilities (de Hoog, 2013).

Local buzz and global pipelines
The benefits for firms located in a cluster is the role of knowledge and spillovers. Companies can profit from the intended and unintended transfer of knowledge. The advantages of proximity arise from continuous observation, comparison and monitoring what other companies are doing. Clusters also consists of companies that are complementary and interlinked through a network of services and consumer relations. Bathelt et al. (2004) refer to two kinds of knowledge flows, namely local buzz and global pipelines. Buzz refers to the information and communication created by face-to-face contact, co-presence and co-location of people and companies in the same economic sector and in the same location. Wolfe et al. (2004) sees buzz as the force that facilitates the circulation of information in a local economy or community and it is also the mechanism that supports the functioning of networks in the community. So local buzz can be described as the communication between companies and other knowledge institutions in the same sector and location. Interaction with companies in other knowledge clusters is called global pipelines. A network with companies and people in other clusters is therefore needed. This can provide knowledge spill over between different sectors. To create such local buzz and global pipelines the cluster needs a place where the companies can interact. This can be a common facility or another kind or interaction environment. Such locations enable people to interact without intention.
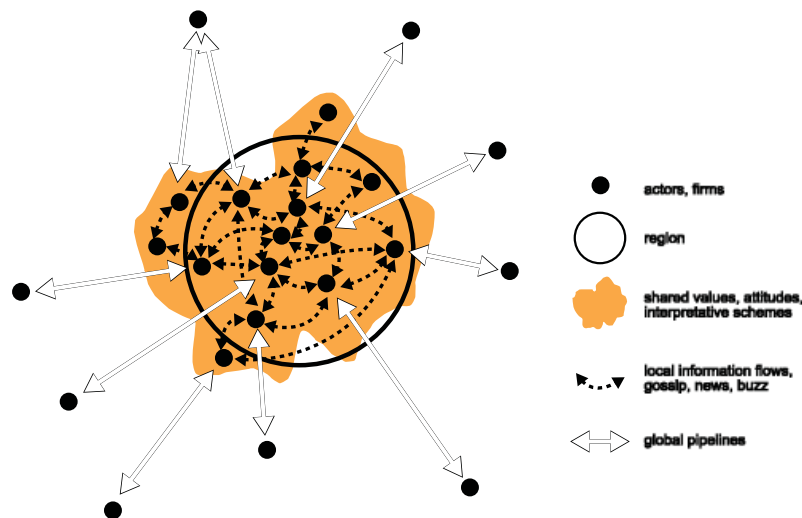
Figure 6: The structure and dynamics of local buzz and global pipelines. (Bathelt et al., 2004)
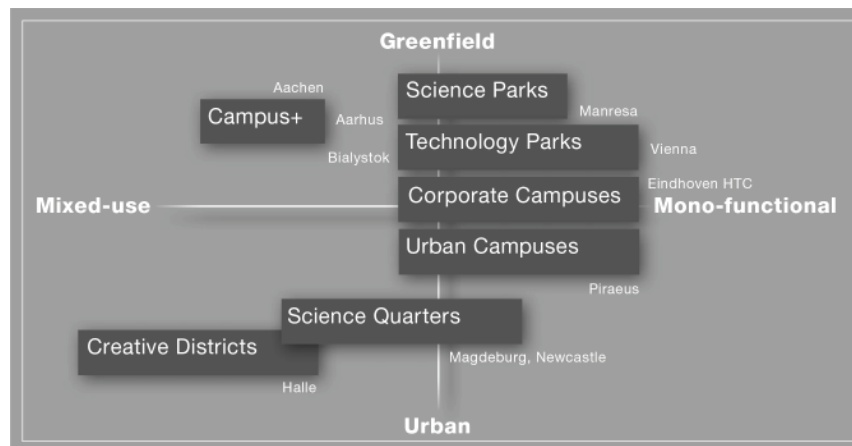

Figure 7: Types of knowledge hotspots. (Van Winden, 2011)

Science parks

Science and technology parks are the best known types of knowledge locations. Vedovello (1997) quoted Matthias when he described a science park as "a planned development of high technology enterprises in an attractive physical environment with close links to a university." They are often located outside the city, close to good infrastructure. It is typical for science parks that there are no housing or leisure functions. Universities and research institutions are mostly the key stakeholders and joint initiators. The main role for science parks is to increase knowledge spillovers and to improve the connection between universities and the industry (Carvalho, 2013). Typically, science parks have incubation facilities where start-ups are helped to develop. By locating on a science park, companies gain access to supporting facilities that provide synergy between the companies.

Science parks as described above are more and more shifting towards a knowledge hub. This knowledge hub has some similarities. Also here, universities and other knowledge institutes are involved in the development and there are incubation facilities. There is often the participation and colocation in the area of intermediate institutions such as cultural centres, development agencies and other organization with responsibilities in fostering networks between firms and educational institutes (Carvalho, 2013).

These new hubs have usually a strong aesthetic and visual drive encompassing cultural facilities, museums, architecture quality, heritage, preservation, public art and trendy streetscapes, event hosting, with housing and living possibilities (Van Winden, 2011). Van Winden calls these hubs knowledge hotspots. He stated that the hotspots have a number of advantages like facility sharing. They may enhance networking and face-to-face

contact, which may result in innovation. A good knowledge hotspot should not only focus on work, but it should also include leisure. He stated that it should be an attractive place. Den Heijer(2011) researched how science parks and campuses work in the knowledge city. She links the seven foundations of van Winden to university functions and space types. She states that a science park is based on the presence of academic functions for education and research, related business functions and a good. Most of the science parks are lacking retail facilities and housing functions. This makes them not a lively area.

According to den Heijer (2011), who did research into university campuses, a university campus have also residential, retail and leisure functions. The university is increasingly becoming dependent on the presence of non-academic space types in the near vicinity. She gives the examples of international student housing and apartments for visiting professors for internationalization goals. To create a lively campus trendy coffee bars and sport facilities are important. This will also create a place to meet, something which is important for face-to-face contact which stimulates innovation.

Such places to meet are called third places. A third place is a place other than home or working place where people can visit or associate with other people like colleagues, friends or even strangers (Oldenburg, 1989). Examples of third places are bars, terraces, espresso bars, parks, events and other retail facilities where people can meet each other. Third places can be the main building where people can interact such as in the High Tech Campus in Eindhoven. Storper and Venables (2004) stated that the face-to-face contact between knowledge workers or students make the cross-fertilization of ideas and knowledge possible. This can result in new ideas and therefore into innovation.
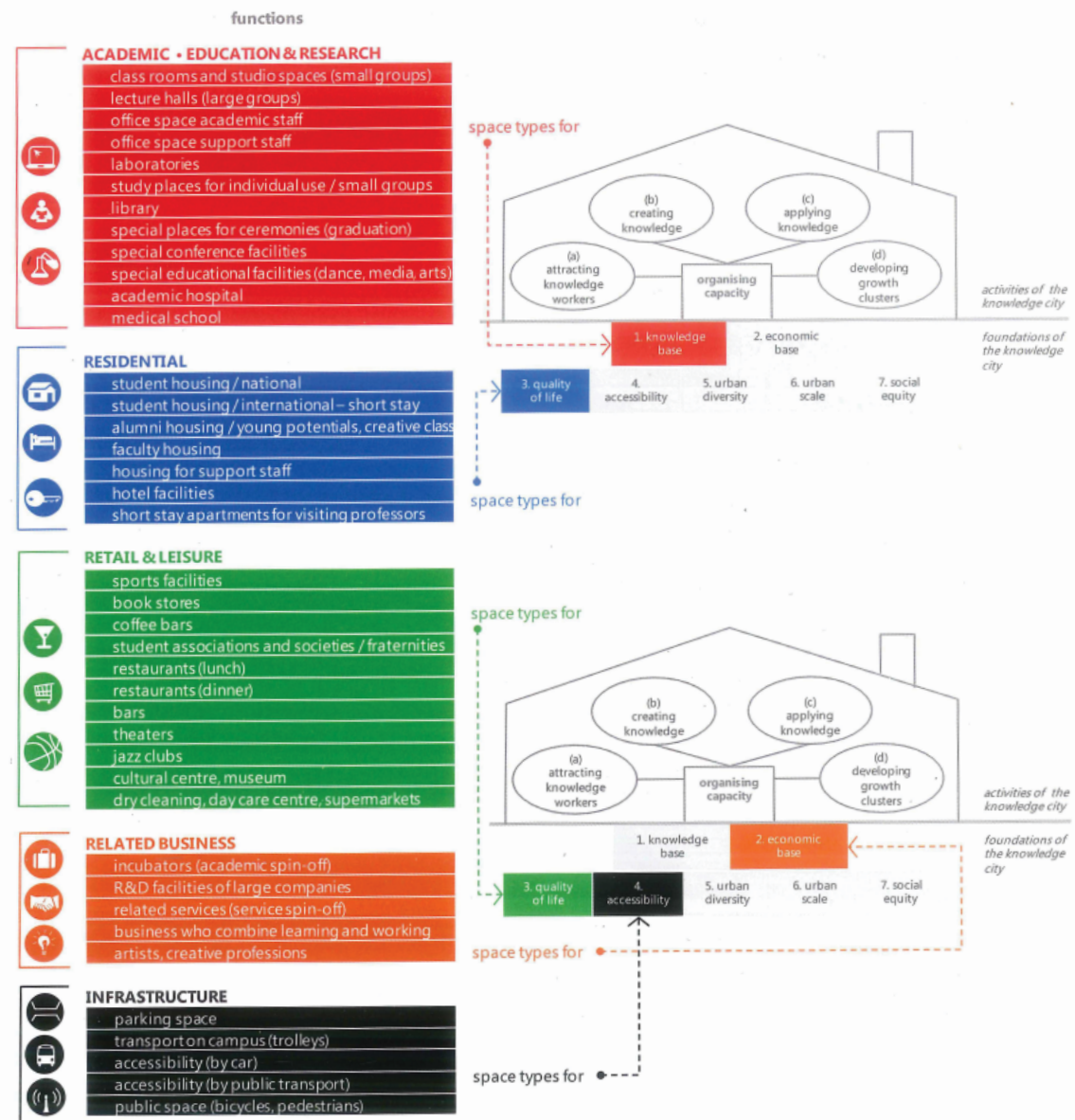

Figure 8: Foundation of the knowledge city linked to university function and space types. (den Heijer, 2011)

Conclusion

Urban designers can have influence on the success of innovation in a knowledge location. By facilitating places where people can meet and interact with each other, local buzz can arise. This local buzz is together with global pipelines (interaction with other knowledge locations) can be a factor in the innovation process. Urban designers can't create this local buzz but they can facilitate it. So urban designers can play a role in the success of a knowledge cluster but they have a facilitating role. They are still dependent on the people that work on the knowledge location. Urban designers need to stimulate them to interact.
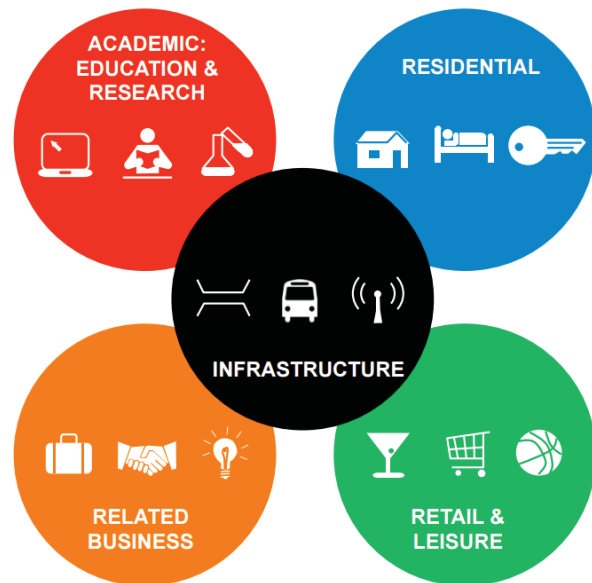

Figure 9: University function types for a campus location. (den Heijer, 2011)

PART 3

City profile of Leiden

As mentioned before Leiden is part of the knowledge axis of South Holland where multiple specialized knowledge locations are connected with each other. Leiden is a midsized city in the Randstad and can be successful if they have a specialization that suits the city and has a global relevance(Duranton & Puga, 2000). This specialization should be visible in the knowledge cluster of Leiden.

The city of Leiden has three knowledge locations which are all knowledge clusters. One cluster, which is located in the city centre, houses the university faculties of the alpha studies. In this cluster is also the university library located. This knowledge cluster attracts a lot of students, knowledge workers and high educated people but is not really part of the knowledge axis due to the specialization of this cluster. The two other knowledge clusters are located on the Bio Science Park. The knowledge clusters on the Bio Science Park are located around the academic hospital LUMC and the beta faculties next to the highway A44. Due to the specialization of this science park this location is important in the knowledge axis

To get a clear view of Leiden as a knowledge city, the foundations of Van Winden et al. (2004) and the university functions by den Heijer (2011) will be checked for the knowledge clusters in Leiden.
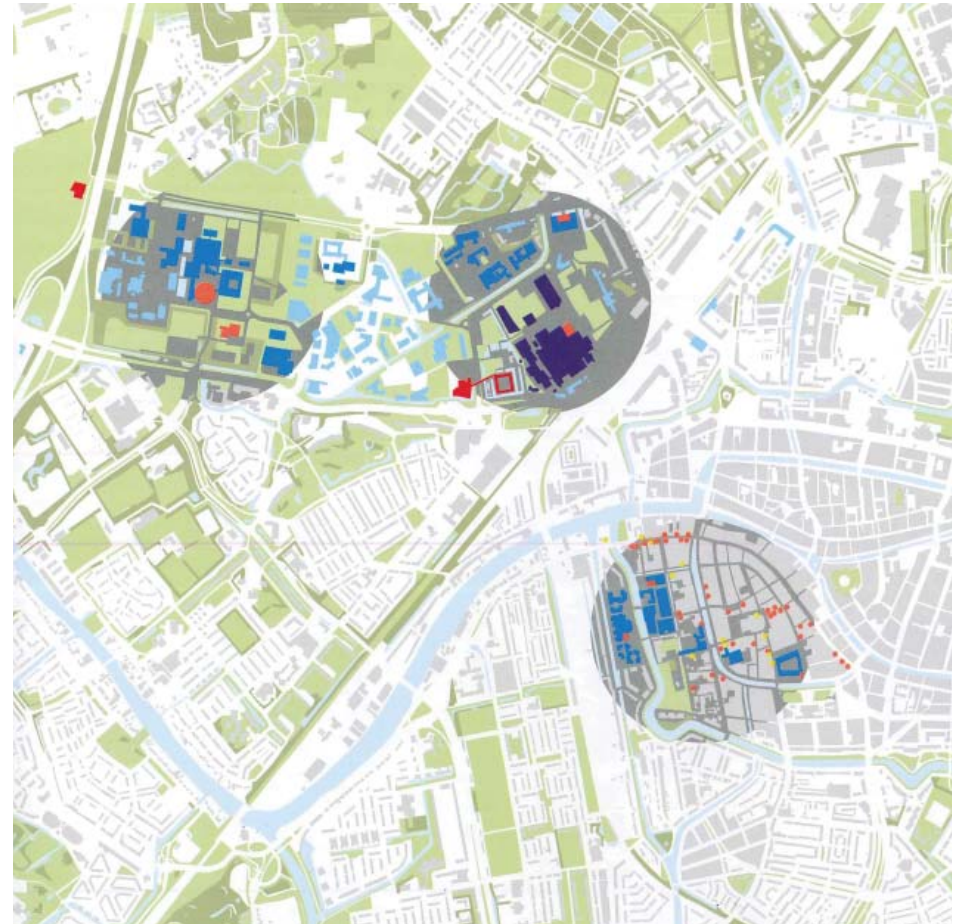

Figure 10: Different knowledge cluster in the city of Leiden. (de Hoog, 2013)

Knowledge base
For the knowledge axis the Bio Science Park is the most important knowledge location in Leiden. It is established by the University of Leiden and the academic hospital LUMC in 1984. The science park has a strong knowledge base with the university, academic hospital and multiple life-science companies. They are the main part of the knowledge base according to van Winden (2004). The knowledge base is not only determined by the kind of knowledge but also how this knowledge can result into innovation(Glaeser & Saiz, 2003). The exchange of this knowledge between the knowledge base of universities, companies and local government is very important. This collaboration is called 'triple helix' and is the driving force in the knowledge economy(Etzkowitz & Leydesdorff, 1995).

Leiden Bio Science Park
Leiden Bio Science Park is a unique science park which is the largest life-science cluster in the Netherlands and it is one of the top business parks in Europe. The high concentration of research, entrepreneurship, education and high level of care attracts a lot of companies, students and scientists from all over the world towards this science park.

The Leiden Bio Science Park is not only located in Leiden. A small part of the park is located in the neighbouring municipality Oegstgeest. The municipality of Leiden and Oegstgeest work closely together with the University of Leiden, the owner of the land.

The Leiden Bio Science Park is, together with the University of Leiden,W the heart of the city and the motor of the knowledge economy in Leiden. In 2009 the science park was awarded for best business park in the Netherlands. The strength of the park is their specialization, which is totally focused on

life-science and health. Life-science and health is one of the sectors designated by the government as Topsector for the Netherlands. Medical research by the University of Leiden, LUMC and life-science companies located on the business park leads from then to now to important discoveries with a major economic and social impact.
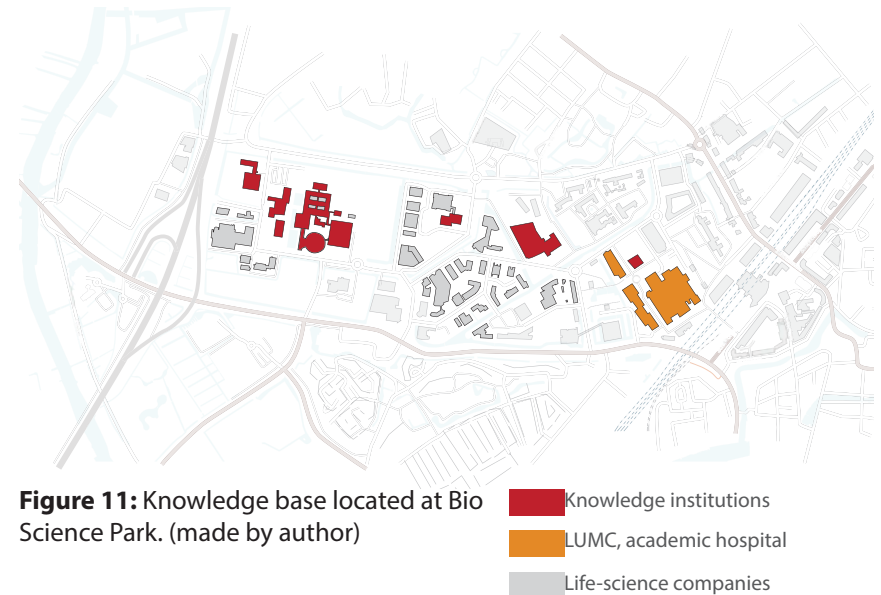

Figure 11: Knowledge base located at Bio Science Park. (made by author)

■ Knowledge institutions
■ LUMC, academic hospital
■ Life-science companies

Knowledge institutions
Leiden houses the oldest university in the Netherlands. It is founded by Willem van Oranje in 1575. Leiden University has acquired a solid international position among top research institutions in several research areas, including natural science, medicine social science, law and literature. The university gives education to around 23000 students and has seven different faculties, of which one is located in Den Haag. It has different studies like archeology, law, humanities but for the knowledge axis the study of science is the most important. For this study a new faculty is being built on the Bio Science Park. It will replace

the old Gorlaeus building. The so called beta campus will house all science studies in one building and will become the centre of life-science education in Leiden. Leiden University is also collaborating with the TU Delft in the bachelor studies life-science and technology. This is a good example of collaboration between different sectors in the knowledge axis.

Figure 12: Visualization of the new faculty of science, the Beta Campus. (www.duurzaamgebouwd.nl)

At the Bio Science Park is also the Leidse Hogeschool situated. This is a school for higher applied education and has a very broad education profile. A lot of students that live in the region are going to this education institution.

The other knowledge cluster is located around the academic hospital LUMC. Leids Universitair Medisch Centrum is a collaboration between the hospital and the faculty of medicine of the university. In this cluster a lot of research is done by students but also knowledge workers.

Companies
Leiden Bio Science Park houses about 85 different life science and health companies. The number of companies in the science park is still growing. They differ from start-ups, spin-offs to large multinationals. The most companies are focussing on research but there are also some companies focussing on pharmacy and medical instruments. The life-science companies are attracted to the Bio Science Park because of the university but also because of the presence of other life-science companies that form together a cluster.

Education level
Florida (2002) mentioned the importance of the presence of knowledge workers. Not only institutions but also high educated population is part of the knowledge base. Leiden has a high educated population compared with other places in the Netherlands. 46% of the inhabitants of Leiden are high educated. This means that they have a master or bachelor degree from a university or so called Hogeschool. The last ten years the population with a high education degree is improved. Leiden has always had a lot of high educated people. This can be explained by the high number of students that live in the city.
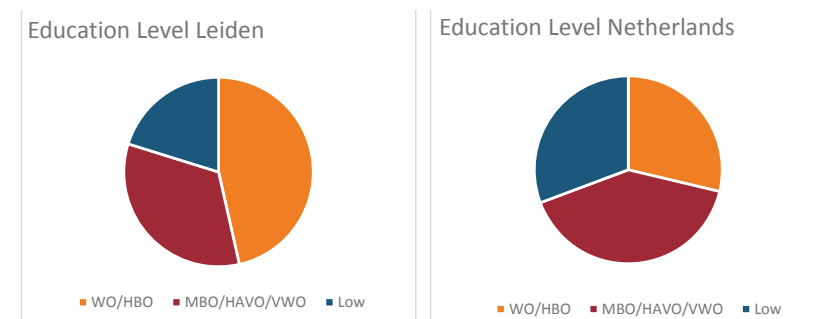

Education Level Leiden — Education Level Netherlands

WO/HBO   MBO/HAVO/VWO   Low

Figure 13: Education level Leiden compared to the Netherlands. (made by author, based on Staat van Leiden)

Economic base

For smaller knowledge cities it is important that they have a sort of specialization. Leiden as city in the knowledge axis is focused on the sector life-science and health. Life-science and health is one of the nine top sectors which according to the Ministry is of crucial importance for innovation in the Netherlands.

The economy of Leiden relies heavily on the healthcare and education sector. This is explained by the presence of the university, other knowledge institutions and the large hospital. Together, these sectors are accounted for almost half of the employment in the city.

Provincie Zuid Holland (2012b) mentioned 5 innovative sectors in their report 'de Weerbare Regio'. Research by Wetzel (2013) stated that over the years the sectors ICT, greenports and life-science and health are growing in Leiden. Especially the life-science and health sector has a considerable growth, it has more than doubled. These highly specialized companies are clustered in the Bio Science Park, which underpins their need for excellent research and laboratory facilities. With 3% in the overall employment, the life-science and health sector shows strong potential for the future.

Figure 14: knowledge workers in the life science sector. (Brochure Leiden BIo Science Park)

The Leiden Bio Science Park manages a strong admission criteria for new companies that want to settle at the park. The Leiden Bio Science Park Foundations is the stakeholder who checks if a company fits on the park. Therefore they look into the sector which should be life-science or health.

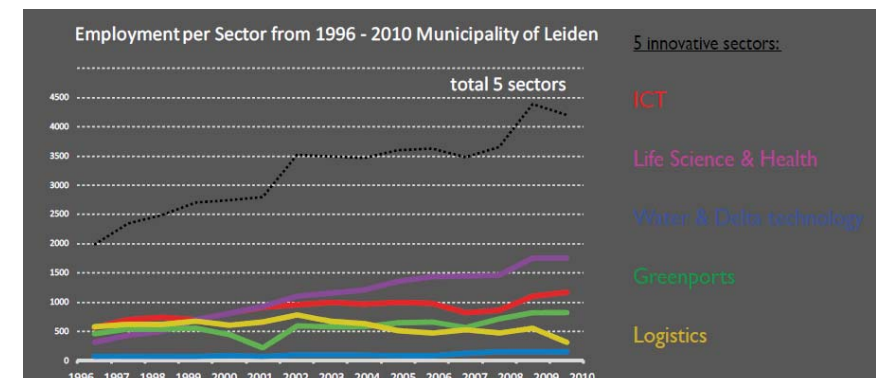**Figure 15:** Employment in the sectors in Leiden. (Staat van Leiden)

Figure 16: Employment in the five innovative sectors in Leiden. (Wetzel, 2013)

Figure 17: Location of the five innovative sectors in the Leiden region. (Wetzel, 2013)

Accessibility

The knowledge economy is a network economy, therefore a good accessibility is crucial. If Leiden wants to attract good knowledge workers from over the world a good international, regional and multimodal accessibility is needed.

Being connected to a transport hub with international reach is very important for a city in the knowledge economy. Leiden is a knowledge city which is very good connected by international transport. Schiphol, the largest airport in the Netherlands, is located close by. Schiphol is not located in the municipality of Leiden but Leiden is part of a polycentric urban system, the Randstad, and can therefore benefit from Schiphol which is located in Haarlemmermeer. This can be called borrowed size (Meijers, 2014; Raspe, 2014). A good train connection towards Schiphol is therefore quit necessary. Eight times an hour a train from Leiden goes to Schiphol airport.

Leiden can be seen as a link between the Zuidvleugel and the Noordvleugel of the Randstad. This because it is located between both of them and in the middle of the Randstad. Therefore Leiden is very good connected to the larger cities in the Randstad. There is a direct train connection to the four bigger cities Amsterdam, Rotterdam, Den Haag and Utrecht. Leiden itself isn't part of the international railway network but Amsterdam, Schiphol, Den Haag HS, Utrecht and Rotterdam are linked to this network. These stations, especially Schiphol and Den Haag HS, can be reached in short time. From there a direct train connection to Belgium, France and Germany is possible.

Figure 18: Schiphol airport, provides international accessibility. (www.taxiasro.nl)

Figure 19: Leiden is located close to internation connections. (made by author)

The knowledge cluster Leiden Bio Science Park is located right next to Leiden central station. This is a huge advantage for the Bio Science Park. It makes the science park extra attractive for knowledge workers which live in another city and make use of public transport. Next to the station is a busstop located, from here different buslines go through the science park.

Leiden is good connected by highway and train, especially in the north-south direction. The city can be accessed via two highways, the A4 on the east side goes directly from Amsterdam to Rotterdam and the A44 on the west side next to the Bio Science Park which goes to Den Haag. Leiden is quite good connected with other cities, especially in north-south direction. The east-west connection is less developed at this moment. The only road towards the east is the N11. From the Bio Science Park the A4 and the N11 can only be reached by driving through the inner city, this is not efficient. To improve this east-west connection a new road is planned. The Rijnlandroute is a new provincial road which will connect the highways A44 and A4. This new Rijnlandroute will improve to connection with the A4, commuters don't have to drive through the city centre anymore.
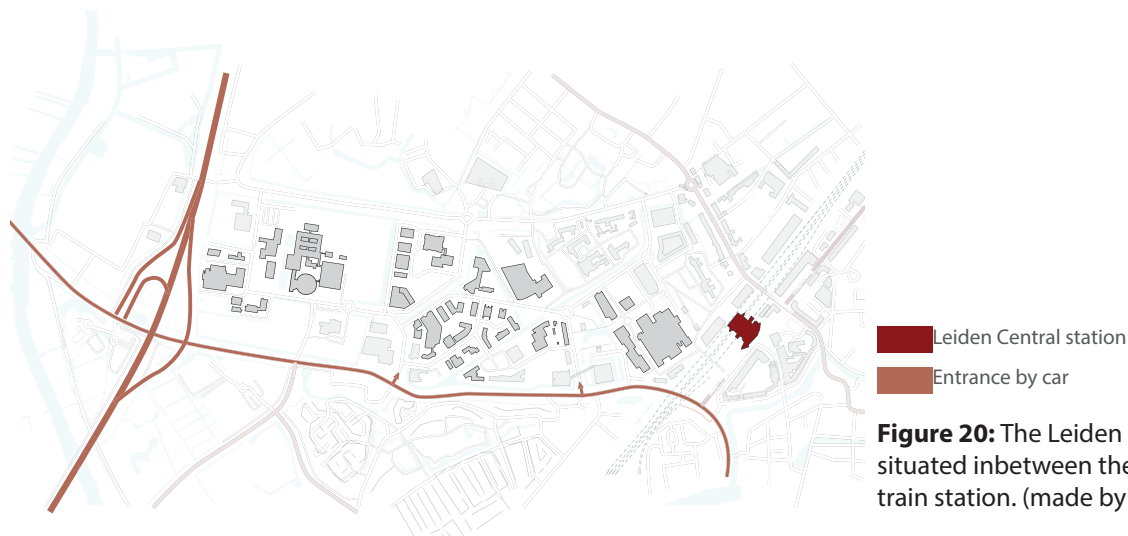

Leiden Central station

Entrance by car

Figure 20: The Leiden BIo Science Park is situated inbetween the highway and the train station. (made by author)

A44

A4

Rijnlandroute

Figure 21: Road and railway network around the city of Leiden. (made by author)

Knowledge workers are more willing to travel longer for their jobs. This maps show the reach of one hour travel time to the Leiden Bio Science Park for car and public transport. Leiden is good connected by road and public transport. This is because the Randstad is a polycentric urban region. The cities work in a network. Leiden has quite a large reach for one hour travel time. Whole the Randstad can reach the Bio Science Park In one hour if they travel by car. If we look to public transport, the area is a bit smaller but still Rotterdam, Den Haag and Amsterdam are in this area.
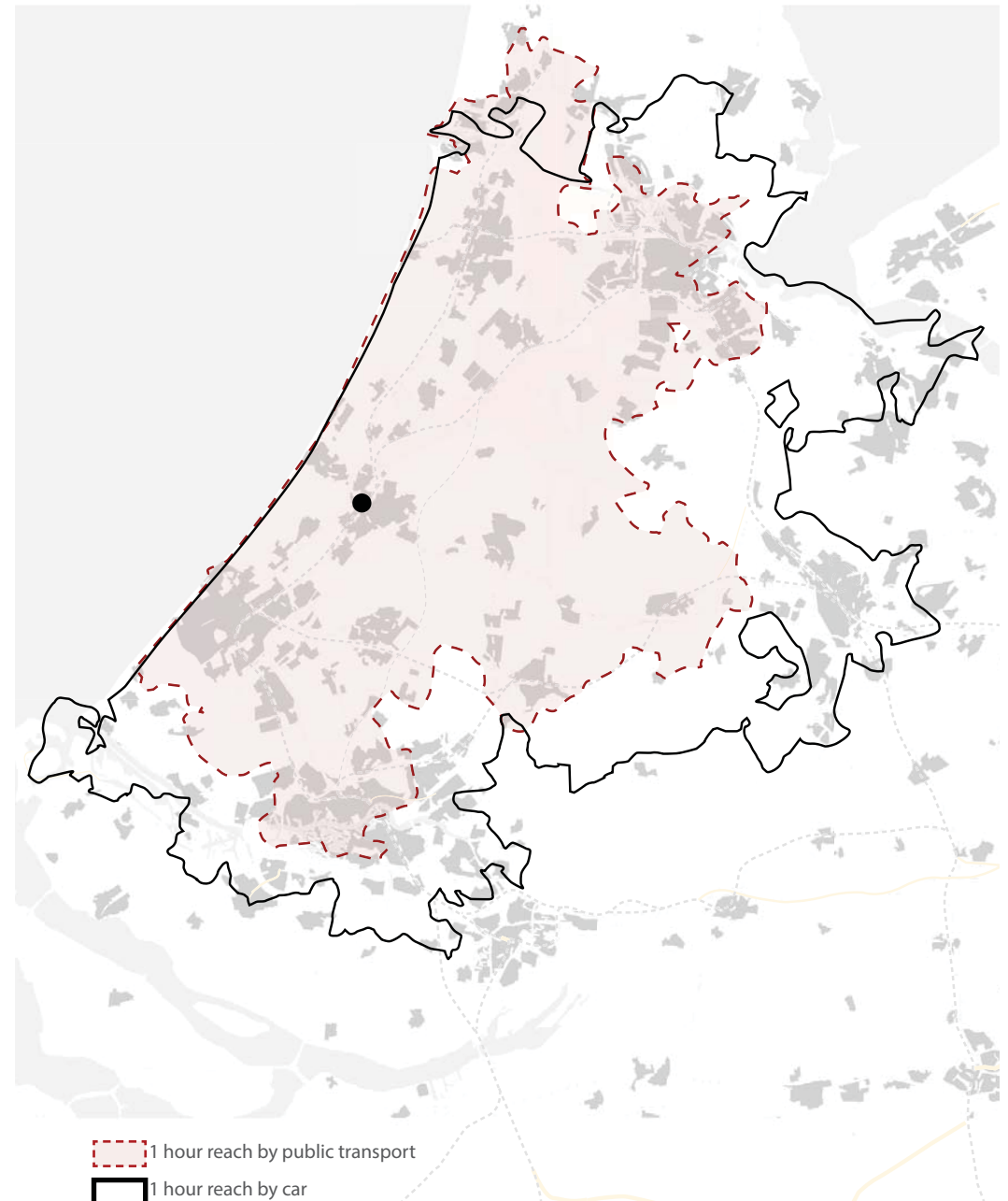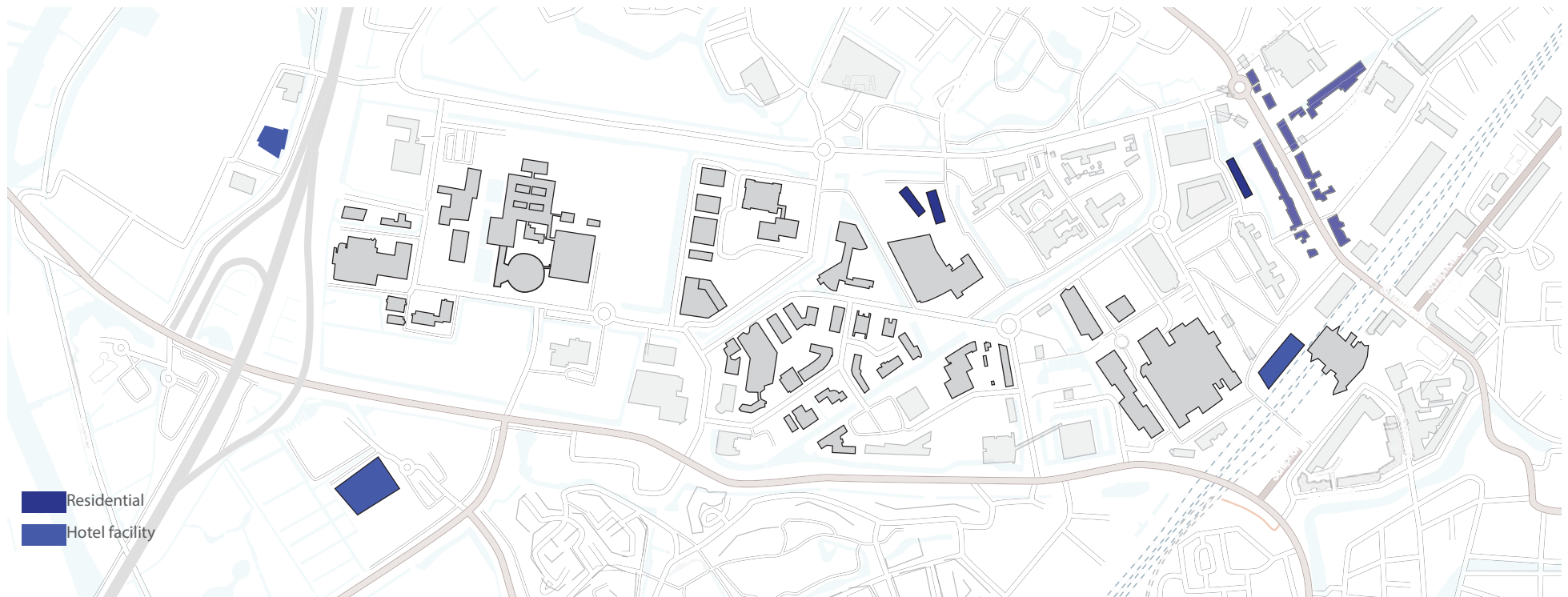

Figure 22: One hour travel time to Leiden by public transport and by car. (made by author, based on www,.bereikbaarheidskaart.nl

1 hour reach by public transport
1 hour reach by car

Quality of life

As mentioned in the theoretical framework, the quality of life is about attracting knowledge workers. Florida(2002) stated that knowledge workers do not select a place to work based on salary, the working environment is also very important. Good amenities are important for them. Due to the fact that Leiden is a midsized city in the Netherlands, it will not have every amenity that larger cities have. Leiden is quite close to Den Haag and Amsterdam, two larger cities, and should therefore benefit from amenities they have.

Figure 23: Residential facilities at the Leiden Bio Science Park. (made by author)

The working environment of the Bio Science Park is also part of the quality of life. To attract knowledge companies to this location it should be a high quality working environment. According to den Heijer (2011) a science park doesn't have retail and leisure and residential functions. The Bio Science Park wants to shift towards a more lively science park. They want to go more into the direction of a campus. We can see this in the fact that there are two buildings for student housing situated on the park. In Leiden there is still a shortage of student housing in the city. Therefore this area on the park can be an interesting place to develop more student housing. There are also two hotel facilities on the park, the Hilton Garden Inn and the hotel in the Level Building. Also the Holiday Inn hotel facility is located quite close to the Bio Science Park.

Residential

Hotel facility

The only leisure facility on the Bio Science Park that is of importance for the knowledge workers and students is the university sport complex. This sport facility is situated next to the faculty of the university. It is mainly used by students but also knowledge workers of the Bio Science Park can use this facility. Such facilities as a sport centre can provide interaction between different users. Other leisure facilities are the two museums, Naturalis and Corpus, they will attract visitors to the area but they are only attracted to this specific facility and not to the Bio Science Park itself.

The Leiden Bio Science Park lacks retail facilities. There are some retail facilities near the station but they don't attract a lot of people of the Bio Science Park because they are on the edge of the park. The only retail facility is grand café de Stal. This is a quite small facility on the Naturalis Park but this facility is not enough to create a lively area.

Figure 24: Leisure facilities at the Leiden Bio Science Park. (made by author)

Leisure facility

Park

University Sport Complex

Figure 25: Parking facility at Leiden Bio Science Park. (made by author)

The companies on the Bio Science Park are very secluded. Most companies have their own parking facility, which are moslty secluded by a gate. They are only accessible for people who work for that specific company. The gates and barriers don't give the area an attractive image. The parking spaces take up much space and are mostly located in between the building blocks so that they are out of sight. The parking places that do lie in sight don't give the area an attractive view.

Figure 26: Amount of secluded parking facilities. (made by author)

Secluded parking place

To stimulate innovation, knowledge workers have to interact with each other (Bathelt et al. , 2004). This interaction can be unintended. This unintended interaction can happen on the street or other public places. Only the areas close to the Hospital, Naturalis Park and Hogeschool have public space where unintended interaction can take place. The rest of the area exist mostly of streets. By adding more quality public space this unintended interaction can be improved.


Figure 28: High quality public space at the Naturalis Park. (made by author)

Figure 27: Public space where unintended interaction can take place. (made by author)

Places for interaction

Interaction can also take place at conferences or meetings in retail facilities. It is already said that the area lacks retail facilities where people can meet each other. The Leiden Bio Science Park has some conference facilities. At conferences different companies can come together. This can be companies which are located on the Bio Science Park but also companies from other knowledge locations. At conferences companies can interact with other companies from different knowledge location, this is called global pipelines and this can cause knowledge spill over (Bathelt et al. ,2004). These conference locations are situated in Naturalis, Corpus, Hilton Garden Inn and the Level building. Also the incubator facilities are a place where different companies can meet. In these facilities multiple start-ups and spin-offs are working in the same building where they can interact.

Figure 29: Buildings at Bio Science Park where meetings can take place. (made by author)

Shared incubator facility

Congres/conference facilty

Retail facility
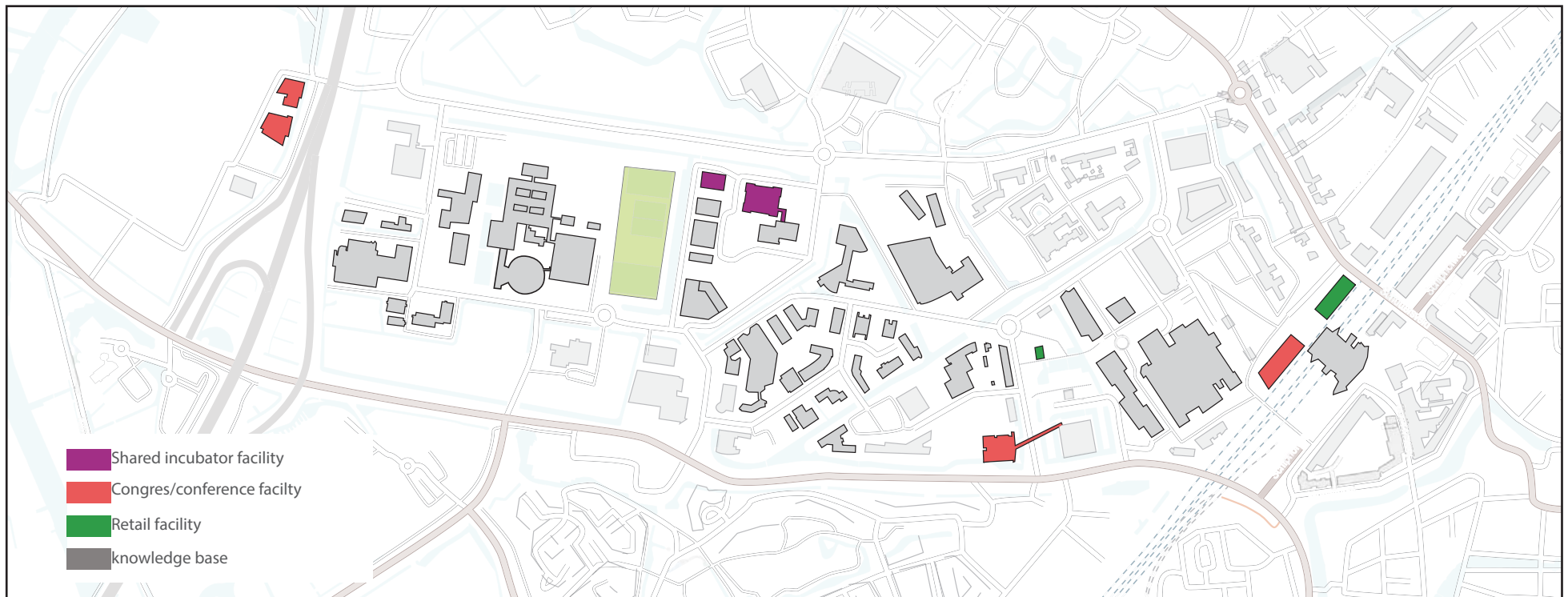
knowledge base

Scale

The foundation scale is already described during other foundations. Leiden isn't a very large city in the Netherlands, but is part of the large metropolitan region of the Randstad. Scale is important for attracting knowledge workers. It is easier for larger regions to find specialized staff. Due to the good connections with larger cities, Leiden can attract a large amount of knowledge workers. For the amenities it can borrow amenities form these cities as well, which is already stated for the amenity of Schiphol. So Leiden can benefit from the scale advantage of the Randstad area. Because of the fact that Leiden is in the middle of the Randstad it can have agglomeration benefits (Meijers, 2014).

Urban diversity

Urban diversity can be related to the diversity of users of the Bio Science Park. It is used by scientists, knowledge workers, students and also lower educated people. Jobs for higher educated people will also create jobs for lower educated people. The diversity can also be linked to the economic base for the Leiden Bio Science Park.

Social equity

Social equity states that the sustainable urban growth is only possible when poverty and inequality is reduced. Leiden Bio Science Park is a safe working location. It received the *keurmerk veilig ondernemen* for several years now.

Opleidingsniveau werknemers van het Leiden Bio Science Park

	MBO en lager	HBO/WO en hoger
Bedrijven	40%	60%
Leids Universitair Medisch Centrum (LUMC)	22%	78%
Universiteit Leiden	10%	90%

Figure 30: Education level employers Bio Science Park. (www.leidenbiosciencepark.nl)

SWOT Analysis

A SWOT analysis for the Leiden Bio Science Park has been made to show what the main focus points are. This SWOT analysis is a summary of the analysis of the Bio Science Park. It shows the strengths, weaknesses, opportunities and threats for the location. It has clearly mapped out what possibilities exist for the area.

Strengths

The strengths are the points which makes the Leiden Bio Science Park an attractive business location. The strong points concluded from the analysis is that the Bio Science Park is a strong knowledge cluster. It has a strong knowledge base with the university, LUMC and multiple life-science companies. This works attractive to new knowledge companies to locate on the park. Also the good location of the park, in between the highway A44 and Leiden central station, can be of main advantage to attract new companies. The Bio Science Park is therefore well connected to other cities in the knowledge axis like Delft and Rotterdam, but also to larger cities in the Randstad like Amsterdam and especially Schiphol airport. The large undeveloped area gives the possibility for expansion with new life-science companies.

- Strong knowledge base with university, hospital and life-science companies
- Good connection with other cities in the knowledge axis and Schiphol airport
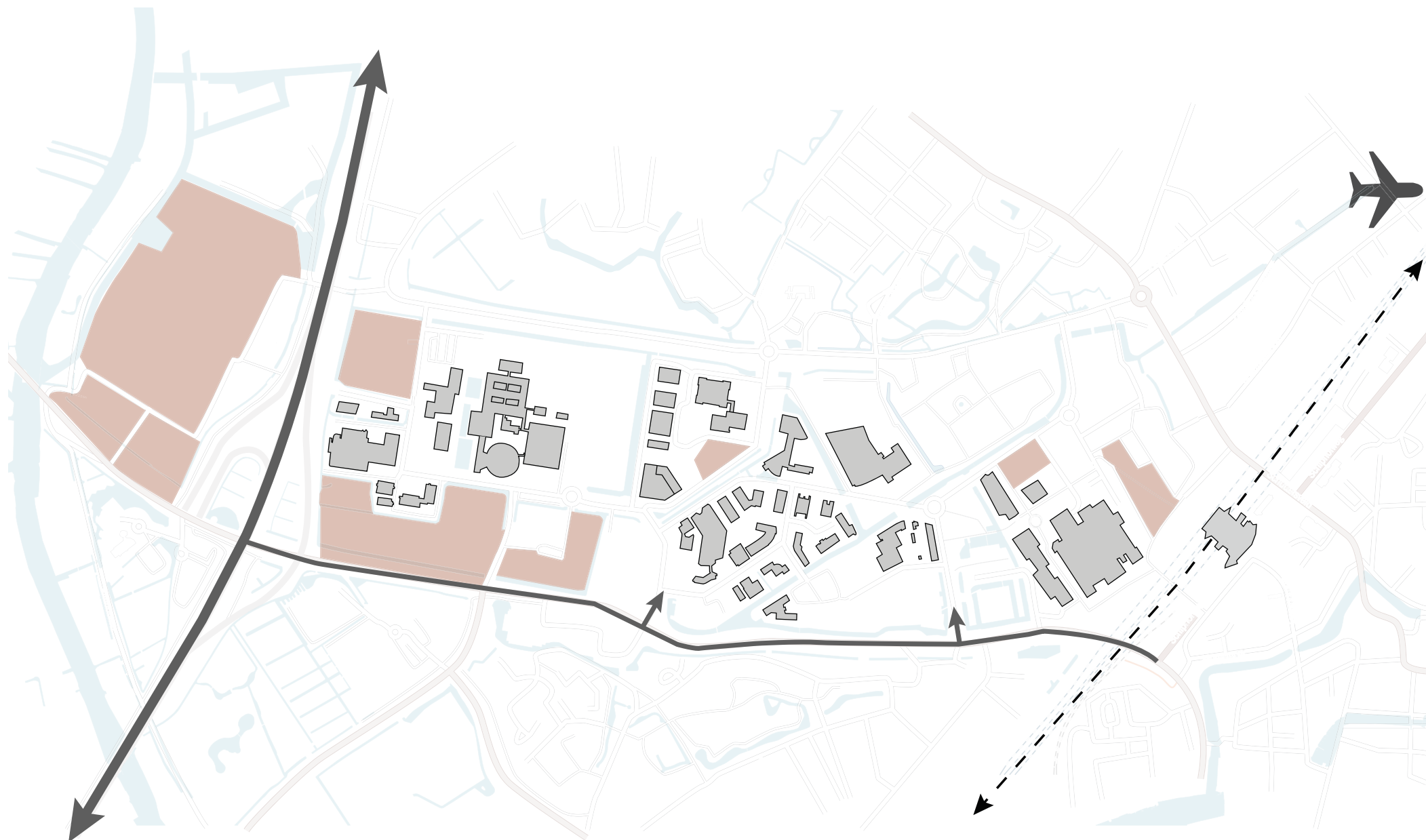- Expansion possiblities for new life-science companies

Figure 31: Strengths combined in one map.
(made by author)

Weaknesses

The highway that makes the Bio Science Park well connected can also be seen as a weakness. It works as a huge barrier between the Leiden area of the Bio Science Park and the area that belongs to the municipality of Oegstgeest. As stated before, the possibilities for interactions and places to meet is lacking. There are almost no retail facilities where interaction can take place. This is one of the main weaknesses of the Bio Science Park. The area is quite fragmented, which doesn't stimulate interaction. A lot of companies have their own parking and private space, which is good for the company, but the gates in front of them gives it a secluded character.

- Highway works also as a barrier between Leiden and Oegstgeest area of the Bio Science Park
- Possibilities for interaction and face-to-face contact is lacking.
- Fragmented area
- A lot of space secluded by a gate, mostly used for parking, doesn't stimulate interaction
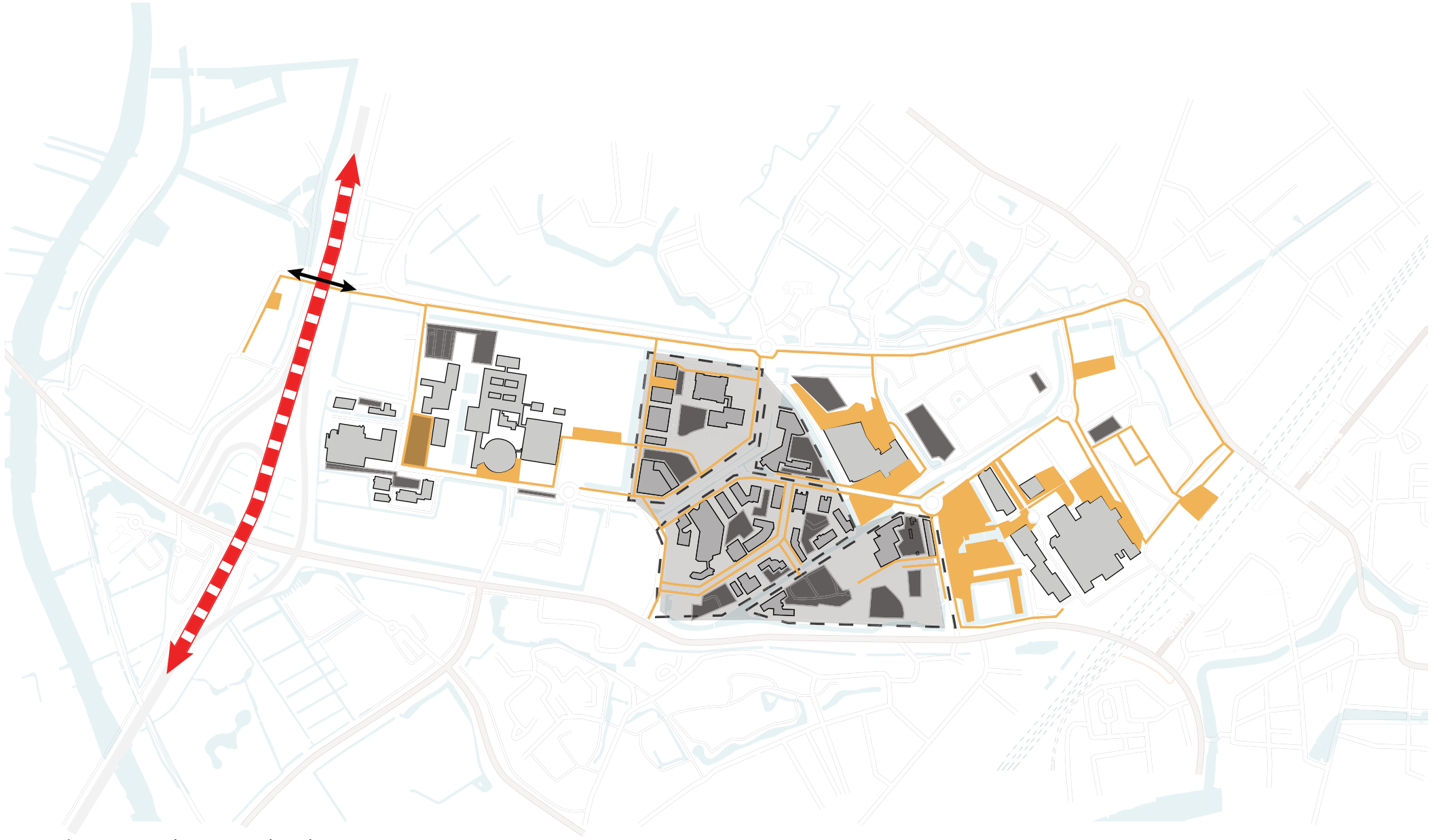
Figure 32: Weaknesses combined in one map.
(made by author)

Opportunities

Opportunities are mostly factors from outside the area. The Stedenbaan project from Atelier Zuidvleugel for the station area of Leiden central station is one of them. This can cause a transformation of the station area. Another opportunity is the shortage of student housing in Leiden in general. Den Heijer (2011) already stated that student housing are important for a lively campus so Bio Science Park can anticipate to this shortage. The new provincial road Rijnlandroute, which makes a better connection between the A44 and the A4, will improve the accessibility of the Bio Science Park. This better connection with the A4 is an opportunity to make the Bio Science Park more attractive for companies.

- Stedenbaan project around Leiden central station can cause a transformation of the station area
- Anticipate into the shortage of student housing in the city
- The Rijnlandroute makes the Bio Science Park better accessibile, which makes it more attractive

Figure 33: Opportunities combined in one map.
(made by author)

RIJNLANDROUTE
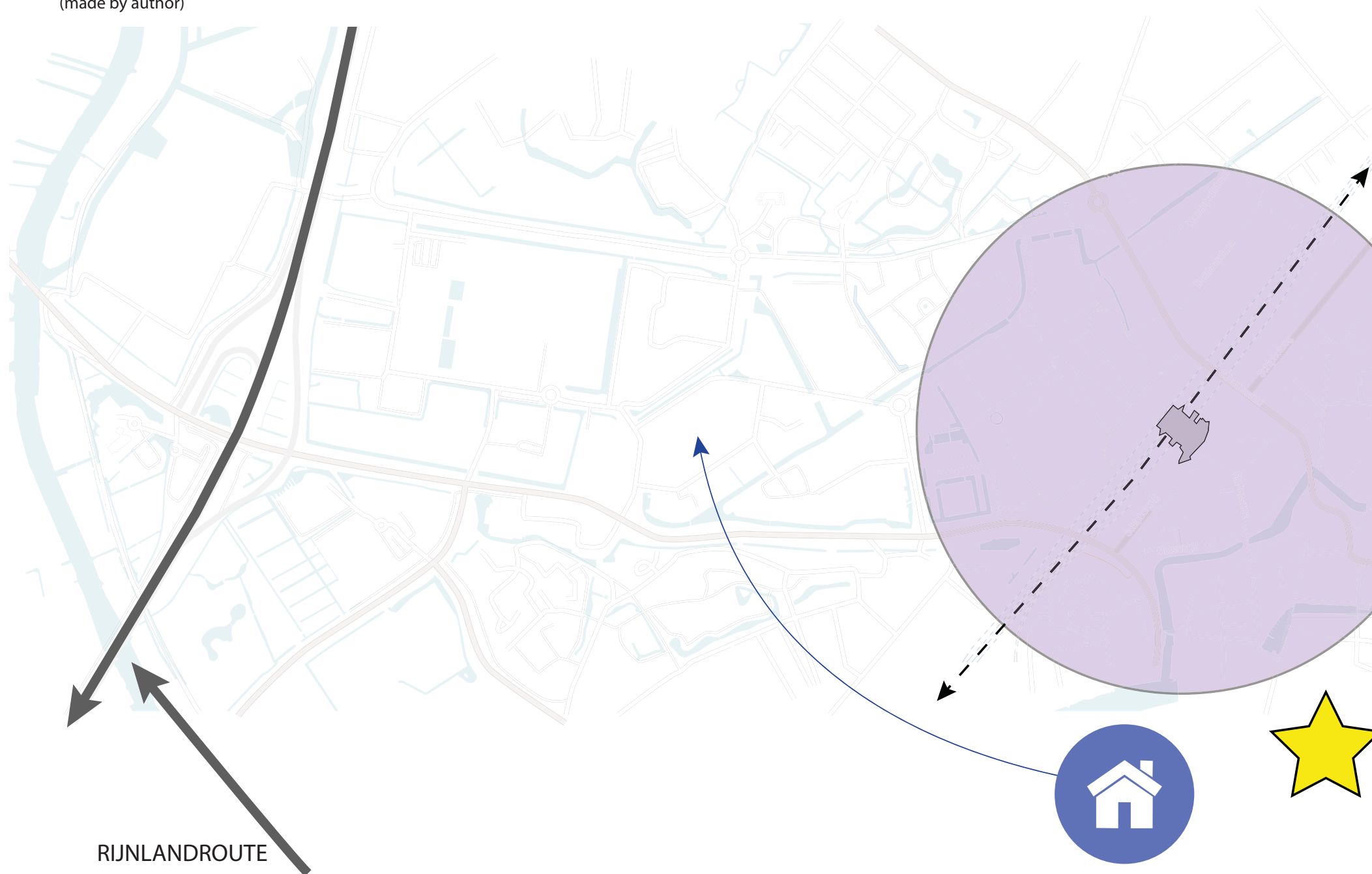
Threats

Due to the fact that the highway works as a barrier, the highway can also cause a threat. The Oegstgeest part of the Bio Science Park is therefore bad connected with the other side. This area is less attractive than the rest of the Bio Science Park. The bad connection with the rest of the park can ensure that companies don't want to settle in this area and that the area stays undeveloped

WHO?

Figure 34: Threats for the Bio Science Park.
(made by author)

Reference study

High Tech Campus Eindhoven

The High Tech Campus Eindhoven is a private development, initiated by Royal Philips Electronics. First, only Philips was located at the campus. Nowadays a lot of other research institutions are located on the site. An explicit goal of the High Tech Campus is to create an environment for open innovation. To achieve this goal several instruments are used.

First, the High Tech Campus has a selective admission strategy. Only R&D companies from a specific sector can locate on the campus. Second, to promote interaction on the campus, a specific organisation is set up. This organisation maintains contact with the companies and pinpoints valuable connections between them. It organises workshops, business meetings and network happenings to enhance knowledge diffusion. Third, to promote interaction and knowledge diffusion, the campus has a specific zoning plan and special rules. The designers have designed a central position of collectively used facilities with different functions around it. Shared functions like a restaurant, shops and meeting rooms are situated in one building called 'The Strip'. There are also several shared parking buildings in between the buildings with mixed functions. The middle zone of the campus isn't accessible by car and the quality of the green spaces is quite high. Employees need to walk to their destinations which increases the chance of encounters. Within the company buildings there are no meeting rooms and lunch rooms allowed. These facilities are located in the Strip.

1. Working in the landscape
It was decided to give the Campus a very rural look. The objective was to achieve an ecology friendly design by getting the buldings to float on top of the landscape, as it were

2. Parking in parking garages
The desired highly rural look of the Campus could only be achieved by minimising the amount of paved ground area by providing centrally located compact multi-story compulsary parking facilities, allowing only disabled parking and loading/unloading bays near the buildings

3. Heavy traffic at periphery and a peaceful central area
The working atmosphere on campus is supported by the traffic concept adopted. Most of the traffic flow is around the edges, while the peaceful central area is reserved for pedestrians and cyclists.

4. Extrovert image with links to surroundings
Apart from the atmosphere of the Campus, its image also plays an important role - no longer an introvert site with a fence all the way round, but an extrovert concentration of high tech activities with good links to its surroundings.

5. Central provisions in The Strip
The Strip, the spot where all canteens, the auditorium, large conference rooms, a supermarket, hairdresser, bank, grand café and many other facilities are located under one roof, is located overlooking the lake in the central pedestrian zone.

Figure 35: Design philosophy for HTCE. Added value to the collective. (www.inbo.com)

Figure 36: Overview of the High Tech Campus
Eindhoven. (www.inbo.com)

Conclusion

The main goal for the High Tech Campus is to create an environment for open innovation. A meeting place for talents and the best researchers, and a place that would attract such people to Eindhoven. To achieve this the High Tech Campus made a design philosophy. The philosophy was added value for the collective. This is achieved by five key aspects. Working in the landscape, shared parking facilities, heavy traffic at the periphery, an extrovert area with links to its surrounding and a building with shared facilities called The Strip.

These design principles can be very helpful for my project for the Leiden Bio Science Park. This case study can therefore be a good method to understand what is needed to create open innovation on the Leiden Bio Science Park. To keep in mind, this strategy model can't be copied directly to every other business park. But the design tools used for this area can be used for inspiration!

Figure 37: Meeting place in the Strip. (www.inbo.com)

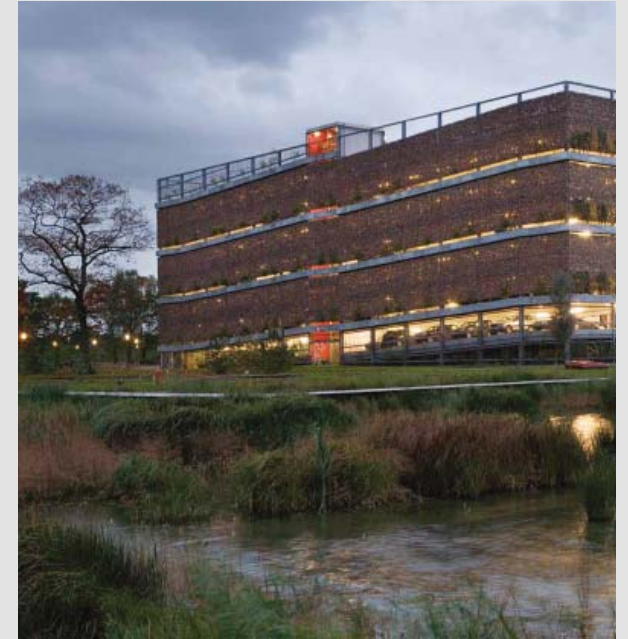**Figure 38:** Shared facility the Strip. (www.inbo.com)

Figure 39: Impressions of the High Tech Campus Eindhoven. (www.inbo.com)

Points of Action

The analysis and SWOT analysis for the Leiden Bio Science Park give a better understanding of what is good and what is problematic in the area. To understand how the location of the Bio Science Park works nowadays, the area is divided into five diagrammatic sub area. These five subareas are all used in a different way and have their own characteristics. For each of the five sub areas the shortcomings are explained. These shortcomings result into different action points. These action points are the base for the new vision for the Leiden Bio Science Park.
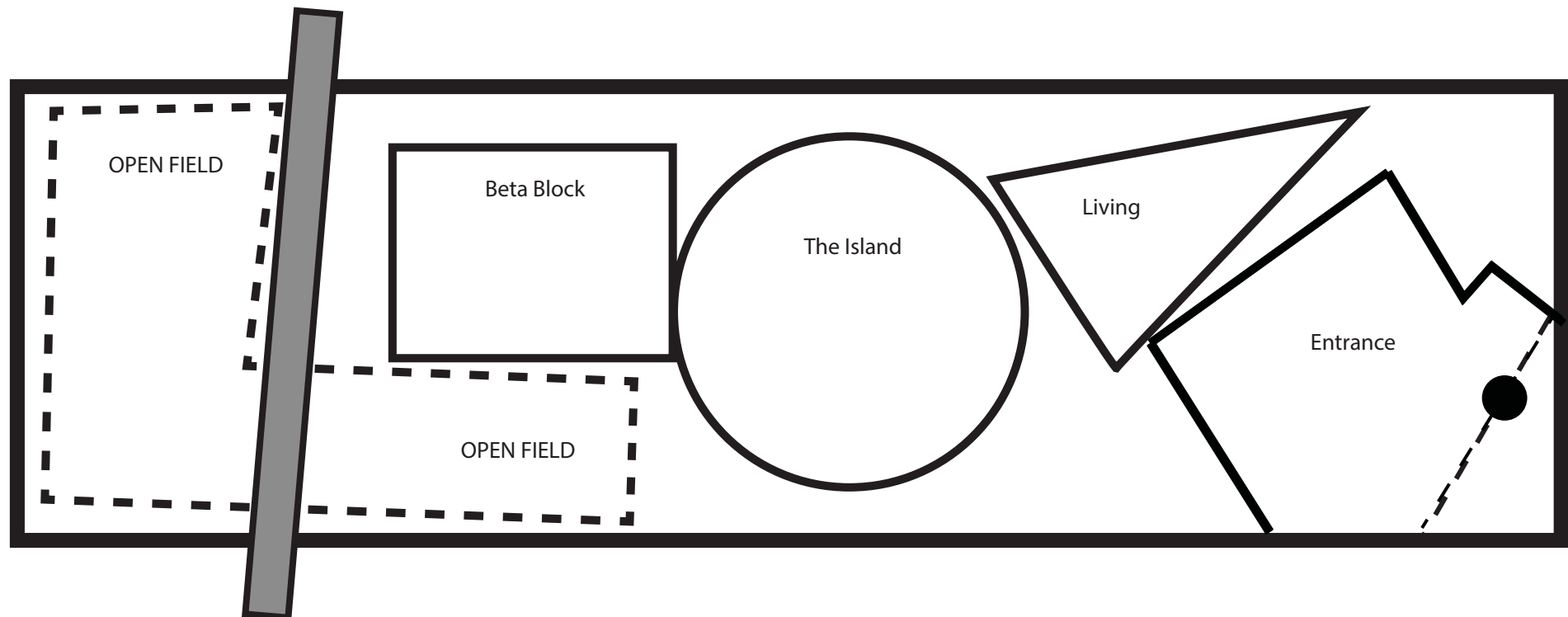
Figure 40: Diagrammetic division into subareas.
(made by author)

The Entrance

The entrance area is the area around the central train station. This area is characterized as entrance but works also as a passage to other locations in the Bio Science Park. This area is the main entrance by public transport due to the train station. Everyday around 65000 passengers are arriving at this train station and a lot have the Bio Science Park as destination. Near the train station, the hospital LUMC is located. This is the main employer of the city with more than 7000 employees. Despite the large amount of train passengers who have the Bio Science Park as destination, this area is mainly seen as the back side of the train station. The large undeveloped area in front of the LUMC confirms this.

To connect the Bio Science Park better with the city centre, the station area as a whole needs to become part of the city centre. Therefore the main action point is to develop the station area into an attractive second front side and part of the city centre.

Leiden central station is one of the stations which are part of the Stedenbaan project. Stedenbaan is a so called transit-oriented-development program for spatial development and high quality public transport in the Zuidvleugel. Their goal is to improve the public transport network in the Zuidvleugel by improving the quality of the public transport connections. Also a high quality station environment is part of the Stedenbaan project.

Actionpoints
* Develop the area into an attractive second frontside and part of the centre, according to Stedenbaan project
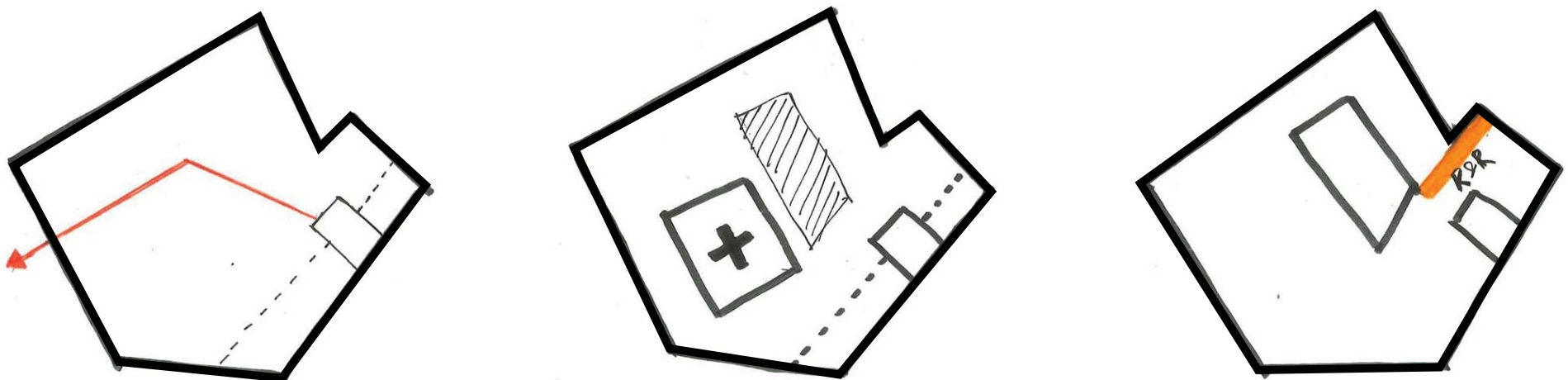

Figure 41: Entrance area, location and action points. (made by author)

Figure 42: Undeveloped area in front of LUMC.
(made by author)

Living

This is the area where education and living come together. The Hogeschool Leiden is located in this area, just as the two student housing complexes. These student complexes are the only residential facilities in the area, there are no other residential facilities. Next to the Hogeschool some older university buildings are located. These buildings are clustered and focused on their own. They are secluded from the rest of the buildings in this area. Nowadays most of these buildings are vacant and no longer used. According to den Heijer (2011) student housing is an important function for universities. This area is close to the station and the fact that there are already 2 housing blocks make this an interesting location for more residential facilities.

Therefore the action point for this area is to develop it into an attractive lively residential area for students.

Actionpoints
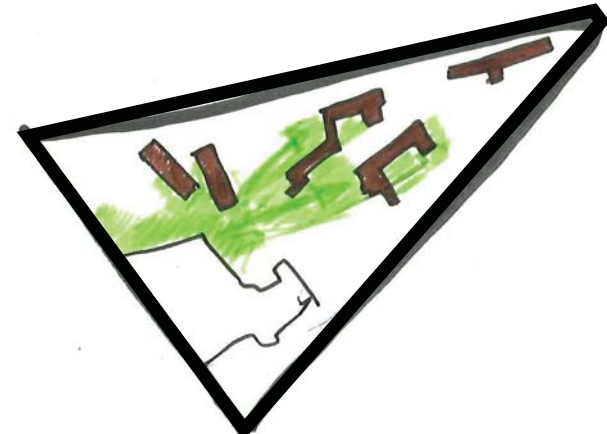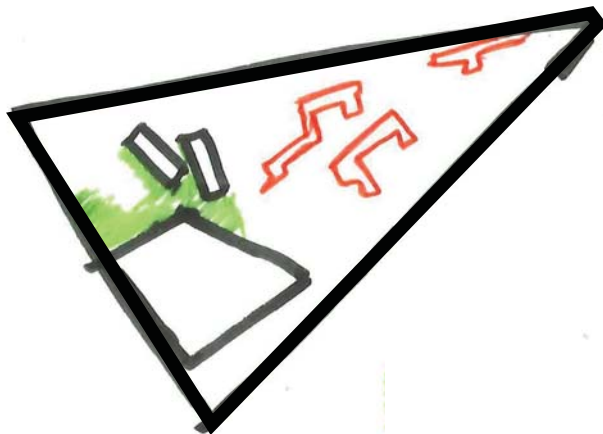- Develop into a lively residential area for students

Figure 43: Living area, location and action points. (made by author)

Figure 44: Hildebrandpad, student housing.
(made by author)

The Island

The companies situated on the Bio Science Park are mostly located in this area. The companies differ from multinationals to new start-up companies. A lot of companies are secluded and work on their own. The water divides the area into three parts, these are therefore fragmented from each other. This fragmentation makes the different parts more on their own. There is a lack of places where people can interact. Places where people can interact and meet with each other are important for innovation. There are almost no places where the so called local buzz can arise.

The Beta Block

The faculties of science and mathematics of the University of Leiden are located in this area. These faculties work as interaction environment for students in the life-science sector. Next to the science faculty, the University Sport Centre is located. This area attracts students not only during working hours but also in the evening and in the weekend. This sport centre is intended for specific use. The rest of the public space lacks quality. So students are not invited to use this public space in their spare time. The area looks outdated comparing to the rest of the Bio Science Park.
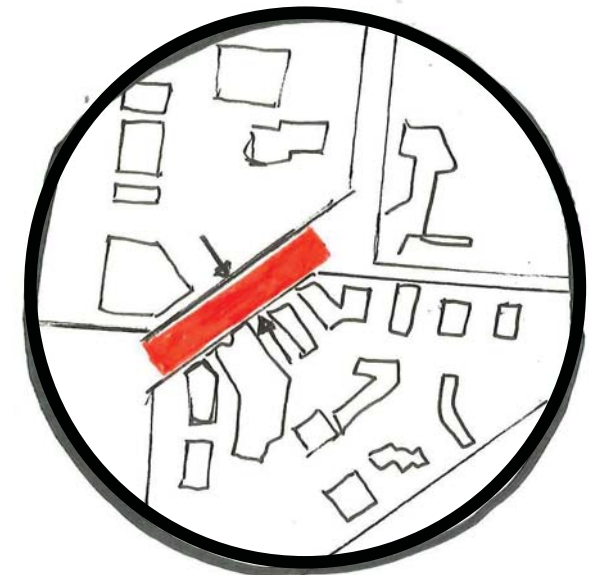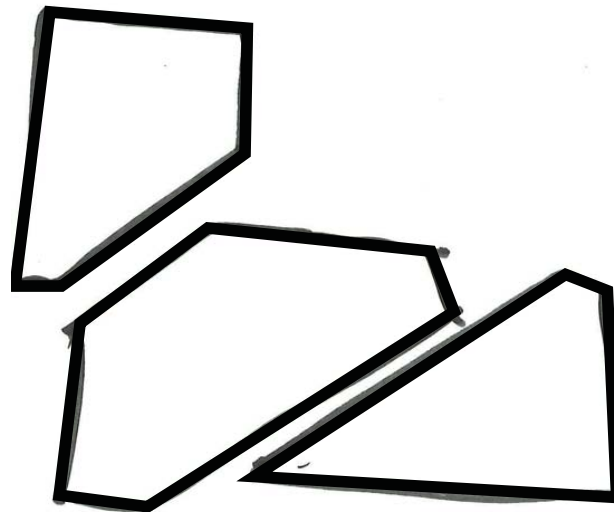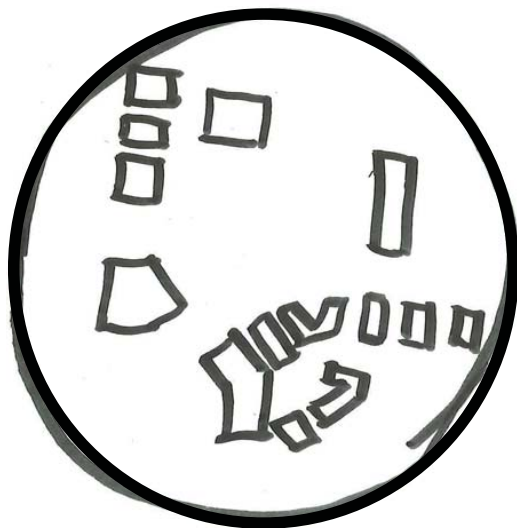

Figure 45: Island, company location. (made by author)

The Open Field

The last subarea is the undeveloped area of the Bio Science Park. The undeveloped area on the right side of the highway was the former location of the University Sport Centre. The left side of the highway was used for temporary student housing. Both functions are removed or replaced. The undeveloped areas don't give the park an attractive image. They are close to the highway which is one of the entrances to the park. This highway works also as a barrier between the two undeveloped areas. To make the area more attractive these undeveloped areas need to have a new function.

To let these three areas work as a whole, several action points needs to be carried out. The fragmentation in the area needs to be reduced. Interaction between the different users must be stimulated. And the open field needs to be developed into an attractive working environment for new companies. These action points should resulted into interventions that let these three subareas work as a whole.

Actionpoints
- Reduce fragmentation in the area
- Stimulate interaction between the different users
- Create an attractive working environment for life-science companies of multiple sizes
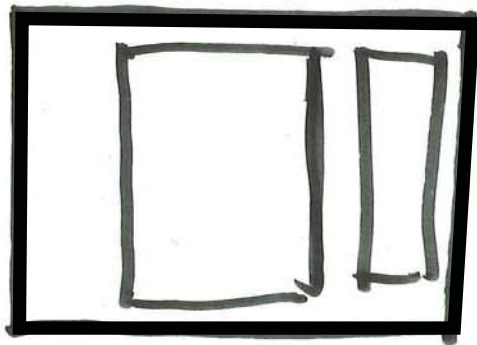

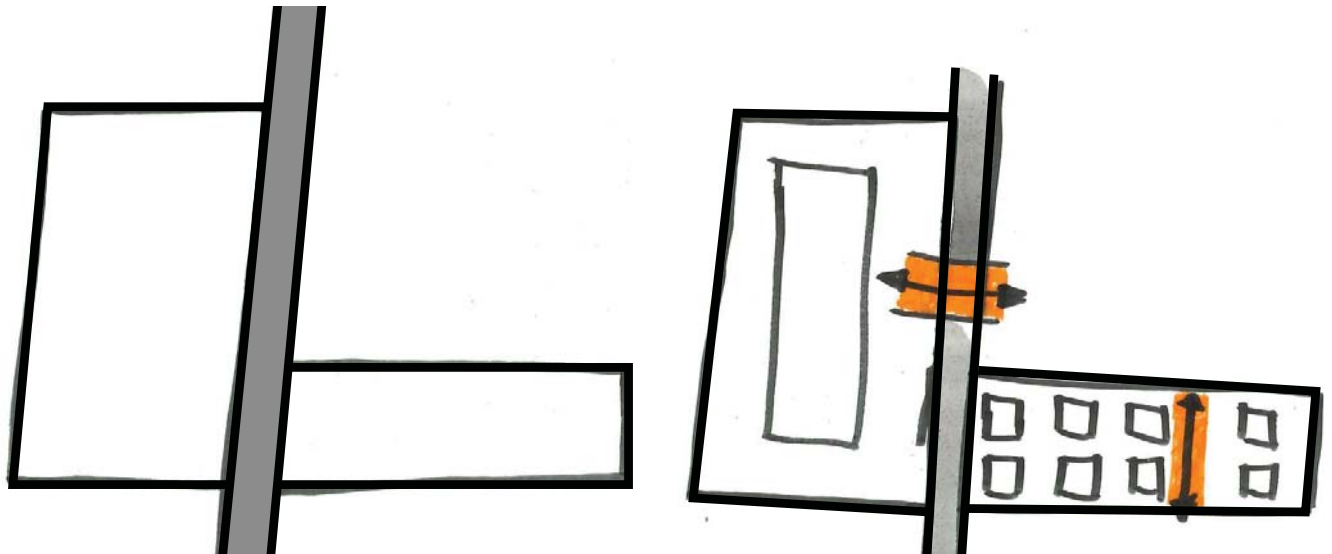**Figure 46:** Beta Campus, scheme of location. (made by author)

Figure 47: Open field, location and action points. (made by author).

Figure 48: Secluded parking space next to office building. (made by author)

Figure 49: Gorlaeus building, Science faculty (made by author)

Figure 50: Undeveloped area in the Oegstgeest area. (made by author)
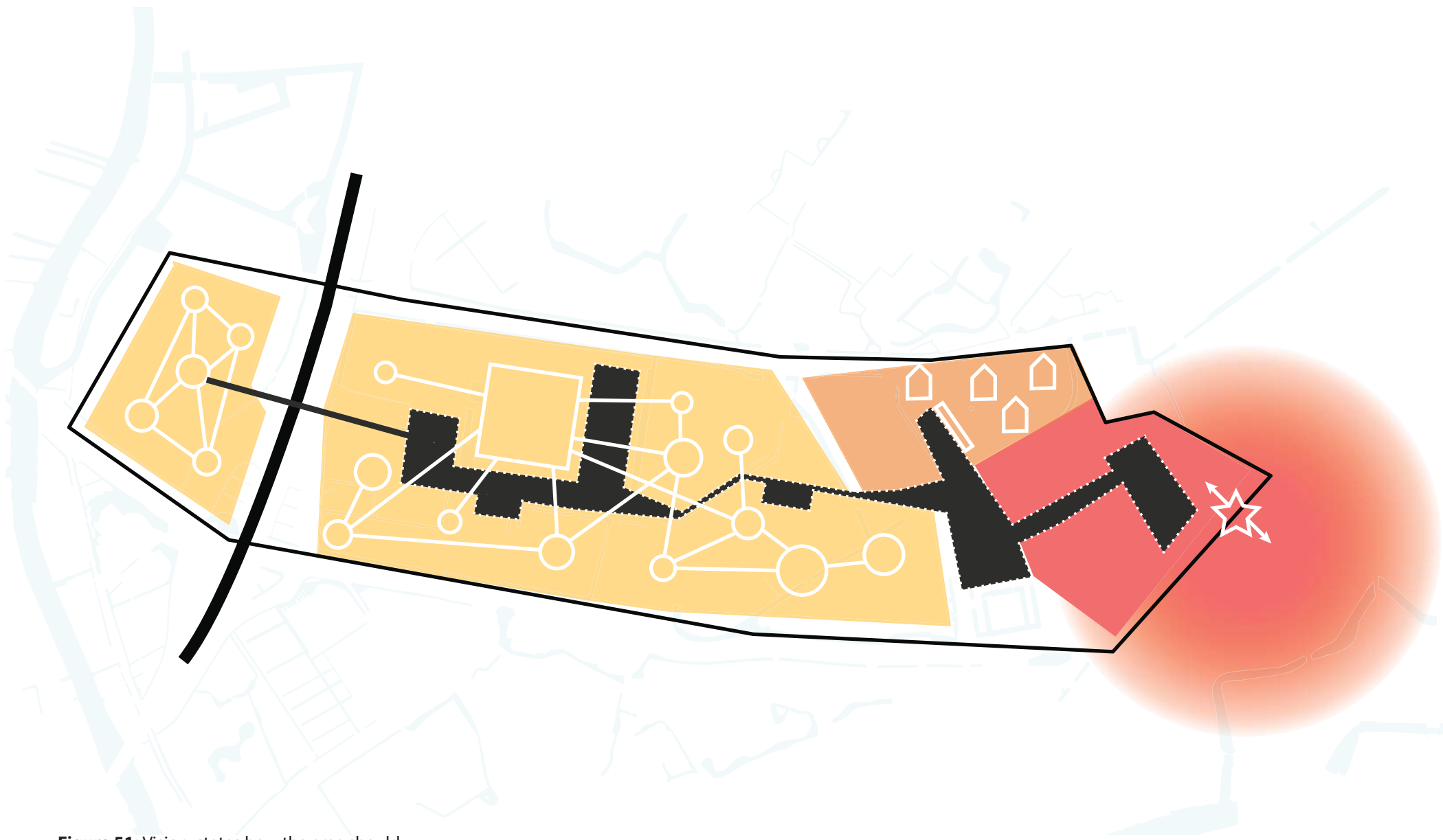
Part 4

Figure 51: Vision, states how the area should work in the future.

Vision

The vision for the Bio Science Park will show how the location in the future should work. Nowadays, the area works as various subareas that work on their own. These parts are described in the previous chapter. The action points mentioned in this chapter are the base for the new vision of the Bio Science Park

The vision exists of a station area which nowadays is focused on the city centre side. In the future, the station area should work as one area around the station. The station can be seen as a part of the city centre. Not only the side that focuses on the city centre side, also the LUMC side will be part of the city centre. In the future there is no front and back side of the station but two equal sides of high quality, both part of the city centre.

The area with old university buildings will be transformed into a living area for (international) students. This area is close to the university, hogeschool, train station and city centre and is therefore an interesting area for student housing.

Most of the Bio Science Park area will be used by life-science companies. These companies should have a lot of interaction with the science faculty of the university. The vision states that these interaction needs to be facilitated in this area. Also a new site for more life-science companies needs to be developed. This will be done at the site of the former sport centre. The area on the left of the highway can be used for further expansion when the vision is a success. When this is needed, relations and connections with the other side should be made.

To connect these areas together so that they can work as a whole, a strip through the area is made. This strip will give the subareas in the Bio Science Park the same character and will work as a backbone. It is based on the open public space where interaction can take place. It should connect the new facilities where interaction can take please with each other.

To let the Bio Science park work as described in the vison, some interventions needs to be made. These interventions are based on the action points described before. For every subarea specific interventions are made and they will be further explained. These interventions will be shown in the design of the new masterplan for the Bio Science Park.

Station area

The station area is the main entrance by public transport. A lot of train passengers have the Bio Science Park as their destination. But this side of the station is seen as the back side and therefore less attractive than the side of the city centre. To get a better connection between the Bio Science Park and the city centre, both sides of the station needs to be of high quality. This will result into a station area where not only one side is part of the city centre, but two equal sides which are both part of the city centre. An attractive high quality Bio Science Park side of the station will make this area also part of the centre.

To create a second front side of the station, this area needs to be of high quality. The undeveloped area in front of the station must be developed into an attractive area where people want to stay. According to the Stedenbaan project the station area will transform into a high quality station area with high quality public space. By anticipating on the Stedenbaan project, the station area will become an attractive third place where people can meet and interact with each other. The Stedenbaan project provides an improvement of the public space and accessibility of the station area. Increasing the density by adding new business locations is also part of the Stedenbaan project.
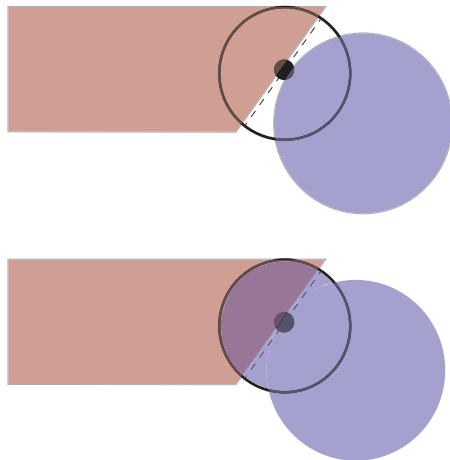

Figure 52: Diagram of the current situation (above) and the new situation(below) where the station area is part of the city centre. (made by author)
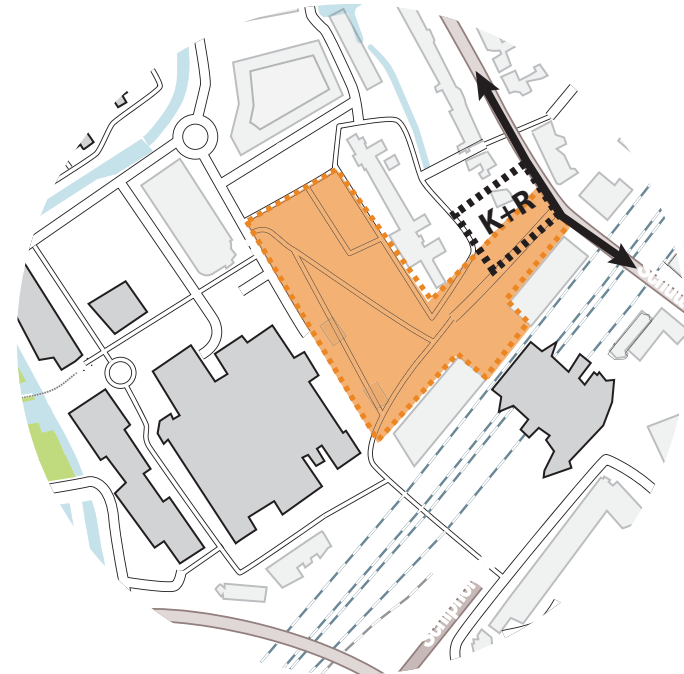

Figure 53: Current situation of the station area, location where the interventions could be implemented. (made by author)

Goal:
Develop the area into an attractive second front side and part of the centre, according to Stedenbaan project

Interventions:
- High quality public space with a third place where people want to stay
- New office locations, according to Stedenbaan, which shapes the public space
- More parking places for kiss and ride to improve the accessibility of the station area by car
- Direct connections for slow traffic from the station towards key locations in the station are

To create an attractive station area, the undeveloped area in front of the LUMC needs to be developed and improved. Attractive in this case means a place where people want to stay and a place they want to use. To create such an area, third places are important. According to the Stedenbaan project, new office locations are added. These buildings will give shape to a park in front of the hospital. This park will give the station area a more attractive character. A small place where people can sit will strengthen this. As mentioned before, a park is also seen as a third place where people can meet. By adding new office locations and a high quality park, more people are attracted to the station area.

The station area is also an area from where people go to other destinations on the Bio Science Park. Therefore good connections for slow traffic is needed to key locations. Direct footpaths towards the LUMC, office buildings and other locations are important to create a better accessibility for slow traffic.

Figure 54: Pedestrian area close to hospital, part of the strip. (made by author)
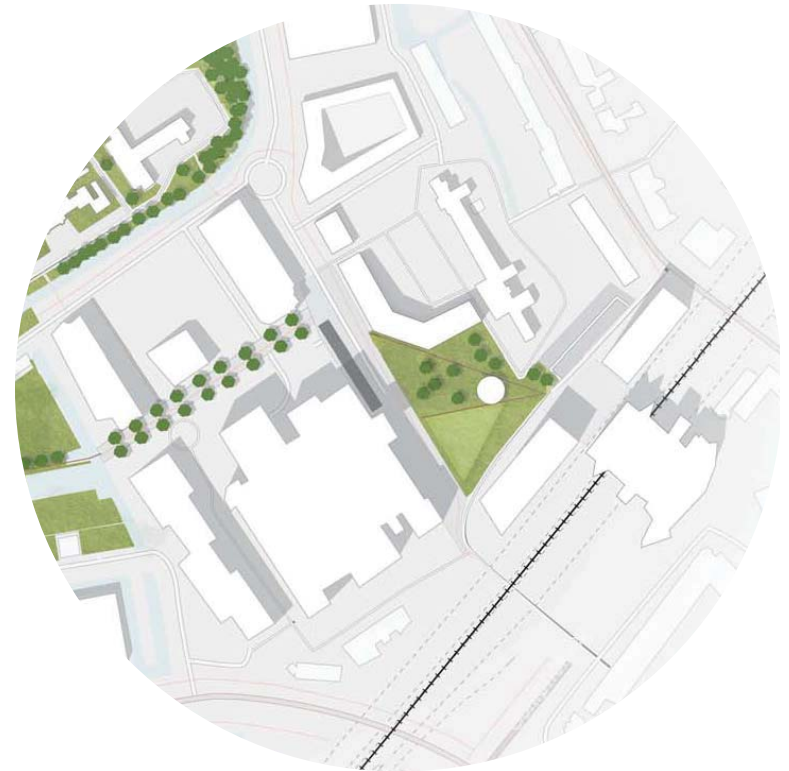

Figure 55: Design station area. (made by author)

Figure 56: Program station area. (made by author)

Leiden Central station

LUMC, academic hospital

Supportive office

Retail facility

P   Parking place for kiss and ride

Figure 57: Visualization of the park designed in front of the LUMC. A new office building shapes this third place.(made by author)

Living area

This area lies close to the university science faculty and due to the shortage of student housing in the city, this is an interesting place to create new student housing. There are already two student residential blocks and some vacant buildings. Den Heijer (2011) stated that student residential functions are important for universities. If the Bio Science Park wants to switch from a science park to a campus, these residential facilities are needed (den Heijer, 2011). Especially international students want to live close to the faculty because their social contacts are based on the university. Ekkelboom (2008) stated that not only residential facilities are important but that also retail facilities are from great importance for a campus. Such facilities will let the area not only be used during working hours, but also in the evening and in the weekends.

So this area needs to be developed into a lively residential area for students. Therefore new residential facilities needs to be added. This can be done by reallocate the old vacant buildings or by replace them for new buildings. The area will be livelier when also retail facilities are added. At such third places students can meet each other.

Goal:
Develop into a lively residential area for students

Interventions:
- Reallocate old buildings into student housing
- Add new student building blocks
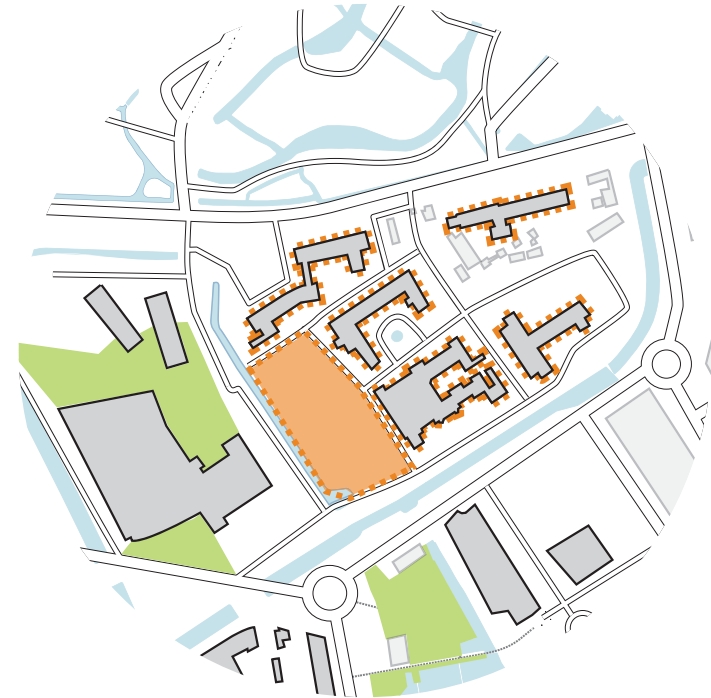- Public garden with retail facility where students can meet

Figure 58: Current situation of the living area. (made by author)

Figure 59: Old vacant TNO building. (www.dtz.nl)

To create a lively residential area for students, both new residential as retail facilities need to be implemented. Therefore the old vacant buildings are reallocated into new student houses as indicated by den Heijer. These old buildings will be accompanied by new housing blocks to reduce the shortage of student houses in Leiden. One old building will be removed to create a better green connection with the Bos van Bosman in the north. A public garden will connect this Bos van Bosman with the Naturalis park. The new building makes this connection possible where the old building blocked this connection.

Ekkelboom mentioned that retail facilities make a campus more lively, therefore a third place, with the function of an espresso bar, will complete this public garden. Den Heijer (2011) stated that espresso bars are very popular at every Dutch university. The public garden together with the espresso bar is the place where students can meet and interact with each other.

Figure 62: Design student living area. (made by author)

Figure 63: Program student living area. (made by author)

New student housing
Shared facility, espressobar
Education

Figure 60: New student housing block with facility in the plinth. (www.heren5.nl)

Figure 61: Public garden for the student living area. (www. untourscafe.com)

Figure 64: Visualization of the espresso bar and public garden. (made by author)

The Collective

The collective area is the name of the area where all life-science companies and the science faculty of the university are located. The area should work as a whole, with relations between the different companies and the university. Therefore places for interaction need to be facilitated. In such third places different knowledge workers and students can meet and interact with each other. Bathelt et al. (2004) stated that such places can provide local buzz which can result into innovation. This makes the area more attractive for other life-science companies to settle in this area as well.

These new companies can settle in the undeveloped area where the former sports fields of the sport centre were located. The sport entre is moved next to the science faculty. The undeveloped area needs to become an attractive working environment for these new companies. To maintain life-science students in the area, a shared facility for new start-ups and spinoffs can be of great importance. At such a shared facility different companies are sharing one building, which can also result in interaction.

Goals:
- Facilitate possibility for more interaction between companies, visitors and university
- Develop the undeveloped area into a work environment which connects with the rest of the area

Interventions:
- Add a facility where different users come togehter for different purposes like lunch, meetings and appointments
- Add shared incubator building for start-ups, spinoffs and students
- Remove gates at existing buildings
- Add new entrance to new business location

Figure 66: Current situation of the Collective area, a place where new company space can be developed. (made by author)

Figure 65: Erasmus pavilion located at the Erasmus University Campus. Reference for the Pavilion. (www.rotterdamarchitectuurprijs.nl
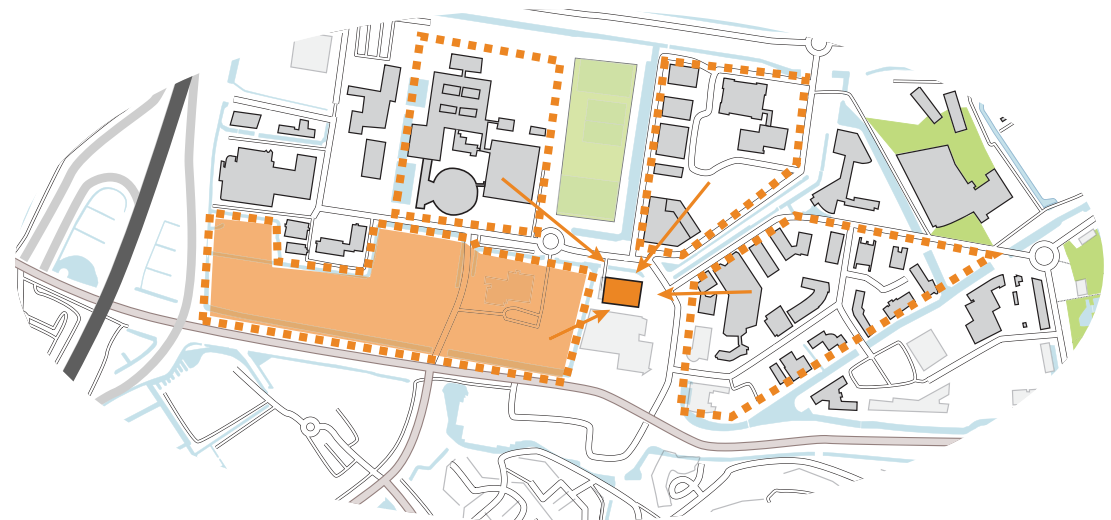
The undeveloped area of the former sport centre will be developed into an attractive business location for new life-science companies. Close to the university faculty a new large incubator for start-ups, spinoffs and students is added. The rest of the new company buildings are located in a green environment. The spaces between the company buildings are green fields which makes it more public. To prevent seclusion the plots doesn't have fences or gates. The users will park in a shared parking facility which is located at the entrance of the area. This will make the area car free which results in more street life.

A shared retail facility, the pavilion, is a new third place which should improve the connections and relations between the different users of the Bio Science Park. It is the main location where students, scientists, knowledge workers and visitors can meet in an (un)official way. This facility must provide more face-to-face contact between these users. Therefore this facility must be attractive to go to. Specific regulation for new life-science company buildings will attract knowledge workers not only for leisure but also for work reasons. These new companies are enforced to use this building for their meetings. This shared retail facility will not only provide local buzz but will also provide a more lively campus area.

If the new Bio Science Park is a success, more and more companies want to settle in this knowledge location. Therefore the location on the other side of the highway can be used as expansion area. When this is needed, a new viaduct has to be made under the highway to get a better connection with the other side. Also for this area an attractive working environment needs to be created.

Figure 67: Program new company area. (made by author)

Figure 68: Design for new company area. (made by author)

■ Education
■ Life-science companies
■ University Sport Centre
■ Shared parking facility
■ The Pavilion

The new company location at the collective area have to have some regulations to give the area more structure. Therefore different plots are made with specific regulations. It is important for developers to know where they can build and what the alignment is. For some places the building type is already stated, because they have a specific function in the masterplan. So can only one building be built on the plot of the incubator facility. Also the plot close to the highway is bound by rules. This plot is intended for a multinational in one large building. The figure at the bottom shows the plots with alignments and where the entrances of the buidling should be located. The spaces between the different buildings should be a green field to create an open character of the business location.
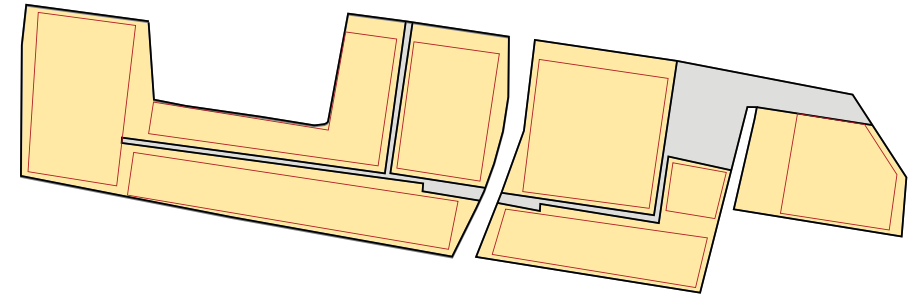

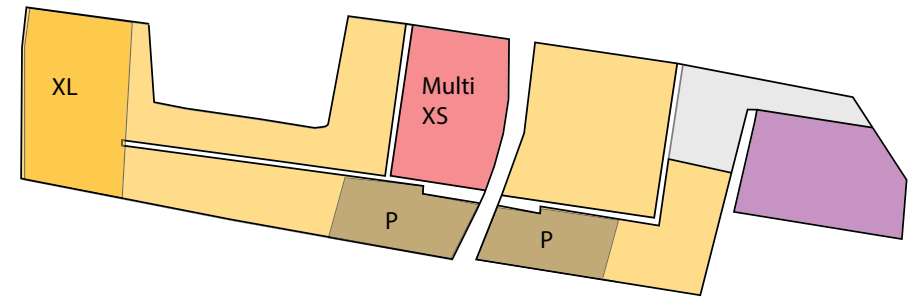**Figure 69:** Construction area with alignments. (made by author)

Figure 70: Program of construction area. Some plots have specific regulation. (made by author)
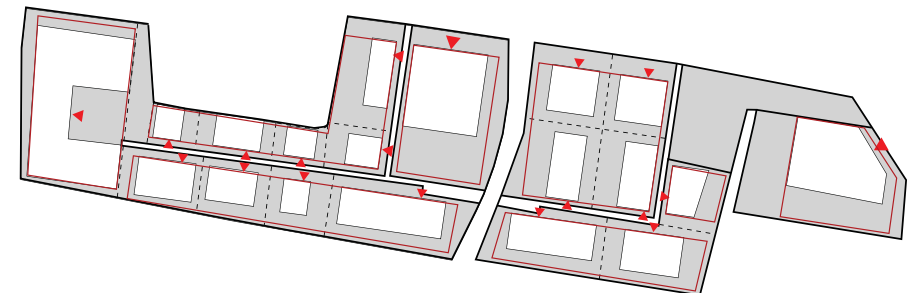

Figure 71: Plots with alignments, examples of buildings and entrances.(made by author)

Figure 72: Visualization of the pavilion in its context. Retail facility where companies can have meetings. (made by author)

The Strip

The Leiden Bio Science Park is developed in different stages, therefore it has not got the same identity and character through the whole area. It results in the fact that some of the public space lacks quality. The Strip is a diagrammatic strip through the area of high quality public space. This strip should provide the same identity of the public space. It also connects the three different subareas with each other. The different third and public places which are part of the subareas are also part of the strip. These places are connected to each other by using the same material, greenery and furniture on the strip.
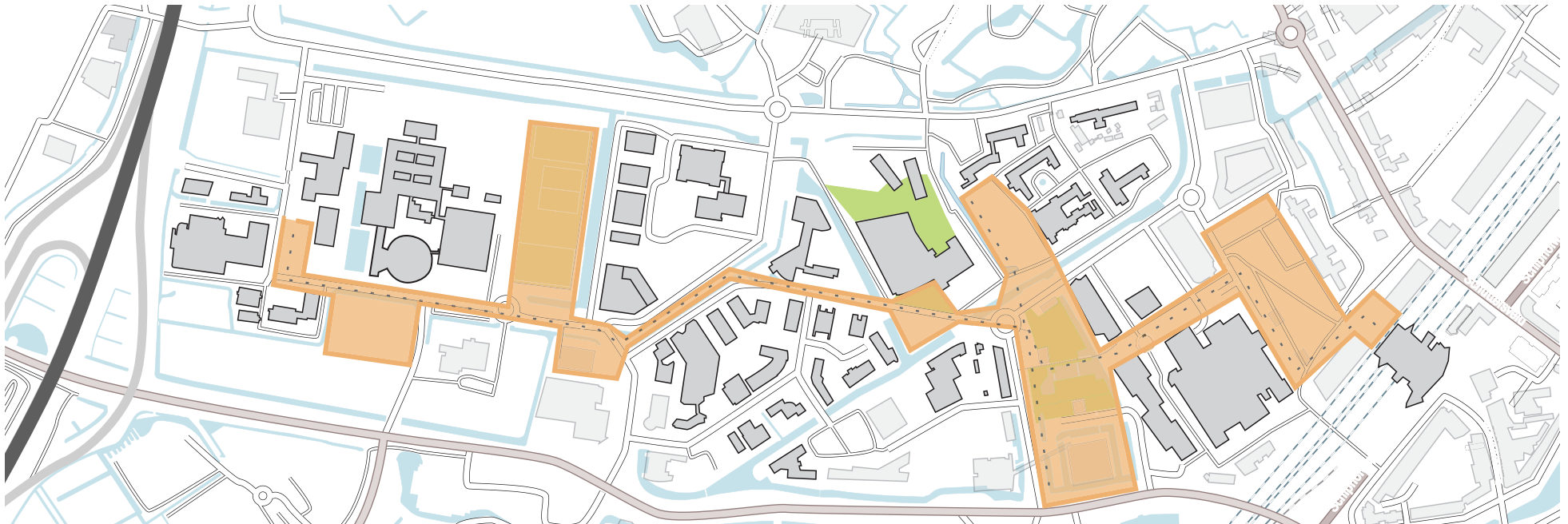
Goal:
Connect the places where people can interact in such a way that they have the same character

Interventions:
Add same looking furniture, material or greenery in the strip area to give it the same identity and to fall back on

Figure 73: Diagram of the Strip, area of public spaces which connect shared facilities. (made by author)

The strip can be seen as an area of high quality public space which connects the interaction places with each other. This high quality public space has the same character and give the area the same appearance. In this high quality public space the same looking streetlights, benches and trees are used. These street furniture and greenery differ from street furniture and greenery in areas outside the strip. The strip goes across the whole area, whereby it connects the different subareas with each other. Previous mentioned interventions which are based on interaction and meeting each other, like the pavilion, incubator and the espresso bar are part of this strip.

University Sport Centre

Incubator

The Pavilion

Espresso bar at public garden

Office building

The Lane
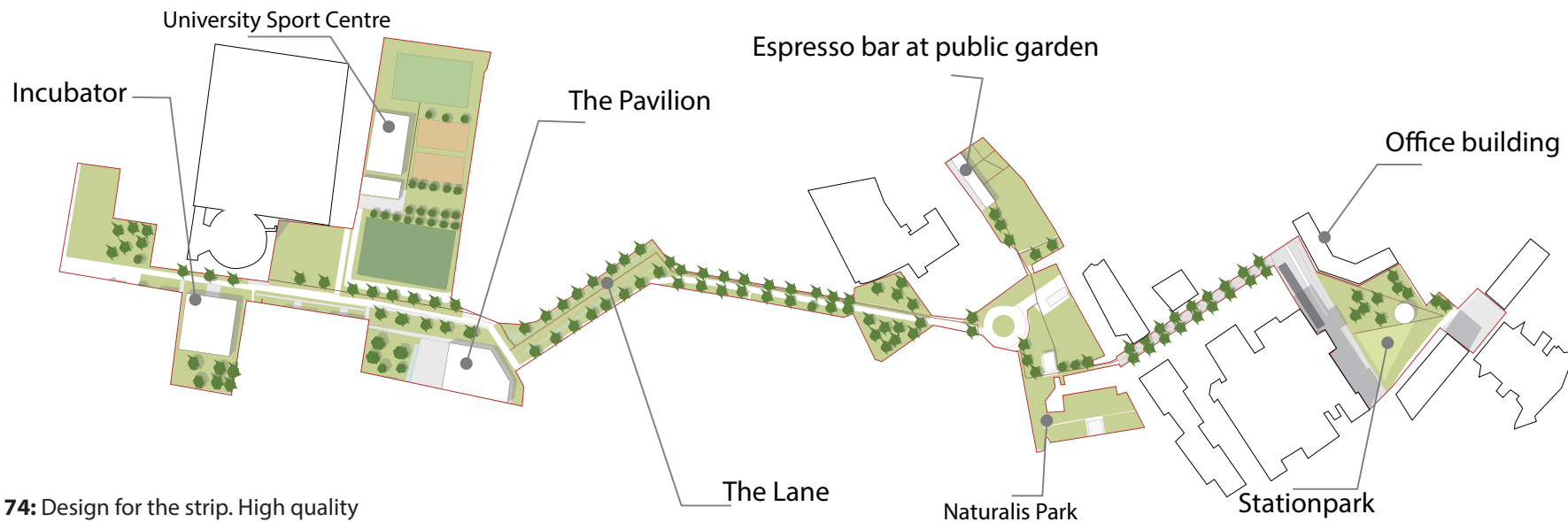
Naturalis Park

Stationpark

Figure 74: Design for the strip. High quality public space as connector between different third places. (made by author)

The strip connects the different public spaces with each other. These public spaces have a different program. The public spaces which are connected to the strip are the new incubator, the university sport centre, the pavilion, the public garden with espresso bar, the Naturalis park, the pedestrian area in between the hospital buildings and the new park designed in front of the LUMC.

These different places have to be easily reached. Therefore the places are direct connected with each other by a footpath that goes from the station to the other side of the area where the incubator is located. Also a lane goes through the strip to connect the places by car. This lane can be reached by multiple brances, most of them from the south side of the area. The entrances of the third and public spaces located at the strip are all faced towards the strip to make them better accessible.
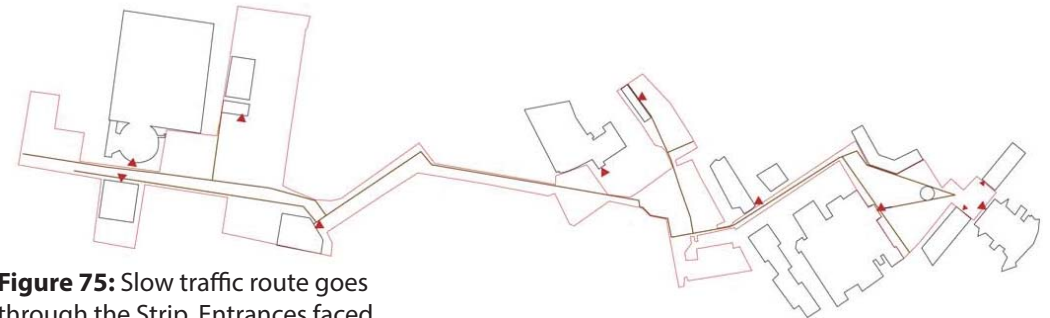

Figure 75: Slow traffic route goes through the Strip. Entrances faced to the Strip. (made by author)
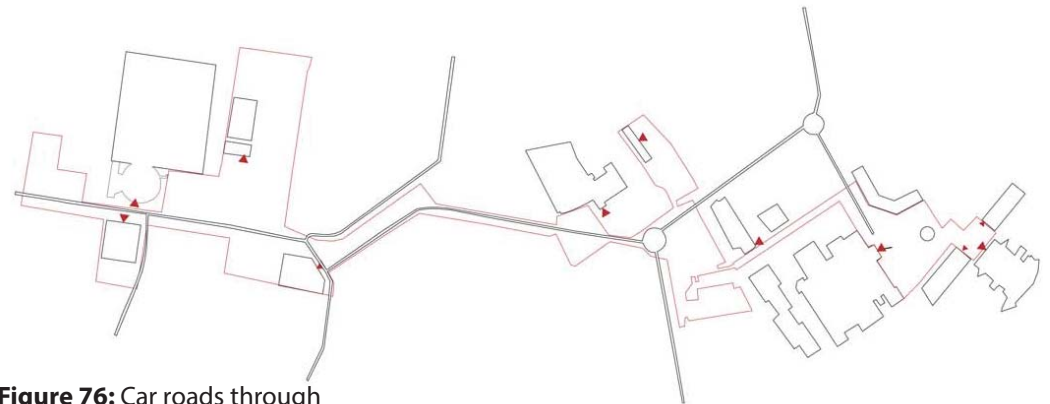

Figure 76: Car roads through the Strip with multiple brances. (made by author)
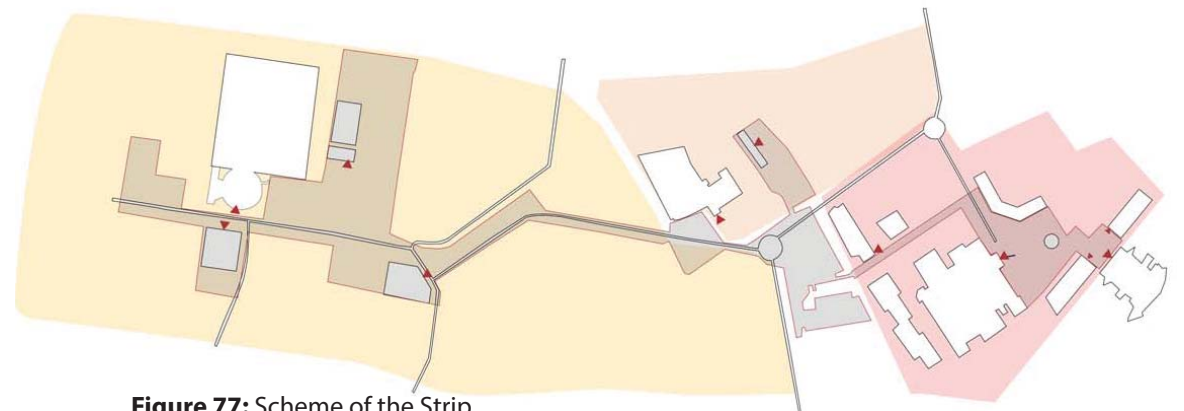

Figure 77: Scheme of the Strip combined with the vision for the area. (made by author)

Overview interventions

The different interventions described before result into a new masterplan for the Leiden Bio Science Park to make it a more attractive innovative life science campus. The table gives an overview of the relations between the described action points of the five subareas, and the design interventions. These interventions should result into a masterplan that meets the stated vision.

Figure 78: Table with relation between action points and interventions. (made by author)

Sub area	Action points	Interventions
1) Entrance	Develop the area into an attractive second front side and part of the centre, according to Stedenbaan project	Create high quality public space Add new office buildings Add parking facilties for kiss and ride Direct footpath to improve passage function of area
2) Living area	Develop into a lively residential area for students	Reallocate old buildings into student housing Add new student building blocks Public garden with retail facility where students can meet
3) Island 4) Beta Block 5) Open Field	Reduce fragmentation in the area Stimulate interaction between the different users Create an attractive working environment for life-science companies of multiple sizes	Add a facility where different users come togehter for different purposes like lunch, meetings and appointments Add shared incubator building for start-ups, spinoffs and students Remove gates at existing buildings Add new entrance to new business location

Masterplan

The new masterplan transforms the Leiden Bio Science Park from a business area, where almost no interaction takes place and where companies work mostly on there own, into an attractive lively science campus where people do meet each other. The new implemented design interventions improve the business location into an area where people can meet and interact with each other. This interaction between different users on the new campus is called local buzz and can stimulate innovation. The new retail facilities which brings liveliness on the campus and the possibility of innovation should attract more companies to this location.

Figure 79: Map of the current situation of the Leiden Bio Science Park. (made by author)

Espresso bar at public garden
facilitates interaction

Student housing
7 buildings
1500+ rooms

University Sport Centre

Incubator
shared building
multiple start-ups

The Pavilion
facilitates interaction

Office building
Stedenbaan

Company area
multiple life science

The Lane

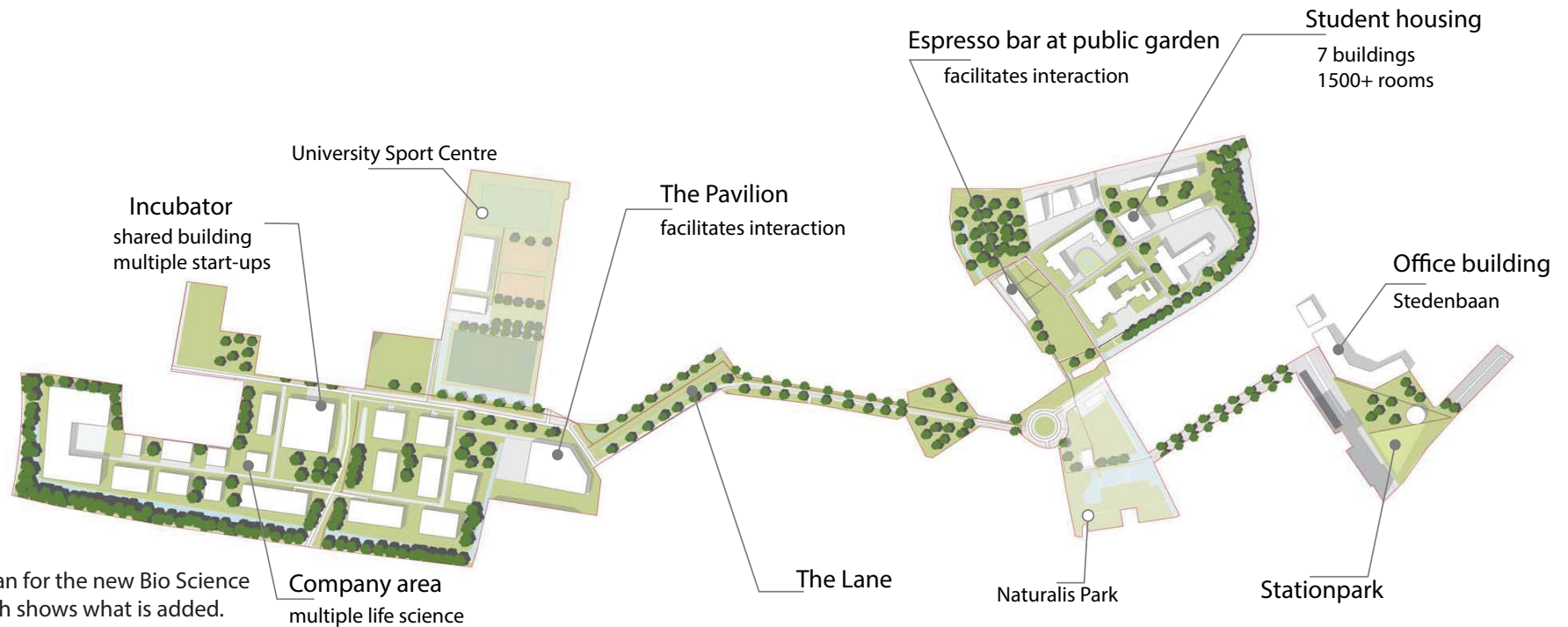Naturalis Park

Stationpark

Figure 80: Plan for the new Bio Science Campus which shows what is added. (made by author)

89

Masterplan

Figure 81: Spatial design for the Leiden Blo Science Park.

Part 5

City scale

As said before, the Bio Science Park is located on the other side of the train station than the city centre. Due to the transformation of the station area, both sides are equal and of high quality. The whole station area can be seen as part of the city centre. This high quality station area is now part of the centre and part of the science park. It works as a connector between both of them. Several passages goes underneath the railway to make this connection. The station itself is one of them. So the station area ensures that the Bio Science Park is not secluded from the city, but that it is well connected with the city centre.
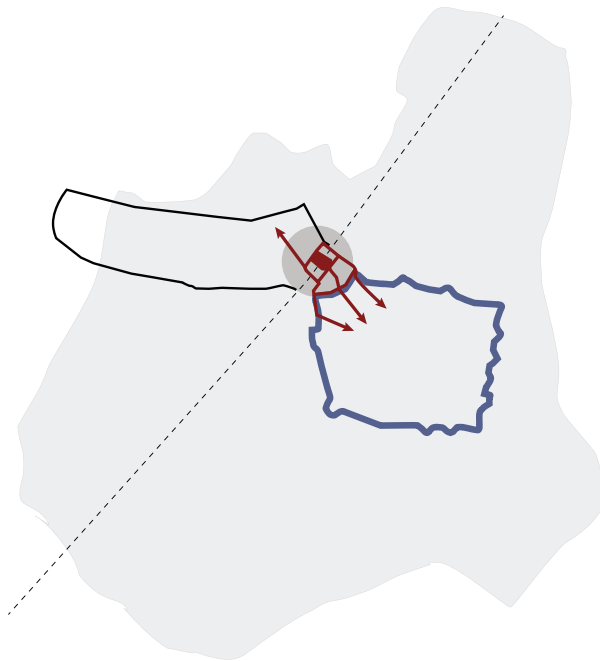
Regional scale

The Randstad can be divided into two parts, the Zuidvleugel and the Noordvleugel. Leiden is part of the Zuidvleugel, but because it is located close to Schiphol Airport It is sometimes stated as part of the Noordvleugel as well. Therefore Leiden can work as a kind of link between both parts of the Randstad. In the knowledge axis of the Zuidvleugel, Leiden can be seen as the head. But if we look to Leiden as a link between Noord- and Zuidvleugel, it can be seen as the centre of knowledge locations in the Randstad. Not only georaphically but also after the transformation it made to the main life-science cluster.

Figure 82: Bio Science Park is well connected with city centre due to the transformed station area, which work as connector. (made by author)
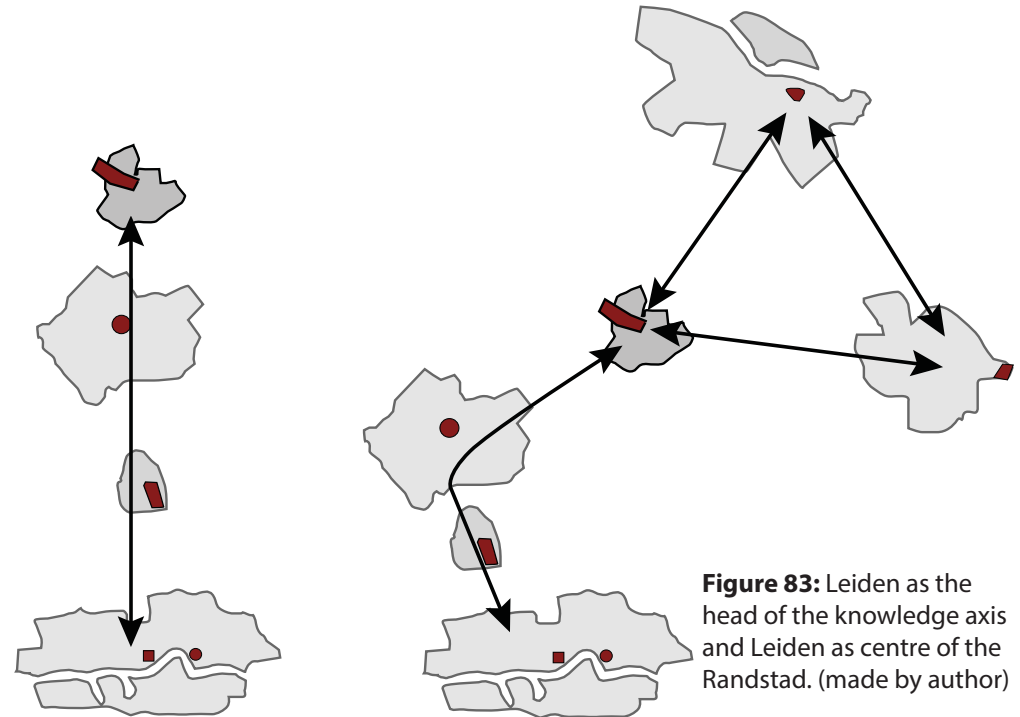

Figure 83: Leiden as the head of the knowledge axis and Leiden as centre of the Randstad. (made by author)
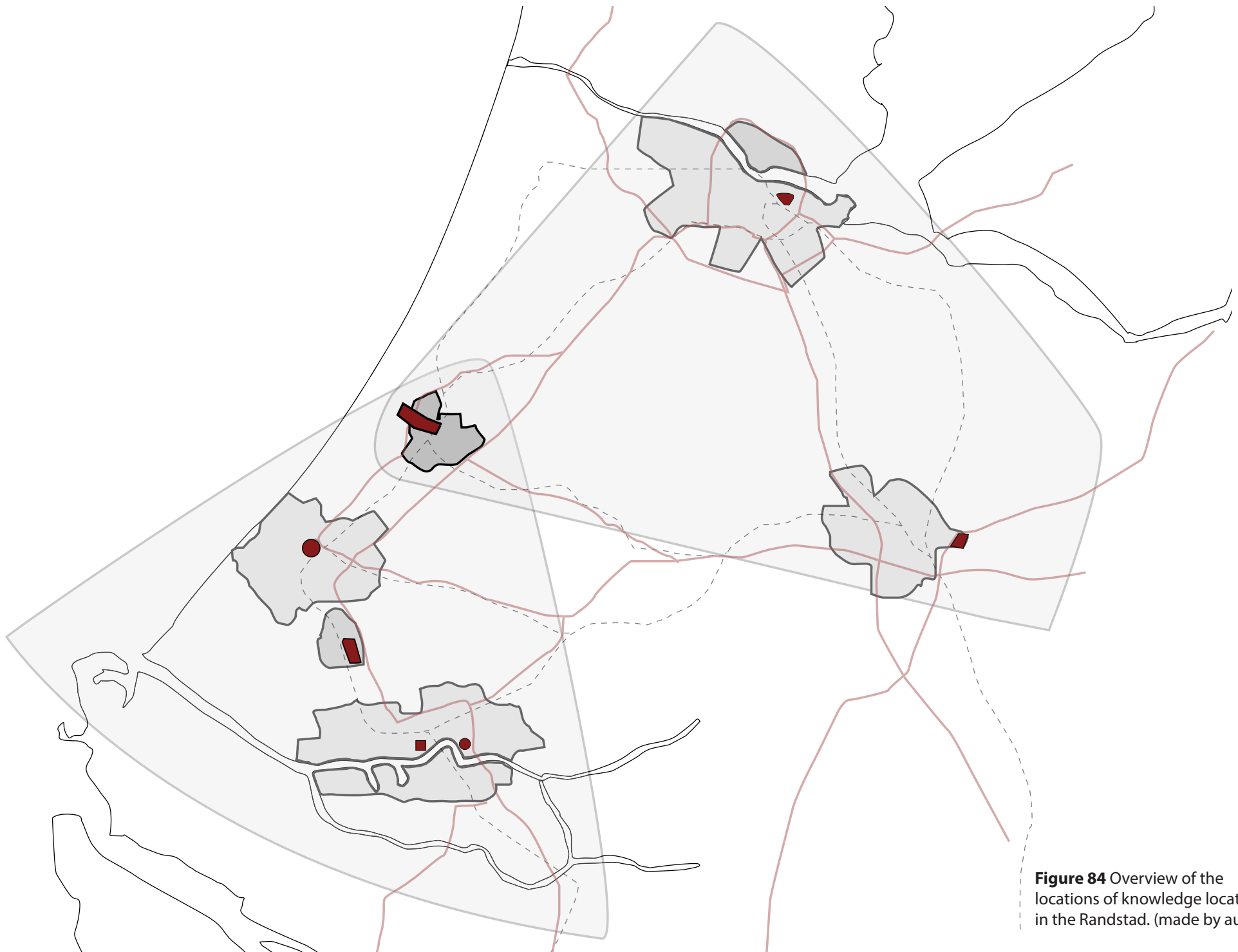
Figure 84 Overview of the locations of knowledge locations in the Randstad. (made by author)

Regional scale

The improvement of the Leiden Bio Science Park will not only have consequences for the area itself but will also have consequences for other cities in the knowledge axis. By improving the Leiden Bio Science Park, the area will work more as a life-science campus. The campus will be an attractive working environment where people can interact which stimulates innovation. Innovation is quite important for the life-science and health sector. The improvement will cause a growth in the number of life-science companies. It will attract more knowledge companies and knowledge workers. The knowledge base of the knowledge cluster in Leiden will grow.

This will also have effect on the scale of South Holland. Other knowledge locations in the knowledge axis can benefit from the growth of the Bio Science Park. As mentioned before, knowledge generated in a knowledge location can be used in another knowledge location (global pipelines). So the innovation developed in Leiden can for example be used in Delft or in the Greenport. Due to the knowledge spill over, they benefit from the growth of Leiden and can therefore grow as well.

Figure 85: Spatial view knowledge axis now(above) and in the future (below). (made by author)

The knowledge axis is a concept for the Zuidvleugel of the Randstad. But the attraction of knowledge companies, knowledge workers and relation with other knowledge location doesn't have boarders. Leiden lies close to Schiphol and is therefore an interesting knowledge location. It can be seen as the link between the Zuidvleugel and the Noordvleugel. Leiden will also have relations with other knowledge locations, not only in the Zuidvleugel.

Where the knowledge cities in the Zuidvleugel have different specializations than the knowledge cluster of Leiden, the cities in the Noordvleugel has science parks with the same specialization. They work competing with the Bio Science Park, they also want to attract knowledge companies to their location.

After the improvement of the knowledge cluster in Leiden it should grow as knowledge cluster and become the main life-science cluster. This can ensure that life-science companies in Amsterdam or Utrecht are moving towards the more innovating knowledge location in Leiden. This can happen because the Bio Science Park is more innovating and have better connections with other knowledge locations such as Delft and Rotterdam. But this is more hypothetical, there are also other points that must be taken into account.
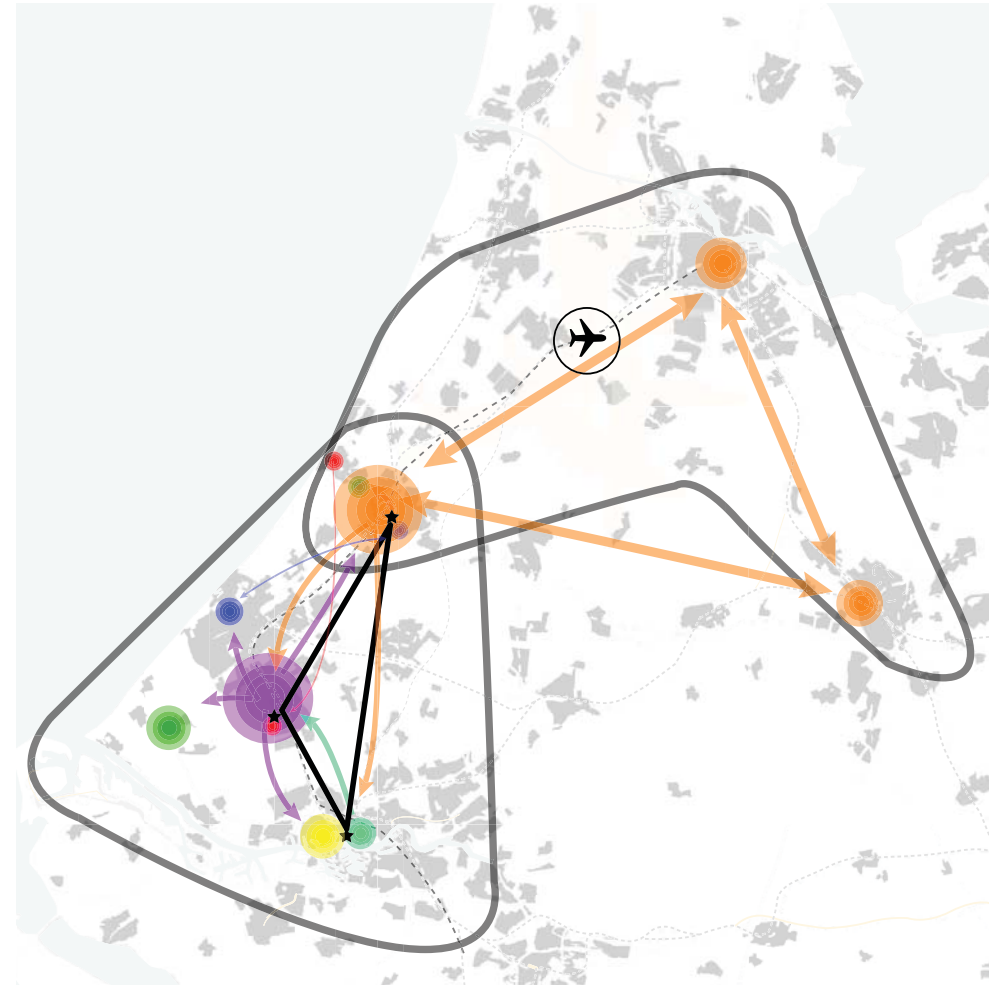

Figure 86: Leiden as centre in the Randstad, link between south wing and north wing.

Part 6

Conclusion

The aim of the graduation project was to develop an urban strategy for the Leiden Bio Science Park making it more attractive for innovative life-science companies and knowledge workers to settle in this area. To get to this aim it is important to know how the Bio Science Park needs to be developed into the main life-science cluster. Therefore the conclusions stated from the theory is applied for the case of Leiden.

Theory
To give answer to this question a theoretical framework is set up. This framework gives a better explanation of what a city in the knowledge economy exactly is. Economic geographical theory is used to describe what the conditions are for a good knowledge city. It is stated that there are several characteristics, of different weight, which a city has to meet. The knowledge base and economic base are the most important characteristics for a city in the knowledge economy, they tell what the sort of specialization of the knowledge cluster is. A knowledge city houses a knowledge location where specialized companies are clustered in an area. Carvalho (2013) stated that a knowledge location is a planned area-based initiatives that is aiming on agglomerating knowledge-intensive activities in a designated area. Science parks and campuses are examples of a knowledge location and form the base for the graduation project.

Science parks and campus differ in the way of facilities. Science parks don't have leisure and retail facilities, where campuses do have them. For innovation it is important that people meet and interact with each other, that they have face-to-face contact. This local buzz can't be created, but can be facilitated. This will mostly happen in third places. These third places can for example be retail facilities that the science parks are lacking. The theory described is tested for the case of the Leiden Bio Science Park

Analysis
The Leiden Bio Science Park is the knowledge location in Leiden that is most important for the knowledge axis. This area is a science park which is focusing on life-science. It has a strong knowledge base with the university and multiple life-science companies. It can be concluded that the area is an interesting knowledge location which is good connected with other cities in the knowledge axis. It lies close to Schiphol, which makes the area also attractive for foreign companies. But the science park lacks the possibilities for interaction, which is needed to support innovation. The area lacks facilities where people can interact, where local buzz can arise.

Due to theory and analysis I concluded that facilities for interaction were important for innovation and that these were lacking at the location. The case study of another business park, the High Tech Campus Eindhoven, gave an answer to the question where and how the same kind of issue was solved. By adding shared facilities that companies and knowledge workers must use, interaction was stimulated. Also specific rules are set up for this area, the buildings may not have own meeting and presentation rooms and they can also not have an own canteen. This stimulates the use of the shared facility. It can be concluded that this strategy can't be directly copied to every business location, but it can help as inspiration.

Design
These sub questions helped me to give an answer to the question which spatial improvements need to be done to develop the area into an attractive innovative life-science cluster. It can be concluded that the area lacks third places where people interact with each other so that local buzz can arise. These third places are the main interventions in the new masterplan for the Bio Science Park. By adding new third places

users of the Bio Science Park should be attracted to a place where they can interact and where local buzz can arise. Theory from Bathelt et al. (2004) stated that local buzz can result into more innovation. More interaction between different users can result into a more innovative area. This will make the area more attractive for other knowledge companies in the life-science sector. Therefore the new masterplan takes the growth of number of companies into account by developing a new business site on the Bio Science Park.

The university can be seen as the main knowledge base in this knowledge location. Companies are also attracted to the area because of the presence of the university. For universities it can be of importance that there are student housing close by. New residential facilities will make the area livelier, especially after working hours. A livelier area stimulates interaction as well.

It can be concluded that spatial improvements in the form of third places, which facilitate interaction and face-to-face contact, are the main interventions to stimulate innovation. Places to meet, and the innovation that can come with it, will attract more knowledge companies and workers to the area. This can provide a growth of the life-science cluster in Leiden. Looking into the knowledge axis, this can also provide a growth of other knowledge cluster on the axis, due to knowledge spill over and the relations they have with each other. Not only knowledge cities in the knowledge axis concept can benefit, but also other knowledge locations in the Randstad, because knowledge transition don't have borders. Leiden Bio Science Park can be seen as the centre of knowledge locations in the Randstad, not only geographically but also due to the transformation it made into the main attractive innovative life-science cluster. This transformation can result into a more competitive region of the Zuidvleugel and Randstand as a whole.
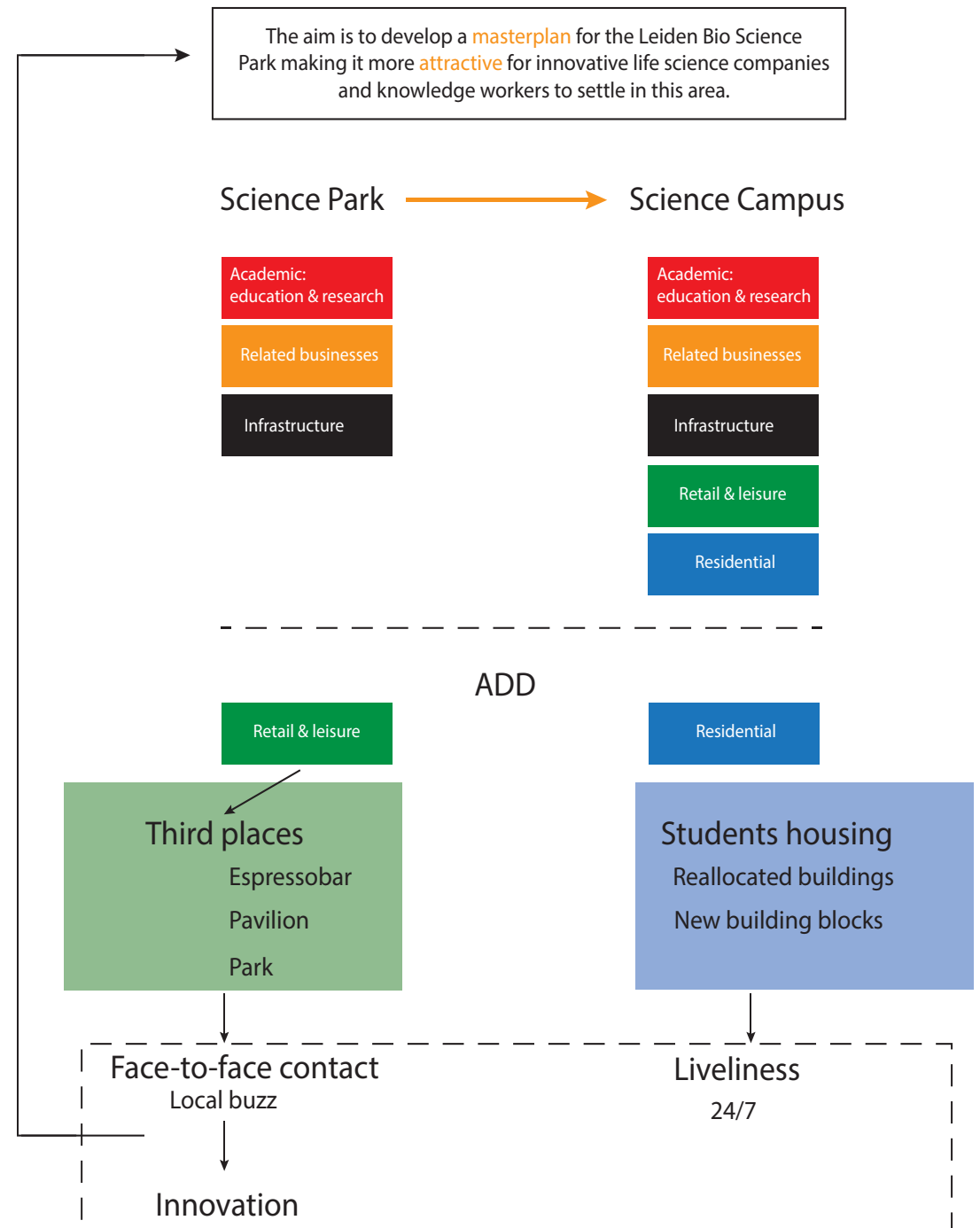

Figure 87: Schematic overview of the graduation project. What is done to meet the stated aim. (made bu author)

Reflection

Approach

The method used for the design of a main life-science innovative cluster was doing research about knowledge locations and how to stimulate innovation. These theories have been researched for the specific location at the same time. The goal was that the theoretical framework should be the basis for the analysis of the location. Only this didn't give a good enough understanding what was needed at the location. For that the area needed to be divided into sub areas. For these sub areas points of action where stated. These point of action where important to understand where the project was going to. These points of action tells how the area works nowadays and together with the vision, which tells how it should work in the near future, it was made clear what was needed into the area. For that new theory about campuses was used and together with a clear case study of the High Tech Campus it was clear how this could be achieved. For the location a stepwise description of which interventions was needed, where it could be placed and final how it fits in the location was made. This stepwise method worked well because no rash decisions were made. At the end the project was zoomed out to the knowledge axis scale. The future effects for the knowledge axis where described which are more a hypothesis.

Process

After P2 it was clear that the theoretical framework had to be expanded. More theory about facilitating interaction was needed and therefore the research period was also expanded. Also it was clear for me that the project area was more focusing on the scale of the science park instead of the scale of the city as a whole. I was a bit struggling with making the step from analysis to the design part. But making a vision which stated what the future goal of the area would be helped me very much. After that it was clear for me what was needed in order

to meet this goal. At the end, it is quite a pity that this step was made later in the project. This made the design period a bit short for P4. After P4 the design could be elaborated a bit further. This last step was crucial for the graduation project. The interventions were better linked to the described action points. Also the elaboration became more reflective instead of descriptive. The interventions that were made are better reflected to the researched theory. At the end I can say that I'm satisfied with the result. One of the goals for the project was to make an attractive, visual good looking masterplan and in my opinion I achieved this goal. I think that the interventions are well thought through and based on the used literature.

The relationship between research and design

During the project a lot of research has been done. The research forms the basis for the project. At the beginning of the graduation year a lot of reading of scientific papers is done. These papers gave a clear understanding of what knowledge locations and what the foundations of a knowledge city are. This theoretical research was the starting point for the analysis. At the end the research by analysis showed what where was needed in the project area. Research remained an important part of the design phase as well. Each design intervention was fed back to theory and theory helped me to make these design intervention. There was a constant relation between both the research and design. Especially the research by case study helped me to make specific design interventions. An example of how research and design where combined in the process is:

Bathelt et al. (2004) stated that innovation can be achieved by interaction and local buzz. A goal for the design was to facilitate this interaction. In the design phase new theory by den Heijer (2011) was needed to make an actual design intervention. In the case of this project the pavilion or the espresso bar, two retail facilities which should provide more interaction on the location.

The relationship between the theme of the graduation lab and the subject/ case study chosen by the student within this framework (location/object)

The basis for my graduation topic is the fact that the province of South Holland wants to become a better competitive region in Europe. Therefore they stated in governmental documents (the Economische Agenda Zuidvleugel) three economic pillars, the knowledge axis is one of them. The knowledge axis exist of multiple knowledge locations around universities in the south wing of the Randstad. These locations are connected with each other by transport but also by relations. The cities have all their own specialisation and are com-plementary to each other. Knowledge generated in Delft can be used in another knowledge location. My project location, the Leiden Bio Science Park, is one of the top locations in the knowledge axis. The main goal is to improve this knowledge location and make it the main player in the life science sector. This should strengthen the knowledge axis and therefore the competitive position of the south wing. At the end of the project is described what the improvement of the Leiden Bio Science Park eventually could mean for the knowledge axis.

This research theme investigates the role of spatial planning and design in managing regions, especially the Randstad where my location is a part of.

The relationship between the methodical line of approach of the graduation lab and the method chosen by the student in this framework

The project is part of the research theme of regional governance, planning and design. The scale for the research theme focuses on the regional scale. It includes governance decisions on different scale levels. For this graduation project, the governance decisions made by the province are the starting point. The project itself is focusing on a specific area in the knowledge axis, an economic pillar stated by the province. At the end a reflection of the effects on the regional scale is made.

The relationship between the project and the wider social context

The province of South Holland wants to strengthen the economy by using the knowledge axis pillar. As said before Leiden is one of these cities in the knowledge axis and wants to be an international oriented knowledge city. Leiden focuses on life science and health. The government stated that the sector life science and health is part of the top sector policy. Therefore the development of Leiden as a better knowledge city in the knowledge axis is relevant because it is of national economic interest.

The design interventions I made should attract more life-science companies to the Bio Science Park. This will attract more knowledge workers to the area as well. This can be also knowledge workers from abroad. Not only high educated knowledge workers will benefit from this but also other educated people. It is stat-ed that high educated jobs also provide jobs for lower educated people. Also students will be more attract-ed to the area. By adding new student housing the shortage of student housing in Leiden can be reduced. This will also make the area more lively which stimulated contact between different people. Therefore the improvement to a more lively campus will be beneficial for the city of Leiden.

Role of urban designer

Urban designers and planners can have influence on the success of knowledge clusters. Although the relation between the new designed interventions and the success of the knowledge clusters is difficult to measure. Knowledge clusters can also be successful in other ways, without such interventions. Or it can even be unsuccessful but still meet all the requirements needed to be a good knowledge location. The success of a knowledge cluster also depends on things where urban designers don't have influence on. Urban designers can't create innovation or interaction between different companies, but we can stimulate and facilitate these things by adding a certain program. Urban design is one of the many things that influence the success of knowledge clusters. There are also some other things that can improve a knowledge cluster where urban designers have less or no influence on, like the management of the location and activities that are organised. Also the willingness of the knowledge workers to interact can influence the success of knowledge locations. So it can be said that urban designers can play a role in the success of knowledge clusters, but that the success also depends on other things where urban designers don't have influence on.

Not all knowledge clusters or locations work the same. The knowledge clusters will not be successful by just meeting certain criteria or by adding a certain program. Every knowledge cluster is different and therefore should be looked different to.

References

Alonso, W. (1973). Urban Zero Population Growth. *Daedalus*, 102(4), 191-206.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Humand Geography*, 28(1), 31-56.

Baum, S., Yigitcanlar, T., Horton, S., Velibeyoglu, K., & Gleeson, B. (2007). The role of community and lifestyle in the making of a knowledge city: Griffith University.

Baum, S., Yigitcanlar, T., & O'Connor, K. (2008). Creative industries and the urban hierarchy: The position of lower tier cities in the knowledge economy. *Knowledge-Based urban development: Planning and applications in the information era. IGI Global, Information Science Reference, United States of America, Pennsylvania, Hershey*, 42-57.

Carvalho, L. (2013). *Knowledge Location in Cities: Emergence and Development Dynamics*. Rotterdam: Erasmus University Rotterdam.

Castells, M. (2000). *The Information City, the New Economy, and the Network Society*. Paper presented at the People, cities and the new information economy, Helsinki.

de Hoog, M. (2013). *De Hollandse Metropool*. Bussum: THOTH.

den Heijer, A. C. (2011). *Managing the university campus information to support real estate decisions*. Eburon, Delft.

Duranton, G., & Puga, D. (2000). Diversity and Specialisation in Cities: Why, Where and When Does it Matter? *Urban Studies*, 37, 533-555.

Ekkelboom, J. (2008). Moderne campus als ontmoetingsplek. *Aedes Magazine*(12), 38-41.

Ergazakis, K., Metaxiotis, K., & Psarras, J. (2006). Knowledge cities: the answer to the needs of knowledge-based development. *VINE*, 36(1), 67-84.

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix--University-industry-government relations: A laboratory for knowledge based economic development. *Easst Review*, 14(1), 14-19.

Florida, R. (2000). The economic geography of talent. *Annals of the Association of American geographers*, 92(4), 743-755.

Florida, R. (2002). *The Rise of the Creative Class*. New York: Basic Books.

Glaeser, E. L., & Saiz, A. (2003). The rise of the skilled city: National Bureau of Economic Research.

Glaeser, E. L., Scheinkman, J., & Shleifer, A. (1995). Economic growth in a cross-section of cities. *Journal of monetary economics*, 36(1), 117-143.

Jacobs, J. (1969). *The economy of cities*. New York: Random House.

Malekzadeh, A., Yigitcanlar, T., Bunker, J., & Dur, F. (2010). *Evaluation of Accessibility for Knowledge-Based Cities*. Paper presented at the roceedings of The 3rd Knowledge Cities World Summit : FromTheory to Practice, Melbourne.

Matthiessen, C. W., Schwarz, A. W., & Find, S. (2002). The Top-level Global Research System, 1997-99: Centres, Networks and Nodality. An Analysis Based on Bibliometric Indicators. *Urban Studie*s, 39(5-6), 903-927.

Meijers, E. J. (2014). Van agglomeratiekracht naar netwerkkracht: Borrowed size in de Metropoolregio. In s.n. (Ed.), *Metropoolvorming: Kansen en opgaven. Reflecites uit de wetenschap* (pp. 43-68). s.l.: s.n.

Oldenburg, R. (1989). *The Great Good Place: Café, Coffee Shops, Community Centers, Beauty Parlors, General Stores, Bars, Hangouts, and How They Get You through the Day*: Paragon House Publishers.

Porter, M. E. (1998). Clusters and the New Economics of Competition. *Harvard Business Review*, 76(6), 77-90.

Provincie Zuid Holland. (2012a). *Beleidsvisie en Uitvoeringsstrategie Regionale Economie en Energie 2012-2015: Kansen zien, kansen grijpen*. Den Haag: De Swart.

Provincie Zuid Holland. (2012b). *De Weerbare Regio: Ruimtelijk-economisch beleid in de Zuid-Hollandse kenniseconomie*. Den Haag: DeltaHage bv.

Raspe, O. (2014). *Trends in de regionale economie*. Den Haag: Planbureau voor de Leefomgeving.

Storper, M., & Venables, A. J. (2004). Buzz: face-to-face contact and the urban economy. *Journal of economic geography*, 4(4), 351-370.

Van Winden, W. (2011). *Creating knowledge hotspots in the city: A handbook*: European Union: URBACT.

Van Winden, W., & Van Den Berg, L. (2004). Cities in the knowledge economy: new governance challenges. *European Institute for Comparative Urban Research*, Rotterdam.

van Winden, W., van den Berg, L., & Pol, P. (2007). European Cities in the Knowledge Economy: Towards a Typology. *Urban Studies*, 44(3), 525-549.

Vedovello, C. (1997). Science parks and university-industry interaction: geographical proximity between the agents as a driving force. *Technovation*, 17(9), 491-531.

Wetzel, A. (2013). Creating Innovative Production Environments: Deltametropolis Association.

Wolfe, D. A., & Gertler, M. S. (2004). Clusters from the Inside and Out: Loal Dynamics and Global Linkages. *Urban Studies*, 41(5/6), 1071-1093.