# Science Parks, what are the real estate conditions for success?

## an identification of the critical factors in the real estate development process of a Science Park

van den Brink, T.

*Award date:*
2016

# SCIENCE PARKS

*WHAT ARE THE REAL ESTATE CONDITIONS FOR SUCCESS?*

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Master thesis Eindhoven University of Technology
Faculty of Architecture Building and Planning,
Department Real Estate Management & Development

# Colophon

**Science Parks, what are the real estate conditions for success?**

*An identification of the critical factors in the real estate development process of a Science Park*


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# PREFACE

Before you lies my master thesis for the completion of the master track Real Estate Management & Development at the Technical University of Eindhoven. Today's society is hard to image without the technological innovations of the last decades, like: the computer, internet, mobile telephone, etc. I always had a thing for new gadgets and technologies and with the determination of the subject I noticed that the slogan of the Technical University of Eindhoven was: *"Where innovation starts"*. Although, innovation is not possible without the supporting real estate facilities, the area development concept that stimulates innovation is called a Science Park. I noticed that this was a new phenomenon that was relatively unknown in the literature, especially from a real estate point of view. With this research my goal is to present you the real estate development process of a Science Park. This process needs to clarify what it takes to create an innovative climate resulting in new technologies which we are all using today.

During my research I learned a lot about the real estate development process and especially the aspects to create a climate with real estate where innovative ideas are born. Therefore, I want to thank the respondents that helped me filling the literature gaps and gave me additional information about the process of a Science Park. Every respondent that was approached for an interview reacted with enthusiasm and was curious for the outcomes of this research.

There were some persons I want to thank during the process of this research. Starting with my gratitude to Professor Theo Arentze and PhD student Benny Ng for their feedback every two weeks for the last half year. In addition my thanks go out to assistant professor Rianne Appel-Meulenbroek my second supervisor for her critical view and feedback on this research. Nevertheless, the person that heard almost on a daily basis about the status of my research was my external supervisor Michiel Boonen, I want to thank him for his feedback and insights during this research and off course for borrowing his car to drive to the respondents across the country. Furthermore, I want to thank my parents for making my educational career of seven years possible starting at the University of Applied Sciences and ending at the Technical University of Eindhoven. Last but not least I want to thank my girlfriend for supporting me and hearing every time about my thesis, especially in the end period.

Enjoy reading this thesis,

Thijs van den Brink

Amsterdam, September 2016

# SUMMARY


Abstract

This thesis is about the development of Science Parks with a focus on the real estate. Science Park concepts are on the rise due to technological innovations that have followed in rapid succession and the economic shift to a knowledge based economy. The rising popularity of Science Parks results in starting Science Parks lacking experience and having difficulties in financing the real estate investments which is affecting the survival rate of these parks. This thesis will therefore focus on the critical real estate factors during a science park development and which of these are relevant for starting science parks.

The critical real estate development factors in becoming a mature Science Park are identified in this research through literature review and conducting expert interviews. Furthermore, the management implications for the real estate development of starting Science Parks are derived through the aforementioned methods. Based on the literature review and the conducted interviews, the management implications for the real estate process of starting Science Parks are the following: creating a unique theme, keeping the development flexible, centralizing supporting amenities, locating parking on outskirts with no fixed spot, phasing of the real estate, obtaining public or private financing, creating an diversification of firms, and clarifying the relevance of the Science Park to governmental institutions. Based on the conducted research, starting Science Parks can apply these management implications in order to stimulate their survival rate.



*Keywords: Science Parks, real estate, development, management implications, survival rate*


## *Introduction*

Tech-companies are on the rise with new innovative products that follow in rapid succession these days. Spatial developments specifically designed for large tech-companies such as the High Tech Campus Eindhoven are a success and resulted in Eindhoven being named the most intelligent region of the world in 2011 (Bell, 2011). The collaborations of businesses in these areas and the increased competitiveness results in an innovative climate for knowledge workers that is of importance for the survival of tech companies in the current economy, which is increasingly focused on knowledge (Dinteren & Keeris, 2014a; Heijer, 2008; Saxenian, 1996). The spatial development that is facilitating R&D, knowledge transfer, and an innovative climate for these types of businesses is called a Science Park (Boekholt et al., 2014; Science Park and Innovation Centre Association, 2016). The terms Technology Park and Research Park are however, frequently used synonyms for Science Park while campus is commonly used in the Netherlands as well. Internationally this term often refers to the campus of a University and therefore the term Science Park, which is broadly used and accepted in literature, is adopted in this research (Buck Consultants International, 2009; International Associations of Science Parks, 2016). This mixed use spatial development consists of laboratories, incubators, industrial complexes, and other real estate tailored to R&D. All these aspects together lead to Science Parks being favored places for tech companies to locate themselves (Boers, 2013; Dinteren & Keeris, 2014b).

The Science Park market in the Netherlands is a real estate niche market although there is a growth foreseen in this market due to the rising number of Science Parks (Dinteren & Keeris, 2014a). According to Buck Consultants International (2014) there were 39 Science Parks in the Netherlands in 2014, an increase of 6 Science Parks compared to 2012. The increase is a result of stimulation of science park

developments by local governments who generally see a Science Park as an improvement of the image of a city rather than the transfer of knowledge and creation of innovation. The latter is negatively affecting the survival rate of Science Parks (Dinteren & Pfaff, 2011). Buck Consultants International (2014) made a diversification in the different stages of a Science Park development resulting in four phases: idea, starting, growing, and mature phase. The primary vision of a Science Park is formed in the idea phase, after which a physical area is realized in the starting phase, taking roughly two years although timing depends on the pace of progress that is being made. After this the growing phase is reached in which more researchers and businesses are added to the science park. This finally results in becoming a mature science park, being of national importance with a high number of researchers and R&D businesses (Buck Consultants International, 2009; 2014). Emphasizing the popularity of this relatively new phenomenon is the figure that more than half of all Science Park developments in the Netherlands were either in the idea or starting phase in 2014 (Buck Consultants International, 2014; Dinteren & Keeris, 2014a).

As a result of banks being hesitant to finance alternative real estate, several literature sources indicate that Science Parks have difficulties in finding capital to invest in real estate facilities (Boers, 2013; Dinteren & Keeris, 2014a; Ministry of Economic Affairs, 2015). This affects the competitiveness of Science Parks negatively because these rely heavily on the quality of the real estate (Boekholt, et al., 2014; Zeemeijer, 2016). Boekholt et al. (2014) and Kooij (2010) acknowledge this by stating that there is a lack of benchmarks on the evaluation process of Science Park developments. As a result of the recent nature of the Science Park concept, there is an absence of a long term vision during a Science Park development. Furthermore, Huang (2013) points out that due to the increasing importance of technological developments and the changing role of the government there is a need to reinvestigate high tech developments.

Heijer, Magdaniel, & Bentinck (2013) benchmark University buildings and corporate real estate on a University campus. Beckers, Voordt, & Dewulf (2015) indicate the occupier requirements for the real estate of University campuses. Nevertheless, it can be concluded that the literature about University campuses is mainly focusing on the University itself and their corporate real estate, leaving out the total Science Park concept. The other aforementioned studies about the Science Park concept leave out the development from a real estate point of view, with or without University, nor touching on the development process of Science Parks in the starting phase. According to Frej (2001) a Science Park is comparable to a business park in various ways. Therefore, the literature regarding to the real estate process of a business park is used for the identification of the real estate development process of a Science Park during this research (Ensink, 2011; Jeurissen & Keeris, 2011; Kooijman & Philipsen, 1997; Laet, 2007; Rietberg, 2012).

Most of the literature sources focus on mature Science Parks with some evaluating the factors leading to success. However, the focus of these studies is on the investment, innovativeness, management, occupiers, policy instruments, and the social-economic aspects of a Science Park concept. Literature on University campuses focus on the corporate real estate and the occupier requirements. It can therefore be concluded that there is a knowledge gap in the existing scientific literature on the real estate development process of a Science Park, especially in a period with a high number of starting Science Parks. In this research the critical real estate factors during the development process towards a mature Science Park are identified. From the literature on Science Parks and the real estate development process of business parks a preliminary set of critical factors is identified as well as the existing knowledge gaps in this literature. These knowledge gaps are answered through expert interviews, identifying the critical factors of importance for the real estate development of a science park. These critical factors are used to derive management implications for the real estate process of a starting Science Park. Eventually, the implications must stimulate the survival rate of these parks.

*Review of literature*

The Science Park concept originated at the Stanford University in California during the 1950s where a connection was established between the academic world and businesses to create an innovative climate (Hansson, 2007). Therefore, the organizational structure of a Science Park is based on the triple helix model of Etzkowitz and Leydesdorff (2000) consisting of a trilateral connection that is made between academia, government, and industry. According to Frej (2001) Science Parks are seen as a subcategory of business parks, although there are some differences. A Science Park for example increases the community´s wealth by promoting an innovative culture while it also stimulates the competitiveness of associated businesses. Furthermore it is characterized by the presence of a knowledge based institution and it is managed by specialized professionals (Frej, 2001; International Associations of Science Parks, 2016). Lastly, the Science Park has an active policy in knowledge transfer, capital, people, facilitation of R&D, and the acquisition of knowledge-intensive organizations (Boekholt, et al., 2014).

A well-functioning Science Park requires four main characteristics. At first the presence of a manifest knowledge that is often the origin of the park such as a University, research institution, or (business) R&D center (Hansson, 2007). Secondly, the real estate needs to be of high quality consisting of a mixed use area with tailored real estate for R&D facilities (laboratories, clean rooms, and pilot production units) and incubators with shared facilities for start-ups (Boers, 2013; Dinteren & Keeris, 2014b; Kooij, 2010). Thirdly, the network of a Science Park needs to contain open innovation (adding external knowledge to existing internal processes and creating additional R&D value), human capital, collaboration with the region, and a professional network (Chesbrough, 2006; Huang, 2013). The fourth and final main characteristic for a science park is that businesses on it need to have a focus on R&D, facilitating knowledge transfer, and creating a theme with a strong innovative climate for businesses operating in the same profession (Dinteren & Keeris, 2014b; Technopolis, 2009). The aforementioned characteristics are of essence to be present in a science park, otherwise it would be characterized as a high quality business park (Frej, 2001). Having established the four main characteristics, two types of Science Parks can be distinguished. This depends on the manifest knowledge supporter which either is a Business or a University. Differences between these two types of Science Parks are found in stakeholders, resources, real estate facilities, and ownership. Furthermore, the University Science Park is focused on locating spin-offs at incubators while the Business Science Park focusses on locating businesses due to its origin from a business strategy (Hansson, 2007; Heijer, 2011; Kooij, 2010; 2015; Langerak & Spijkerbroek, 2015). There are three main perspectives in a Science park development in line with the aforementioned, each with a different interest and focus (Castells & Hall, 1994; Grimaldi & Grandi, 2005; Kooij, 2010):

- a business wants to gain profit;
- a University want to increase human capital;
- a government wants to create economic growth in the region.

Having a large amount of research institutions and R&D businesses, being of national importance, being distinctive, and possessing the four main characteristics are the requirements of a mature science park (Buck Consultants International, 2009; 2014).

According to Frej (2001) the flexibility of a business park is the key to success. With the rapid changing technologies this also applies for a Science Park development (Dinteren & Keeris, 2014b). Over the last years, as a result of the economic crisis, there were shifts noticeable in the general real estate development process. While there used to be a tight planning regime and mostly large-scale developments, a shift occurred to more flexible planning and phased developments. This resulted in lower investments required at once and an increasing involvement of occupiers and landlords in the development process (Neprom, 2014). The study of Olden (2010) points out that in a Science Park development, both the land development and construction are taken care off by a single party. The

development is then disposed of wholly, resulting in the ownership of the public space and real estate by a single owner. The financing of a Science Park development touches the three main financing difficulties which are the following ones: specific functions buildings, lack of comparables, and new concept design (Steiner & Butler, 2006).

In addition, the real estate on a Science Park requires a large investment which should lead to higher rental prices than common on a regular business park. However, the risks of investing in a science park are also higher (Boers, 2013; Dinteren & Keeris, 2014a). Other critical factors that apply to Science Parks are the communication between parties, the marketing of the main theme of the science park and having a connection with the surrounding region (Dinteren & Keeris, 2014b; Kooij, 2010). In terms of governmental regulations a Science Park has some advantages over a regular business park. As a result of attracting human talent to the region and increasing the focus on the knowledge economy, the local government is willing to stimulate a Science Park development (Dinteren & Pfaff, 2011; Heijer, 2008; Huang, 2013). The amenities and services that are offered on a Science Park are more specific than those present at a regular business park. A Science Park its amenities and services stimulate knowledge transfer and consist of among others: meeting rooms, restaurants, retail, and leisure facilities (Dinteren, 2009; Löfsten & Lindelöf, 2002; Mondor, 2014). In line with this, the study of Kooij (2010) points out that start-ups share facilities in incubators to reduce the costs and offer more flexibility in the duration of rental contracts.

Knowledge gaps were found during the literature review regarding to the identification of the critical real estate factors during the development process of a Science Park. Friedman (2006), Louw et al. (2009), Olden (2010), and Peet (2014) elaborate the general development model that is frequently used during a Science Park development. However, more specific practical input is missing, for example of how flexibility is achieved during the real estate development of a Science Park and what the side conditions of this development are. Moreover, it is clear that the manifest knowledge supporter is the initiator of a Science Park- However, Hansson (2007) does not describe what kind of role these manifest knowledge supporters have during the real estate development which also applies for the stakeholders. In addition Boekholt et al. (2014), Dinteren & Keeris (2014a), and Geerdink et al. (2010) examine the different policies and grants for innovative businesses. However, the policies and grants during the real estate development of a Science Park are only partially specified in these studies and miss elements like zoning regulations, zoning flexibility, the kind of incentives granted by regional or local land policies and the competition of other Science Parks due to municipalities only boosting the image of their city. The difficulties in financing a Science Park development are elaborated by Boers (2013), Boekholt et al. (2014), and Dinteren & Keeris (2014b), reporting that mature Science Parks already have investors and venture capital. However, the starting process of mature Science Parks and how they dealt with financing during that time and established a solid and stable cash flow during the years is not mentioned in any of this research. The same counts for risk management, which is marginally examined by Dinteren & Keeris (2014b). A more thorough identification of risks during the real estate development of a Science Park is missing. For example, what if the real estate on a Science Park becomes vacant and how can the large investment that is made in the specific real estate on a Science Park be earned back without being too risky. Furthermore, the different real estate facilities that are present on a Science Park are clarified by Boekholt et al. (2014), Boers (2013), and Kooij (2014), although the phasing of these facilities during the development as well as possible rental agreements that are used are not present in the literature.

### *Methodology*

Due to the limited availability of literature and identified knowledge gaps on the real estate development process towards a mature Science Park this research is exploratory and has a qualitative basis (Baarda & Goede, 2012). The data collection of this research consists of a literature study in which the critical real estate development factors that are relevant for Science Parks are identified, and expert interviews with respondents holding senior positions with firms that have a direct link with the

real estate development process towards a mature Science Park. In order to cover all the different aspects in the selection of respondents there were two elements of relevance: the mature Science Park where the respondent is active on and the profession of the respondent. The interview population of this research consists of people being involved in five mature Science Parks (Amsterdam, Eindhoven, Leiden, Wageningen, Sittard-Geleen) of the total eight mature Science Parks present in the Netherlands. Furthermore, the seven respondents were chosen with different backgrounds, varying from owners, consultants and a developer. In addition the retrieved information from the respondents is more reliable due to the seniority in function (directors, deputy directors, and partners). The knowledge gaps in the literature were identified in the previous paragraph and are used to form the interview guide. The conducted interviews in this research were semi-structured and based on the relevant topics found in the knowledge gaps of the literature, supported by open questions. To avoid biased answers open questions are used instead of presenting the list of critical factors which can affect the answer. The different topics during the interview were the following ones:

- real estate development process;
- policy governments & grants;
- initiators & stakeholders;
- financial & risk management;
- real estate facilities.

Lastly, a final question to identify failure factors that were missing during the interview was asked to all interviewees. The importance of the identified critical factor was asked during the interview. The qualitative data have been compared with the literature in order to identify the critical real estate development factors towards a mature Science Park and derive management implications for the real estate process of starting Science Parks.

### *Findings*

The literature study and the qualitative data collection resulted in the identification of the critical real estate development factors in order to become a mature Science Park. During the data collection interesting contrasts and similarities were found, while new information was also found during the qualitative research that proved to be of added value for the identification of the critical factors in the process to become a mature science park.

The respondents added to the studies of Hansson (2007), Louw et al. (2009) and Olden (2010) that the real estate development process of a Science Park is a dynamic and continuous process that originates from the manifest knowledge supporter. While Dinteren & Keeris (2014b) and Frej (2001) report the urgency of shared facilities on Science Parks, the respondents clarified the phasing of the real estate facilities during a Science Park development. A Science Park development starts with the manifest knowledge supporter and is followed by the addition of businesses and incubators. Then, in a final stage, shared facilities (retail, leisure, and hospitality) are realized. In terms of sharing facilities at incubators Dinteren & Keeris (2014b), Kooij (2010; 2012), and McAdam & McAdam (2008) describe that laboratories, clean rooms, and pilot production units are usually shared by starting businesses. However, the respondents pointed out that due to the certification and secrecy in patenting products it is unusual to share laboratories, clean rooms and pilot production. In addition Greiner (1998), Lamnak (2015), and McAdam & McAdam (2008) claim that a start-up leaves an incubator after a certain period. In practice the respondents argued that the incubators are often kept occupied by start-ups due to the high moving costs and the difficulties involved in the certification of laboratories.

Boekholt et al. (2014), Dinteren & Keeris (2014b), and Technopolis (2009) emphasize the importance of knowledge transfer on a Science Park. However, the programming of real estate functions on a Science Park to achieve this is not mentioned in the literature. The respondents pointed out that the shared facilities are located in a centralized place on the Science Park surrounded by the businesses

and incubators on a relative short walking distance. Thus, from a practical point of view it can be stated that most of the knowledge transfer takes place in these facilities instead of in the laboratories and offices. Therefore, the respondents assert that a Science Park developer must create as many meeting moments as possible to support knowledge transfer. Businesses can for example not be allowed to have their own canteen or meeting rooms while parking spots can be located on the outskirts of the park with no fixed places. Furthermore, Heijer (2011) and Kooij (2014) state that shared facilities stimulate the livability, however, there is nothing mentioned about the real estate development process to make this feasible. The respondents reported that the realization of shared facilities is easier achieved on a University Science Park, due to the large amount of students that are already present. A Business Science Park needs to attract enough businesses and employees to make these shared facilities feasible, which may be difficult. In addition Grimaldi & Grandi (2005), Hansson (2007), Heijer (2008; 2011), and Kooij (2012; 2014; 2015) state that University Science Parks focus on incubators in order to facilitate spin-offs from the University which is in line with the respondents comments. Business Science Parks on the other hand focus on profit and the attraction of businesses due to the business strategy where they originate from. In addition to the literature the respondents report that for the attraction of businesses it is beneficial that a Science Park has a connection with a University for the input of human capital.

In terms of governmental policies the respondents and Boekholt et al. (2014), Ministry of Economic Affairs (2015), and Zeemeijer (2016) emphasize that most of the local governments are supporting Science Park developments. However, the respondents added that the support of regional governments depends strongly on the region where the Science Park is located. In some of the regions the regional governments are active in forming of a public development firm during a Science Park development (foundation or consortium), whereas in the Randstad region the regional governments are or do not have to be supportive because of the economic strength of the Randstad. Nevertheless, the respondents stated that all regional governments are willing to invest in infrastructure in order to make the Science Park well-accessible.

The literature highlights that the financing of a Science Park development is hard to obtain, which was acknowledged by the respondents (Boekholt, et al., 2014; Boers, 2013; Dinteren & Keeris, 2014b; Ministry of Economic Affairs, 2015; Steiner & Butler, 2006). Therefore, from both the literature and respondents it can be stated that the financing of a Science Park development depends on the ownership structure and the region in which the park is located. A privately owned Science Park relies on private capital, whereas a Science Park that is owned by a foundation or consortium relies on a public development firm or a private investor. Furthermore, in line with Dinteren & Keeris (2014a; 2014b), the respondents point out that it is essential to maintain all buildings´ rental situation and apply leasehold to the ground policy during a Science Park development, in order to guard the theme of the Park. In addition, the respondents assert that the flexibility of the rental period depends on the amount of specialization to the building. They also report that staff can sometimes be temporarily hired with the laboratories and clean rooms. In terms of risk management the literature and respondents evaluate that due to the high demand for specific real estate functions (laboratories, clean rooms, and pilot production units) it can be stated that the risk of vacancy is low (Boers, 2013; Dinteren & Keeris, 2014b; Grimaldi & Grandi, 2005). Nevertheless, in addition to the literature the respondents added that a diversification of firms (large, midsized, and small firms) is needed in a Science Park development to cover a certain loss of rent and to lower the risk. In addition they claim that this results in flexibility due to the possibility of locating starting firms in older buildings and build or transform buildings for larger more stable firms.

### *Conclusion*

The different critical real estate development factors in order to become a mature Science Park were identified in the findings of this research. These critical factors are used to determine management implications for the real estate process of starting Science Parks. During the development of a starting

Science Park it can be concluded that one of the most important implications is creating a unique theme for the Science Park to distinguish itself. The real estate needs to facilitate knowledge transfer with as many meeting moments between the staff present in a Science Park as possible which should result in the creation of a community. In order to facilitate the transfer of knowledge centralizing support amenities (retail, leisure, and hospitality) and locating parking facilities at the outskirts of the park without a fixed parking spot are implications that need to be implemented. The shared facilities on a starting Science Park can be developed more rapidly with a University as manifest supporter, due to the presence of students. In the scenario without a University, it can be concluded that it is more difficult to realize the shared facilities because of the critical mass required, even though it is relevant to include these in the master plan. Nevertheless, another implication for a starting Science Park is establishing a connection with a University, resulting in an influx of human talent which makes it interesting for businesses to locate themselves on a starting Science Park.

During the real estate development process of a starting Science Park the development needs to be as flexible as possible on the master plan, zoning plan and building level by phasing the development. In addition it is essential to have a manifest knowledge supporter with the focus on R&D at the origin of the starting Science Park. From the findings it can be concluded that it is difficult to create a stable cash flow during the development of a Science Park. In order to create a stable cash flow, an implication can be attracting businesses that do not fulfill the theme of the Science Park perfectly. However, these need to have short or terminable contracts in order to be able to guard the theme. Furthermore, to retrieve the large investment in real estate, to lower the risk, and to cover potential rental losses, creating a diversification in firm sizes during a starting Science Park development is essential, even though starting Science Parks generally lack older buildings to locate start-ups which results in a limited flexibility. Due to the limited flexibility an implication is monitoring the demand in specific real estate (laboratories, etc.) to avoid the rejection of businesses. In terms of governmental policies it can be concluded that an implication is clarifying the relevance of a starting Science Park in relation to the economic growth to receive support from the local government. For the support of the regional government it depends on the region in which the starting Science Park is located. The same counts for the financing of a starting Science Park which depends on the ownership structure and the region. Obtaining financing can originate from private capital, a private investor or a foundation or consortium (public development firm). It can be concluded from the input of the respondents that the most important management implications for a starting Science Park are the following ones:

- creating a unique theme;
- keeping development flexible;
- centralizing support amenities for knowledge transfer;
- locating parking on outskirts with no fixed spot;
- phasing of the real estate development;
- creating a diversification of firms;
- clarifying relevance of the Science Park to governmental institutions;
- obtaining public or private financing.

As a result of this research the large amount of starting Science Parks can implement the different management implications during their real estate development process in order to increase the survival rate for the starting Science Parks.

### *Further research*

During this study there were some deficiencies that could influence the management implications for starting Science Parks. The different deficiencies and experiences during this research lead to subjects that are of interest for further research. In the first place the selection of the respondents during this research was essential to cover as much information as possible. Therefore, seven respondents were approached from five different mature Science Parks covering the different professions in the real

estate process of a Science Park. Nevertheless, for a total comprehensive view on Dutch science parks it could be of interest to interview respondents from the other three mature Science Parks, Utrecht Science Park (Utrecht), Kennispark Twente (Enschede), and Science Park Technopolis (Delft). However, a note must be made that while the interviews progressed during this research project, the amount of new critical real estate factors that were identified was limited. Although, for further research it might be interesting to interview respondents from Science Parks in foreign countries and make a comparison with their real estate implications.

Another aspect is the input from professionals related to starting Science Parks. After the interviews with the professionals that are active on the mature Science Parks, the critical real estate development factors that were identified could be presented to professionals from starting Science Parks. This would clarify the practical input of the management implications for starting Science Parks. However, due to time constraints interviewing professionals from starting Science Parks was not possible during this research project. Nevertheless, for further research the effects of the management implications for the real estate process of starting Science Parks are interesting to identify and to see if these are of relevance to starting science parks.

Furthermore, this research elaborated the different main perspectives in the focus and interest of businesses, Universities, and governments during the Science Park development. These three parties are frequently involved in nearly all Science Park developments while no further description exists in literature from a real estate point of view. For further research the identification of the critical factors of the occupier requirements in relation to the real estate development of a Science Park could be interesting. This could result in a comparison of these factors with the critical real estate factors to identify the differences between the occupiers on a Science Park and the managers, owners, or developers of a Science Park.

Finally, as stated by the literature and respondents, Science Parks have difficulties in financing their real estate. During the identification of the critical real estate development factors towards a mature Science Park there were some financial factors, however, there is a lack of literature available for the financing of the real estate of a Science Park development. Therefore, it is interesting to investigate the different parties that finance a Science Park development and indicate the factors needed to receive capital during this development.

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# 1. Introduction

*Source: Brainport.nl*

# 1. INTRODUCTION

Technological innovations follow each other in rapid succession tech companies are growing and governments want to stimulate their knowledge economy. For example, the High Tech Campus in Eindhoven has proven itself to be a successful area development, hosting big tech companies like: ASML, IBM, Intel, NXP, Philips, VDL, etc. Resulting in a contribution of Eindhoven becoming the smartest region of the world in 2011 (Bell, 2011). The mix of businesses in near proximity creates face-to-face interactions between knowledge workers which promotes the competition and collaborations (Saxenian, 1996). This is of importance for the innovativeness of a firm if it wants to survive in today's rapid changing economy (Dinteren & Keeris, 2014a). The area development concept that is supporting these kind of firms with the transfer of knowledge, facilitation of R&D, and the creation of an innovative culture is called a Science Park (Boekholt, et al., 2014; Science Park and Innovation Centre Association, 2016). The real estate in this spatial development needs to be of high quality if it wants to facilitate the innovative climate on a Science Park, consisting of a mixed used area that contains different functions, like: industrial complexes, offices, incubators, laboratories, and other real estate that is tailored to R&D (Boers, 2013; Dinteren & Keeris, 2014b).

Nowadays, the development of Science Parks in the Netherlands is seen as a real estate niche market, due to the fact that it is a relative recent phenomenon. Nevertheless, on the international and national market a growth is foreseen in the number of Science Park developments (Dinteren & Keeris, 2014a). According to Buck Consultants International (2014) the amount of Science Parks has increased with 18.2% in comparison with 2012, to a total of 39 Science Parks in 2014. Dinteren & Pfaff (2011) acknowledges this trend and suggests that the popularity of the Science Park concept can result, on local level, in being seen as an improvement of the image of a city rather than the transfer knowledge and the creation of innovation. The research of Buck Consultants International (2014) made a diversification of four different phases during a Science Park development, these phases are: idea, starting, growing and mature. Whereas, in the idea phase a vision is formed, this vision is elaborated in the starting phase that contains a physical area with sometimes several businesses (mostly the first two years). In the growing phase researchers and businesses are added to the Science Park development, this finally results in the mature phase where the development is of national importance and contains a high number of R&D businesses and research institutions. Approximately 53.8% of all Science Park developments in the Netherlands are venturing in the idea or starting phase in 2014 (Buck Consultants International, 2014).

These starting Science Parks have difficulties in finding investors, and despite the large demand in high quality technological real estate the banks are conservative minded and only investing in markets they know (Boers, 2013; Dinteren & Keeris, 2014a; Ministry of Economic Affairs, 2015). However, the competitiveness of a Science Park is depending on the quality of the real estate (Boekholt, et al., 2014; Zeemeijer, 2016). This influences the survival rate of the large amount of Science Park developments in the idea or starting phase. Boekholt et al. (2014) emphasizes this and states that there are too few benchmarks or evaluations of Science Park developments and there is a lack of long term vision. This is in line with the statement that Kooij (2010) makes about the concept of a Science Park, "*…there is a lack of insight into these developments because of the recent nature of the phenomenon." (Kooij, 2010, p. 3).* In addition to this Huang (2013) states that there is a pronounced need to reinvestigate high-tech spatial developments due to the period of time where technological developments are increasingly important and with the changing role of the government (Huang, 2013). The studies that investigated Science Parks are seen from different points of view, focusing on: investment (Dinteren & Keeris,

2014a), innovativeness (Colombo & Delmastro, 2002; Diez-Vial & Montoro-Sanchez, 2013; Löfsten & Lindelöf, 2002; Link & Scott, 2007; Squicciarini, 2008), management (Beckers, Voordt, & Dewulf, 2015; Borgh, 2007; Hansson, 2007; Smulders, 2011), occupiers (Boers, 2013; Castells & Hall, 1994; Dinteren & Keeris, 2014b; Dinteren & Pfaff, 2011; Kooij, 2012), policy instruments (Boekholt, et al., 2014; Frassoldati, 2008; Kooij, 2010, 2014; Zee, et al., 2012), and the social-economic aspect of a Science Park (Buck Consultants International, 2009, 2012, 2013, 2014; Dinteren, 2009; Huang, 2013). This is in line with the literature found on University campuses[1], which focuses mainly on the management of corporate real estate and the determined strategy of the University (Heijer, 2008; Heijer, 2011; Beckers, Voordt, & Dewulf, 2014). In addition Heijer, Magdaniel, & Bentinck (2013) benchmarks new University buildings and the corporate real estate changes that come with it. Some evaluating the University campuses from the user point of view and the alignment of the real estate on this (Beckers, Voordt, & Dewulf, 2015). However, it must be stated that the literature found on University campuses is mainly focusing on the real estate of the University itself, and thus not the total Science Park development concept. The aforementioned studies leave out the real estate development process of a Science Park with or without University, let alone the development process of Science Parks in the starting phase. This is of difference with the literature found on business parks, which are according to Frej (2001) in a lot of ways comparable with Science Parks. The literature that elaborates the development of a business park from a real estate point of view is more comprehensive than the literature on Science Parks. These studies can help in the identification of the real estate development process of a Science Park (Ensink, 2011; Jeurissen & Keeris, 2011; Kooijman & Philipsen, 1997; Laet, 2007; Rietberg, 2012).

## 1.1 Research aim

It is clear that the Science Park concept has a rising interest and popularity, which is resulting in a lot of Science Park developments in the idea or starting phase. Combined with the difficulties from a financial point of view and the pressure from local governments only trying to boost the image of the city, the survival rate of these Science Parks is at risk. As mentioned earlier the competiveness of a Science Park is heavily relying on the quality of its real estate (laboratories, clean rooms, offices, etc.). The literature is focusing mainly on mature Science Parks, some evaluating the factors a Science Park need in order to be a success. However, these studies are focused on an investment, innovativeness, management, occupiers, policy instruments, and the social-economic point of view. The studies on University campuses focus mainly on the corporate real estate management or strategy of a University. Therefore, it can be concluded that the process of a Science Park seen from a real estate point of view is missing. Nevertheless, the literature about the real estate development process of business parks can be used as a stepping stone for the real estate development process of Science Parks. This research will reveal the critical real estate development factors (successes and pitfalls) in the process of becoming a mature Science Park. These critical factors are used as input for Science Parks in the starting phase, which already have realized a physical development, in order to give insights and derive management implications for the real estate development process of these Science Parks. Therefore the goal of the research is:

Identify the critical factors from a real estate perspective during the development process of becoming a mature Science Park in the Netherlands, and use these insights to derive management implications for the real estate process of starting Science Parks.

The critical factors in the real estate development process towards a mature Science Park are the challenges (successes and pitfalls) a Science Park had in order to become one.

[1] University campus, definition according to Oxford Dictionaries (2016): *"the grounds and buildings of a university or college"*.

## 1.2 RESEARCH QUESTION

Having established the research aim, the main research question needs to be created. After the main research question the sub-research questions are elaborated to support the main research question.

The main research question for this research is:

*"What are the critical real estate development factors in the process of becoming a mature Science Park in the Netherlands, and what are the implications for the real estate management of starting Science Parks?"*

To come to an answer of the main research question the following sub-research questions are used:

1. *What is a Science Park and its main characteristics?*
   a. *Which types of Science Parks can be distinguished?*
   b. *Who are the initiators and stakeholders of a Science Park?*
   c. *When is a Science Park mature?*
2. *How does the real estate development process of business parks in general evolve, and which stages can be distinguished?*
   a. *What is the difference between a business park and a Science Park in this aspect?*
   b. *What are the critical factors during the real estate development process of a business park?*
3. *Which of these critical factors have effect on the real estate development process towards mature Science Parks in specific?*
4. *Which critical factors in the real estate development process can be used to form the management implications of the starting Science Parks?*

## 1.3 RESEARCH APPROACH

Due to the lack of literature available about the real estate development process of a Science Park, this research is exploratory and will consist of a qualitative analysis. Therefore, the data will be collected through literature study, case studies, and interviews (Baarda & Goede, 2012). The research plan is visualized in figure 1.

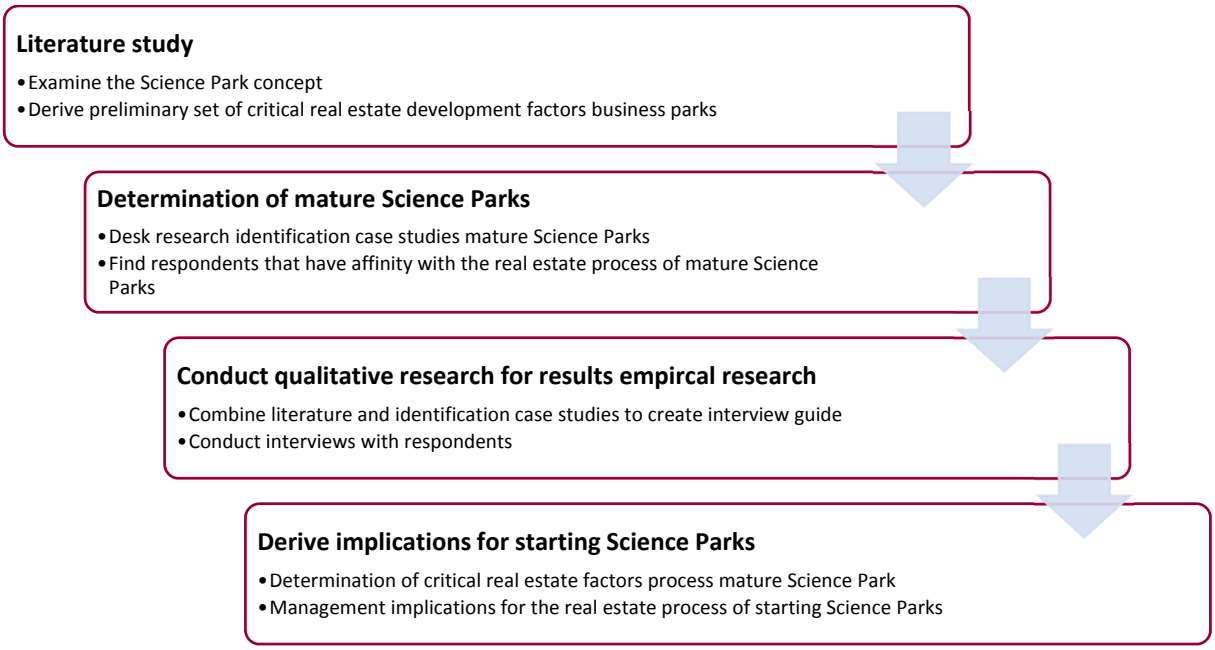


*Figure 1, research plan.*

As visualized in figure 1 the research starts with a literature study which examines the Science Park concept and determines the critical real estate development factors during the process of a business park. After conducting the literature study the mature Science Parks in the Netherlands are determined and elaborated in different case studies. For the results of this empirical research a qualitative research is conducted in the next step, where the literature is combined to create an interview guide that is used for the interviews with the respondents. Having collected all the data the critical real estate development factors towards a mature Science Park can be identified. These are used to derive the management implications for the real estate process of starting Science Parks.

## 1.4 STRUCTURE OF THE THESIS

The structure of the thesis is visualized in figure 2. Where the first chapter contained the introduction that lead to the research objective with the research aim, main research question, and several sub-research questions. The Science Park phenomenon is examined in the second chapter, where the current status of the Science Park developments, their main characteristics, and the mature Science Park is defined. The third chapter clarifies the real estate development process of a business park. After the business park and its different development phases are elaborated, the critical real estate factors during a business park development are identified. Chapter four contains the approach of the empirical research where the interview topics and the interview population are determined. The different interviews are processed and from the respondents the critical factors in the real estate process towards a mature Science Park are identified in chapter five. Chapter six identifies the critical real estate development factors towards a mature Science Park from the literature and qualitative analysis. Finally, the conclusion is formed in chapter seven, were the critical real estate development factors towards a mature Science Park are concluded and used to define the management implications for starting Science Parks. This chapter concludes with the recommendations for further research.

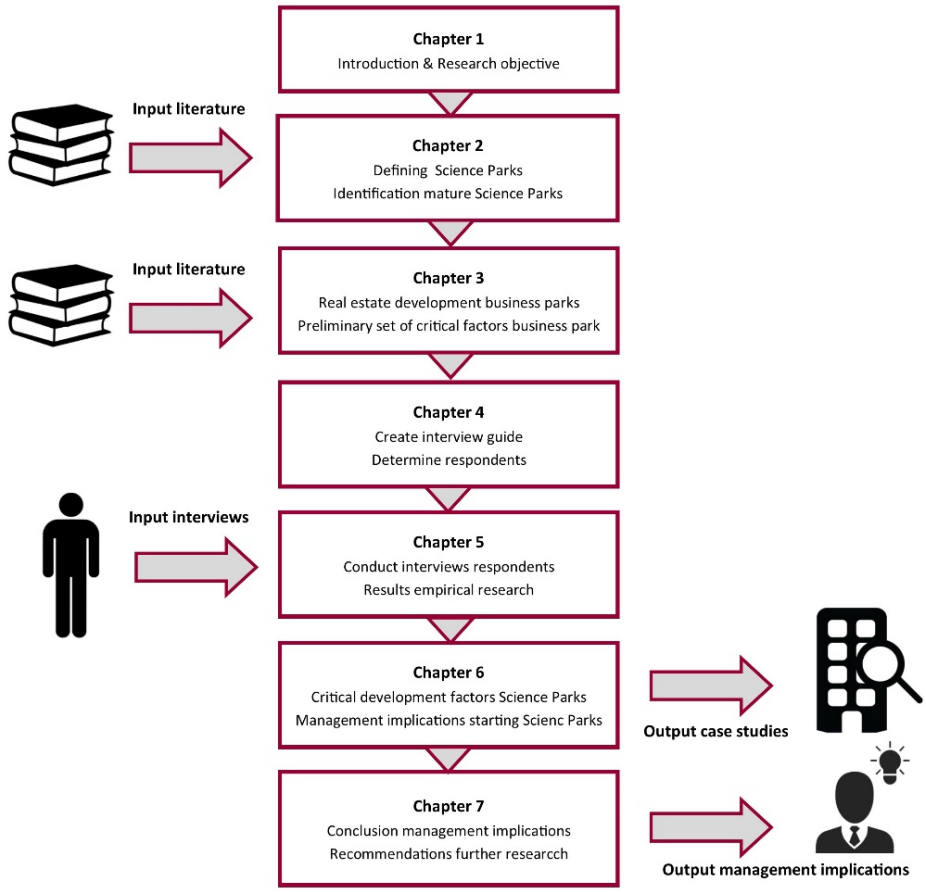


*Figure 2, structure of the thesis.*


# 2. The Science Park phenomenon

Source: broekbakema.nl

# 2. THE SCIENCE PARK PHENOMENON

This chapter contains a detailed explanation of the Science Park phenomenon. The chapter begins with the definition of a Science Park and the background information. When the definition is made the current status of the Science Park phenomenon is elaborated in the next paragraph, starting with Europe and zooming in on the Netherlands. In addition the economic and financial status is given for the Science Park developments in the Netherlands. The following paragraph clarifies the main characteristics of a Science Park. After this the different types of Science Park developments are elaborated in the next paragraph. Furthermore, the different interests and focus of the three main perspectives active in a Science Park development are examined. The next paragraph describes the process of a mature Science Park and the characteristics of these parks. Finally the first sub-research question will be answered in a concluding paragraph:

*"What is a Science Park and its main characteristics?"*

## 2.1 DEFINING A SCIENCE PARK

Before a definition of a Science Park is elaborated from the literature, first the history about the origin of the Science Park concept will be briefly described. After this the different terminologies and synonyms are further elaborated with eventually the definition of a Science Park.

### *History*

The Science Park concept originated from the campus concept. The term campus ('open field' in Latin) was first used at the Princeton University in the 18$^{th}$ century to indicate the green open character. After a while it not only indicated the green open character but the entire university terrain (surrounding area and buildings). During this time it was not common that businesses located themselves on University campuses (Kooij, 2012). This changed in the late 1950s when the first Science Park concept originated at the Stanford University in California. The project developers located business sites near the Stanford University to establish a connection between businesses and the academic world, in order to create science and technological innovations. This concept lead to a success and resulted in the Science Park concept as we know it today. When it comes to developing local or regional economic growth in the 1970s and 1980s the Science Parks are an important tool in the Western Societies in the combination of entrepreneurship and knowledge, and the establishment of new firms (Hansson, 2007).

In the Netherlands the first Science Park concept was the High Tech Campus Eindhoven. In the 1990s the different divisions of Philips were spread out over Eindhoven in outdated real estate facilities. Therefore, Philips wanted to create a campus where the different divisions were grouped in order to stimulate the efficiency, cooperation, and strengthen the corporate image of the firm. This resulted in the Philips High Tech Campus in 1998. By coincidence different suppliers and autonomous departments of Philips were located on the campus, partly to keep the real estate on the campus occupied and avoid loss of income. Businesses share the laboratories and thus have to invest less (Kooij, 2012). Later on this was called 'Open Innovation', which suggests firms can and should use both internal and external means to advance the market (Chesbrough, 2006).

### *Terminology*

The literature uses different terminologies to identify the Science Park concept. According to Link & Scott (2007) the terminology depends on where the park is located, they state that the term 'Research Park' is often used in the United states, whereas in Europe 'Science Park' is prevalent, and in Asia the term 'Technology Park'. Buck Consultants International (2009) states that the term campus is mostly

used in the Netherlands, however, internationally this term often indicates the campus of a University. The International Associations of Science Parks (2016) states that the terms 'Technology Park' and 'Research Park' are used as synonyms for Science Park, later on this term is broadly used and accepted within the literature (International Associations of Science Parks, 2016). Therefore, within this research the term Science Park is adopted.

### *Definition*

The Science Park organizational structure is based on the triple helix model of Etzkowitz and Leydesdorff (2000), where a trilateral connection is made between academia, government, and industry, which creates an innovative milieu and encourages new knowledge to commercialize (Etzkowitz & Leydesdorff, 2000). This is where a Science Park distinguishes itself from a normal business park, although, the Science Park can be seen as a specialized subcategory of a business park (Frej, 2001). The International Association of Science Parks defines the Science Park concept as:

*"A science park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions* (International Associations of Science Parks, 2016)."

This definition is supported in different studies, all proclaiming that a Science Park needs to stimulate knowledge transfer and technologic innovations for universities, R&D institutions, businesses, and markets. This makes a Science Park the bridge between (academic) research and industry, resulting in the creation of an innovative culture and economic growth on local, regional or national level (Buck Consultants International, 2009; Castells & Hall, 1994; Dinteren, 2009; Dinteren & Keeris, 2014b; Hansson, 2007; Huang, 2013; Löfsten & Lindelöf, 2002; Squicciarini, 2008). In addition Boekholt et al. (2014) states that a Science Park is a physical location with high quality real estate facilities which aims to establish knowledge intensive businesses in order to create an innovative climate and synergy between these businesses. This is supported by an active policy for the transfer of knowledge, capital, people, facilitation of R&D, and the acquisition of knowledge-intensive organizations (Boekholt, et al., 2014).

## 2.2 Current status Science Parks

Nowadays the development of Science Parks in the Dutch real estate market is a niche market, which is due to the fact that it is a relatively new phenomenon. However within this market a growth is foreseen both on international and national level, resulting from technological innovations that follow each other in rapid succession and the rising interest of governments in high-tech developments (Dinteren & Keeris, 2014a). To give a provisional international overview of the number of Science Parks and business incubators the Science Park and Innovation Centre Association's (SPICA) Directory states that there are 342 Science and Technology parks and 1,496 business incubators in 104 countries with 82 associations (Science Park and Innovation Centre Association, 2016). These figures give a global insight into the magnitude of the development of high-tech places at the moment. Within the European market the Regional International Scoreboard (2014) examined the innovativeness of each country, categorizing them into innovation leaders, innovation followers, moderate innovators, and modest innovators. This is visualized in figure 3.

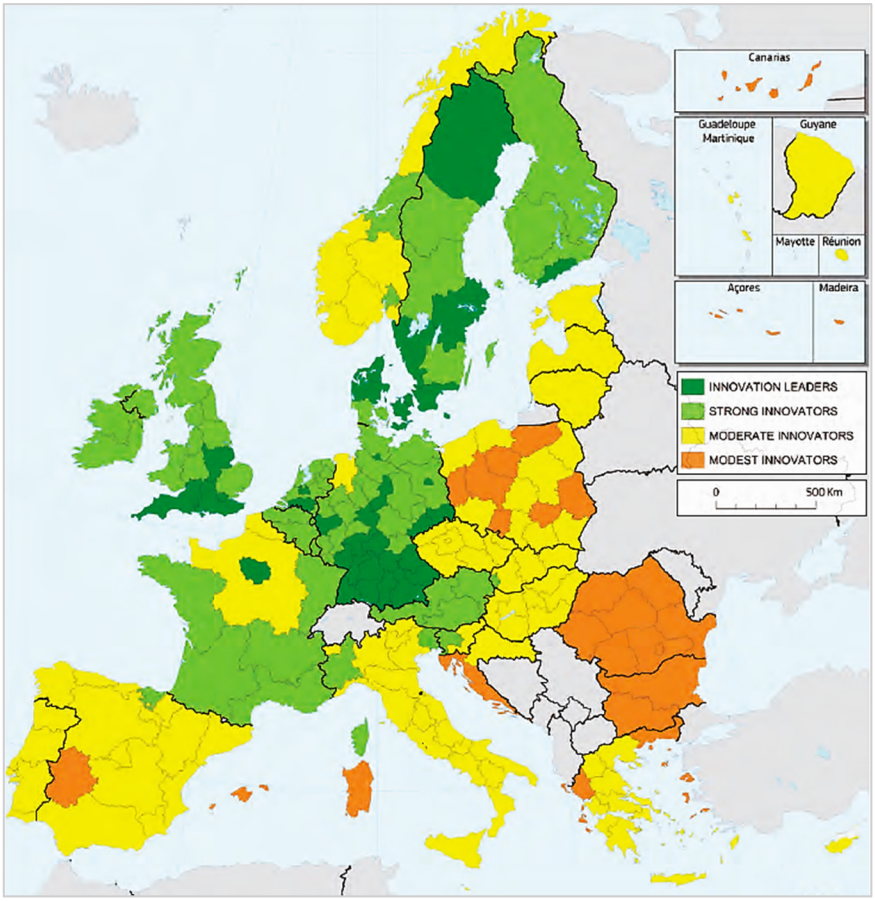


*Figure 3, regional performance groups RIS 2016, on NUTS-2 level. Source: Es-Sadki, Hollanders, & Kanerva (2016), edited by author.*

In figure 3 the Netherlands is in most places a strong innovator, and in some places an innovation leader (regions Noord-Brabant and Amsterdam, Utrecht). This is in line with most parts of the west, north, and central Europe. The south of Europe is partly falling behind and is identified as moderate innovators. The modest innovators are mainly situated in the east regions of Europe (Es-Sadki, Hollanders, & Kanerva, 2016).

In the Netherlands there were according to Buck Consultants International (2014), 39 Science Parks present in 2014 (appendix B). In addition they defined different phases for the Science Park developments, and the changes of these phases between 2012 and 2014. These phases are defined as follows, in the idea phase the initiative of the Science Park is in exploratory-, feasibility-, and vision phase. Within the starting phase the physical area of the Science Park is being realized, sometimes already containing some businesses (first two year of a Science Park development). In the growing phase the Science Park increases with more researchers and businesses. Finally in the mature phase the Science Park contains a high number of research institutions and R&D businesses. However, it must be noted that in the idea phase (and other phases) a Science Park needs to contain a focus on R&D and a manifest knowledge support needs to be present. This is shown in table 1, where the rows contain the phase of a Science Park, for instance: idea, starting, growing, or mature. The columns contain the years of measurement (2012 & 2014), the gross growth in Science Parks, the changes in the number of Science Parks (stopped or developed into a higher phase), and the net growth (retrieved from the changes minus the gross growth).

*Table 1, the number of Science Parks in different phases in the Netherlands. Source: Buck Consultants International (2014), edited by author.*

| Phase Science Park | 2012 | 2014 | Gross growth | Stopped/changed phase Science Park | Net Growth |
|---|---|---|---|---|---|
| Idea (focus R&D/manifest knowledge support present) | 8 | 12 | +6 | -2 | +4 |
| Starting | 10 | 9 | +2 | -3 | -1 |
| Growing | 8 | 10 | +3 | -1 | +2 |
| Mature | 7 | 8 | +1 | 0 | +1 |
| Total | 33 | 39 | +12 | -6 | +6 |

Concluding from table 1 and the study of Buck Consultants International (2014) it can be stated that within the idea phase there is a growth of six Science Parks, two of the Science Parks in the idea phase transferred to the starting phase. This also applies for three Science Parks changing from starting to growing, and one Science Park from growing to mature. In total there are six Science Parks added in 2014 compared to 2012 in the Netherlands. These data give a good insight in the growth and trend of the Science Park phenomenon, with the addition of six Science Parks in just two years. In figure 4 the different Science Park developments in the Netherlands in 2014 are visualized. The different colors indicate the phase the Science Park development is situated in.


*Figure 4, situation of Science Parks in 2014 in the Netherlands. Source: Buck Consultants International (2014), edited by author.*

As shown in figure 4 there are twelve Science Parks in idea phase (blue), nine in starting phase (yellow), ten in growing phase (orange), and eight in mature phase (green). More information about the mature Science Parks can be found in appendix A, where factsheets are elaborated for these parks. It can be stated with the data from table 1 and figure 4 that a lot of Science Parks are currently venturing into the idea or starting phase. This indicates the increasing trend of the Science Park phenomenon.

*Economic status*

The Science Park concept creates economic prosperity due to the stimulation of R&D activities and the connection between different businesses on regional and local level (Castells & Hall, 1994). The concept improves the economic growth by encouraging the high-tech industry to innovate. In most contemporary societies 'knowledge' is seen as the key to the creation of wealth (Dicken, 2003; Roberts, 2005). This is in line with figure 5 where the percentage of employment for people in agriculture and industry are declining during the years, while service and knowledge are increasing. This is resulting in a changing economy that is focusing more and more on service and knowledge (Heijer, 2008).

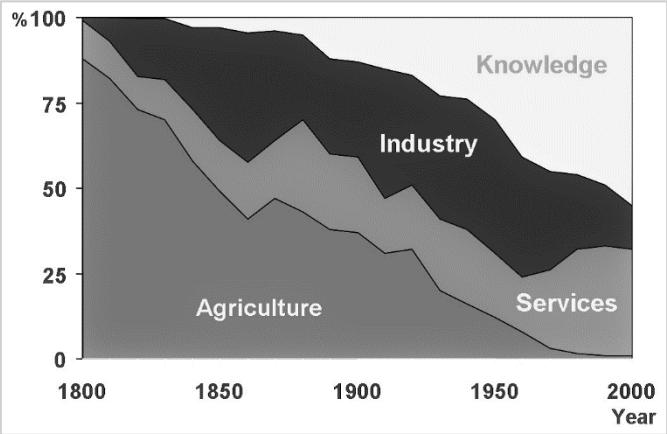


*Figure 5, change of working population in OECD countries to service and knowledge economy. Source: Heijer (2008).*

The Dutch government, therefore, is supporting these developments with grants from the Peaks in the Delta program, a spatial strategy policy which is a collaboration between the Ministry of Economic Affairs, the business sector and knowledge institutions in developing spatial-economic concepts. The granted places in the program get the opportunity to develop themselves, which will contribute to the economic growth on local or national level (Kooij, 2010). According to Geerdink et al. (2010) the Peak in the Delta program resulted in a stronger connection between education and labor market, a settlement of new businesses, the development of competitive (new) products and services, higher educated and qualified personnel, and a strengthening of the local economic policy. They also revealed that without grants from the Peaks in the Delta program many of the projects would not have been started, or would have been less ambitious (Geerdink, et al., 2010). The Peaks in the Delta program is based on the collaboration of the Triple Helix model, which creates a trilateral connection between academia, government, and industry. With this regional economic policy the Dutch government wants to stimulate the organizational capacity, innovativeness, human capital, and competitiveness of the economic region. With the competitiveness the government wants to strengthen Science Parks, logistic services, investors, starters, attractive living conditions and branding. It must be stated that the grants from the Peaks in the Delta program stopped in 2011, thus projects that were requested before this date still benefit from this policy (Boekholt, et al., 2014).

Nowadays grants can be obtained with the 'Horizon 2020' program, which is a European policy. Businesses, research institutions and individual scientists that commit research qualify for this program. The program offers financing of innovative projects, attract or keep researchers, strengthen the international network, and gain knowledge and expertise (Rijksoverheid, 2016b). In addition the Ministry of Economic Affairs in the Netherlands offers an 'innovation credit' for businesses in the technological or clinical sector, this is part of the 'Top Sector' policy that strengthens the business sectors in which the Netherlands already flourishes. This fund helps businesses in financing innovations with a high level of risk, and the credit is only refunded when the innovation succeeds (Ministry of Education, Culture and Science, 2014; Rijksoverheid, 2016c). For the economic outlook of the Science Park market in the Netherlands, Buck Consultants International (2014) examined the result of the development in Science Parks over the years, the number of companies, jobs, and spin-offs. In

appendix D the number of companies, jobs, and spin-off are elaborated for each Science Park in 2014. Table 2 contains the development of Science Parks in the Netherlands, in terms of the rows the number of companies, jobs, and spin-offs on Science Parks are shown. The columns compare the years 2012 and 2014 and the growth that is established.

*Table 2, growth Science Parks in the Netherlands. Source: Buck Consultants International (2014), edited by author.*

| | 2012 | 2014 | Growth |
|---|---|---|---|
| **Number of businesses** | 1,506 | 1,709 | + 13.5% |
| **Number of jobs** | 33,824 | 41,448 | + 22.5% |
| **Number of spin-offs** | 646 | 827 | + 28.0% |

Table 2 clearly shows that there is growth in every aspect. The highest growth is established in the number of spin-offs with 28.0%. The number of companies had the lowest growth with 13.5%. It can be stated that a Science Park concept helps the economy with the creation of new jobs, new businesses (spin-offs), and the attraction of businesses (Buck Consultants International, 2014). The increase in businesses, jobs, and spin-offs are partially a result of changes in policies. Since the 1960s research was not the goal, but seen as a supporting factor to education. After this the government funded mostly research projects with a practical application that needed to be of relevance to society. However, during the Rutte I cabinet the funding of research transformed into a 'knowledge-skill-jackpot', meaning that research is connected to the economic value chain and not only to educational objectives (Buck Consultants International, 2010; Kooij, 2014; Ministry of Economic Affairs, 2010).

Nevertheless, the quality of real estate on a Science Park is of great importance for its competitiveness. With high quality real estate more entrepreneurs will be attracted, thus, resulting in more innovativeness on a Science Park (Boekholt, et al., 2014; Zeemeijer, 2016). It is necessary for the competitiveness of the Dutch economy and welfare in the future to create a more knowledge based economy, however, then the real estate in the technology sector needs to be of a higher level (Boers, 2013; Ministry of Economic Affairs, 2015; Zeemeijer, 2016).

### *Financial status*

The fast growing number of companies in the technological sector demand a large amount of high quality real estate (Boers, 2013). However, currently there is a shortage of high quality real estate in the Dutch technological sector, especially the public research facilities are outdated due to the fact that businesses are not willing to be co-financier. Therefore, these facilities mainly rely on public capital (Ministry of Economic Affairs, 2015). According to the Ministry of Economic Affairs (2015) 500 million euros are needed to keep these research facilities up to date. This delays the development of R&D activity by small companies, although larger companies (like Philips, ASML, NXP, DSM, AkzoNobel, and Unilever) still maintain their R&D at a stable level (Zee, Manshanden, Bekkers, & Horst, 2012). The total expense in R&D of each different sector in the Netherlands is visualized in figure 6, during the years 1990 till 2014. The left axis in the figure defines the ratio of the different sectors and their expenditures, the right axis the total amount of million euros spend on R&D in the Netherlands, and split across different sectors.

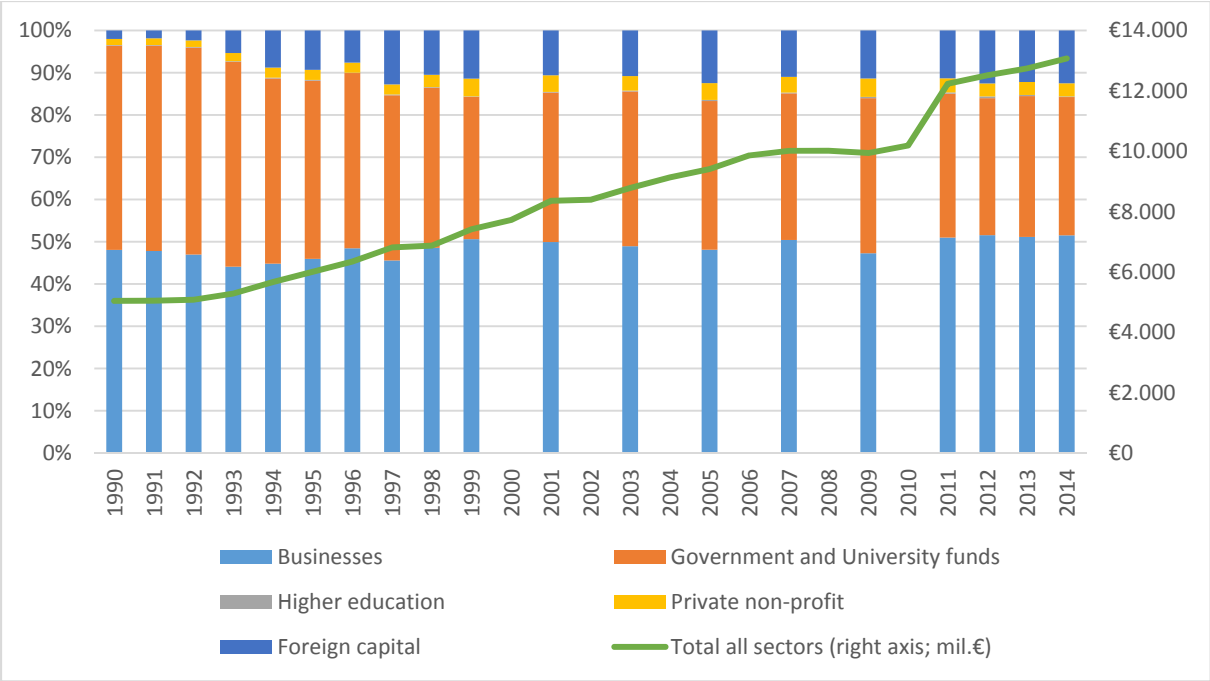


*Figure 6, total expense R&D in different sectors in the Netherlands in million euros. Source: CBS Statline (2016), edited by author.*

Figure 6 shows an increase in the expense of R&D during the years, with the highest expense in the Netherlands of approximately 13,074 million euros in 2014 (green line in figure). The amount of R&D expense of businesses has the highest ratio with 51.5%, the lowest ratio of R&D expenditure is higher education with 0.2% (and therefore not shown in figure 6). The ratio of foreign capital R&D expense has been rising during the years, while government and University funds have been declining. Thus, it can be concluded that the absolute amount of R&D expenditure has increased over all different sectors. However, in some sectors the R&D expense is higher than others, resulting in a ratio that changes during the years. For instance the sector businesses had an increase of R&D expenditure of approximately 222 million euros last year (2014), while government and University funds had an increase of respectively 30 million euros (CBS, 2016).

A large amount of R&D expenditure is the high investment that needs to be made in technological facilities, due to the fact that there are offices, laboratories, clean rooms and pilot production units required (Boers, 2013). Banks are conservatively minded and only investing in markets they are familiar with, this is resulting in a lack of venture capital (Ministry of Economic Affairs, 2015). This not only creates a problem in the financial aspect but also in the time aspect, the moment of investing till the moment the investment gets profitable is large (Boers, 2013). Mature Science Parks already have investors and venture capital, mostly in different funds, in order to keep its real estate on level and stimulate starting businesses (appendix A) (Löfsten & Lindelöf, 2002). However, for Science Park developments it can be hard finding an investor, due to the fact that it is specific real estate, and thus not easy to transform in case vacancy arises. Private parties that are the owner of a Science Park carry the risk of operating the real estate. The detached attitude of the banks in investing capital and providing a loan is making it difficult to finance the real estate developments on a Science Park. Therefore, investment funds for Science Parks are created in which private parties can participate. The conservative minded banks cause damage for the innovativeness and competitiveness of the economy, as a result the economic welfare of the Netherlands is at risk (Dinteren & Keeris, 2014b).

The funding of R&D real estate is a stable investment in the industrial market for the direct rate of return. However, the indirect rate of return causes a higher risk due to the fact that the technological specifications of R&D real estate is ageing fast. Therefore, within the operating of R&D real estate this

risk is included, making the rents for R&D real estate higher than for office- or industrial space. This leads to a higher book value on the balance, due to the high investment that needs to be made by the lessor for the different specific conditions, finishing, and furnishing. In addition the employees of technological firms are higher educated and thus have a higher living standard. In order to keep them, the working climate needs to be of high level (Dinteren & Keeris, 2014b). Nevertheless, the investment in R&D real estate is hard to obtain with the fact that it is an unknown sector for banks and most investors, even with the different programs from the government to provide grants for the development of R&D real estate (Boekholt, et al., 2014).

## 2.3 MAIN CHARACTERISTICS

There are different factors that are contributing and supporting a well-functioning Science Park, the results in the study of Kooij (2014) contain some 'success factors':

*"…excellent knowledge carrier, shared facilities, incubators, professional campus management, public-private partnerships, space for experimentation, trained staff, venture capital, supportive government policy, supporting businesses and a good regional ecosystem (Kooij, 2014, p. 11)."*

The different real estate facilities, policies, human talents, financial equipment, and businesses that are mentioned in the above citation can be categorized in four main characteristics that are of influence for the functioning of a Science Park (Buck Consultants International, 2009; Huang, 2013; Kooij, 2014; Ministry of Education, Culture and Science, 2014). These four characteristics are visualized in figure 7, and consist of: manifest knowledge supporter, high quality real estate, networking, and focus on R&D.

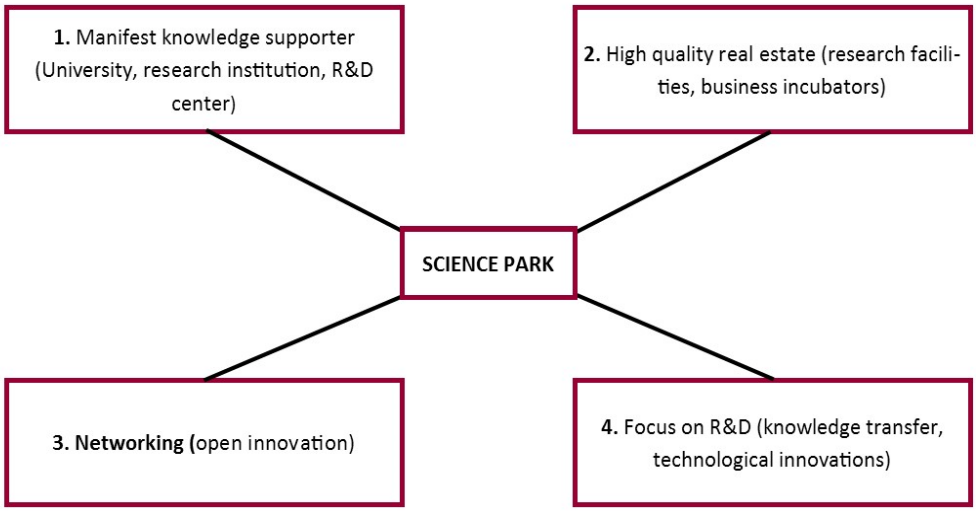


*Figure 7, main characteristics of the Science Park concept. Source: Buck Consultants International (2009), Huang (2013), Kooij (2014), Ministry of Education, Culture and Science (2014), edited by author.*

However, there are many Science Parks that miss one of these main characteristics, although, for a well-functioning Science Park these characteristics are needed. Especially during a period where many new Science Park developments are created, a Science Park needs to distinguish itself (Buck Consultants International, 2014; Huang, 2013; Kooij, 2014). This trend and the popularity can result, on municipal level, that a Science Park is being seen as an improvement of the image of a city rather than the transfer of knowledge and the creation of innovation (Dinteren & Pfaff, 2011). Therefore, the Science Park concept need to be well guarded, otherwise it is just a business park (Frej, 2001). The four different characteristics that a well-functioning Science Park needs to have will be elaborated and clarified in the next couple of paragraphs.

### *1. Manifest knowledge supporter*

To establish a Science Park a manifest knowledge supporter needs to be present in the form of a University, research institution, or R&D center. These manifest knowledge supporters (anchor tenants) drive the other firms of the Science Park (Hansson, 2007). The type of Science Park depends on the manifest knowledge supporter, this will be further elaborated in paragraph 2.4. Furthermore, the origin of a Science Park is mostly from the manifest knowledge supporter and seen as a strategic move, for example (Kooij, 2012; 2015):

- A business or University has a spin-off that settles nearby in order to share facilities and knowledge;
- A business or University needs to occupy vacant real estate that relies heavily on the financial balance;
- A business or University stimulates its suppliers to settle nearby to reduce costs and optimize the process;
- Competitors locate near each other and start precompetitive collaborations to reduce the R&D costs.

### *2. High quality real estate*

The real estate on a Science Park needs to be of high quality with joint facilities where smaller companies can share their laboratories in order to reduce costs. Also the accessibility and physical locations are of high importance for the Science Park. The spatial development of a Science Park concept contains industrial complexes, incubators, and other real estate that is tailored to R&D, resulting in a mixed use area of office and industrial real estate functions (Dinteren & Keeris, 2014b). This is in line with Boers (2013) which states that the real estate on a Science Park consists of offices, laboratories, clean rooms, and pilot production units. The access to academic knowledge and the expertise of businesses on their site, is an essential connection for the functioning of these type of businesses (Löfsten & Lindelöf, 2002). Furthermore, a Science Park needs to facilitate business incubators, where start-ups and spinoffs get a chance to develop themselves offering shared facilities and support to improve the survival rate and growth of the businesses (European Union, 1990; Kooij, 2010). An incubator can be seen as a multi-tenant building that is focused on start-ups with four main aspects that make an incubator attractive for start-ups to settle:

1. Shared office space with favorable rents;
2. Shared supporting facilities in order to reduce the overhead costs;
3. Professional business support and advice;
4. Opportunity to create an internal and external network (for example, through open innovation).

These aspects reduce the chance of failure for starting businesses, due to a dynamic business development concept and a high variety of activities (Aaboen, 2009; Bergek & Norrman, 2008; CSES, 2002; Lamnak, 2015). According to McAdam & McAdam (2008) the lifecycle of a start-up in an incubator can be categorized in five different phases, these phases are further elaborated in table 3.

*Table 3, different phases of a start-up in an incubator. Source: Greiner (1998), McAdam & McAdam (2008), edited by author.*

| | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 |
|---|---|---|---|---|---|
| **Definition** | Starting (policy plan) | Starting, growing (basic facilities) | Growing (learning programs) | Growing, leaving (control/advice) | Leaving (coordination) |
| **Basic shared Real estate** | Office facilities, Canteen, Parking space, Reception (administrative employees), and optional laboratories. | | | | |
| **Use of shared knowledge/ services** | - | - | Entrepreneurship programs/ exchange of advice | Accessibility to: investors, research, services, and advice | Same as phase 4 only with coordination from advice and investors |

The first two phases can be roughly seen as the first two years of a start-up business. During this time the businesses share their administrative employees in the incubator as well as the basic sharing facilities, like: canteen, parking space, reception and office facilities. The sharing of laboratories is optional, due to the fact that computer simulations in some cases can replace the expensive laboratories. During the next phase (3) the start-up can be identified as growing, within this phase different entrepreneurship programs are offered and advice will be exchanged. In the fourth phase the start-up has accessibility to investors and research, however, they still have accessibility to the advice of phase three. In the last phase (5) the start-up is leaving and is supported by coordination from advice and investors, during this phase the start-up is preparing to settle in their own building. These different phases are also visualized in figure 8 (Greiner, 1998; Lamnak, 2015; McAdam & McAdam, 2008).

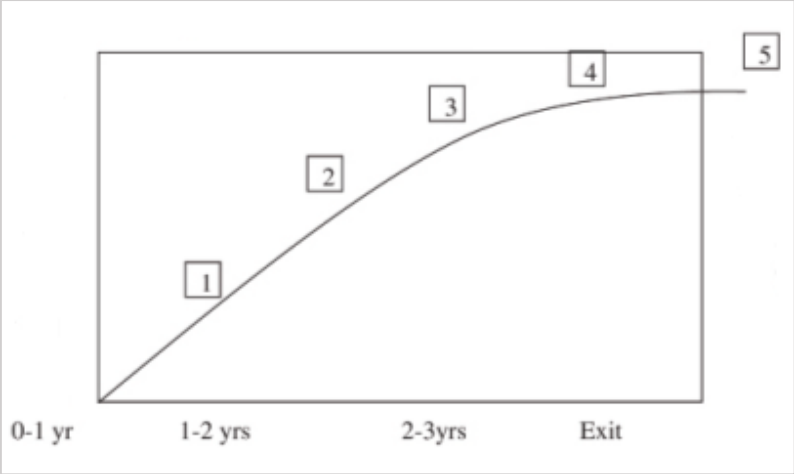


*Figure 8, lifecycle of a start-up in an incubator. Source: McAdam & McAdam (2008).*

### *3. Networking*

The connection between government, business and university (triple helix) is essential for start-ups and their knowledge transfer. Thus, for the growth of a start-up they are more depending on social networks than only the individual performance (Culkin, 2013; Tang et al., 2014; Weterings & Ponds, 2007). Therefore, in order to meet a start-up's demand a good network with the right mix of actors needs to be available at the incubator (Lamnak, 2015). The incubator where a start-up is situated need to have a triple helix connection in order to facilitate knowledge transfer with well-equipped laboratories. In addition the connection with industrial clients, suppliers and supporting businesses (e.g.: ICT, cleaning firms, etc.) is beneficial for the starting businesses (Culkin, 2013; Tang et al., 2014; Weterings & Ponds, 2007). Furthermore, it is beneficial for a Science Park to stimulate open innovation (Buck Consultants International, 2014). With open innovation external knowledge is added to the internal process in order to increase the effectiveness and create extra value to R&D. Resulting in boundaries between firms and research institutions that become vague, this can lead to spinoffs that establish themselves on the Science Park (Chesbrough, 2006). The addition of external knowledge prevent an (local) organization from getting into a non-competitive technological isolation and helps establishing the continuity of the region (Bathelt, Malmberg, & Maskell, 2004). A network is created where knowledge transfer can take place, due to the collaboration of different businesses (Kooij, 2010). Collaboration and competition between starting businesses and the stimulation of interaction and meeting enhances the serendipity, thus, resulting in a higher survival rate for starting businesses (Lamnak, 2015).

The essence of a well-functioning network for a Science Park is determined in the 'buzz-and-pipeline' model of Bathelt et al. (2004). The local network within the region defines the quality of the cluster, their knowledge, skills and information. However, a system of global pipelines that connect the local

knowledge region with other regions elsewhere is of essence for the competitiveness of a Science Park. A global network creates competitive advantage for the Science Park to obtain new and valuable knowledge that is created around the world. When the information is obtained via the global pipelines, other firms in the region also acquire this through buzz (Bathelt, Malmberg, & Maskell, 2004). This model is visualized in figure 9.

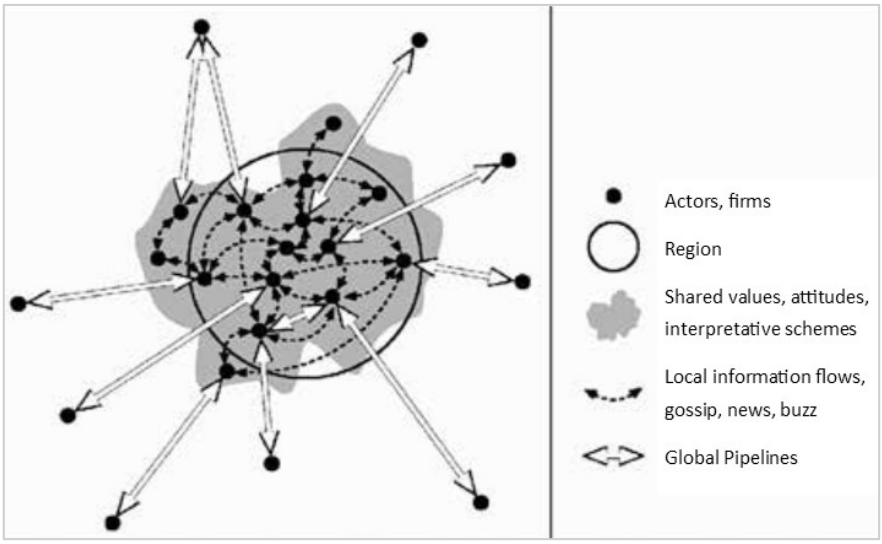


*Figure 9, buzz-and-pipeline model. Source: Bathelt, Malmberg, & Maskell (2004), edited by author.*

However, in order to create and maintain a global linkage for a firm it requires effort, time, and capital. In addition there needs to be trust between different regions and organizations in order to share knowledge and information (Bathelt, Malmberg, & Maskell, 2004; Huang, 2013). Furthermore, relational capital is of importance for the persistence of a Science Park. Where not only the collaboration within the region is of importance, but also the external knowledge and professional networks are beneficial for the region. The (inter-regional and international) network, as mentioned earlier, prevent isolation and loss of competitiveness for the region. In addition the region where the Science Park is located needs to facilitate and attract human capital (talent) with educational programs (Universities, research institutions) and a high quality of urban life, thus, higher educated people demand a higher life standard (Huang, 2013).

### *4. Focus on R&D*

To create a Science Park a foundation needs to be established for businesses and organizations to cooperate and create an intensive innovation climate, with an active policy that is focused on research and development for the transfer of knowledge and creation of innovation (Technopolis, 2009). For the functioning of the Science Park concept it is essential to create a theme with a climate where businesses in the same sector operate. The real estate area developments are more or less supportive services consisting of industrial complexes, incubators, laboratories, and other real estate that is focused on supporting the R&D of businesses (Dinteren & Keeris, 2014b). This innovative climate with the focus on R&D affects the region of the Science Park, this is visualized in figure 10 which is based on the buzz-and-pipeline model in the previous paragraph.

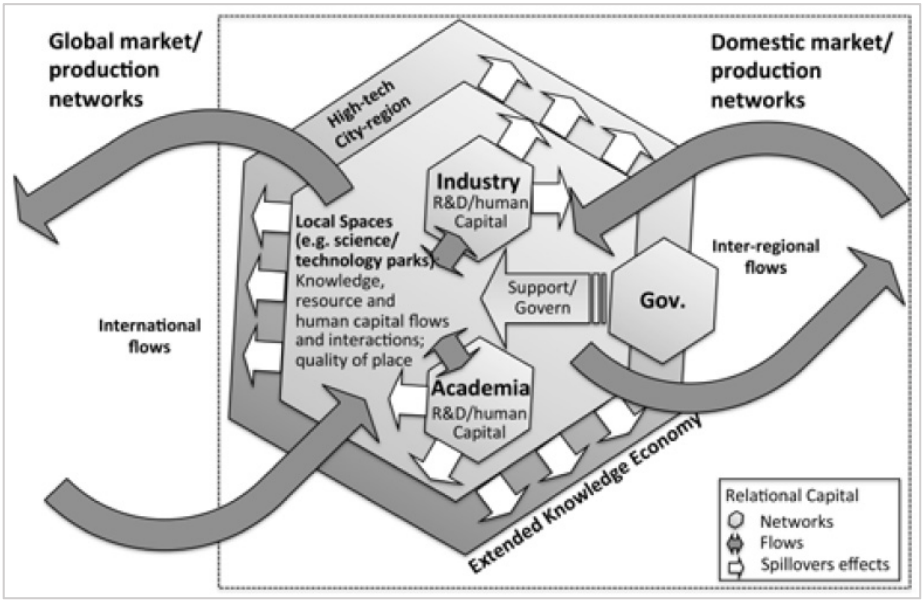


*Figure 10, interrelationship between key players. Source: Huang (2013).*

In figure 10 the industry and academia are with their R&D focus the generators and exploiters of knowledge. Within the region they create an innovative climate in order to develop new technologies. The government is only a supporting function and facilitates with grants, zoning plans, and (municipal) land policies. Eventually the government of the region gets an economic growth in return (Huang, 2013). However, a note must be made that industry and academia need a R&D focus that is in line with the theme of the Science Park for the transfer of knowledge between businesses that want to cooperate with each other (Dinteren & Keeris, 2014b).

## 2.4 Types of Science Parks

Based on the manifest knowledge supporter of a Science Park a diversification can be made in the current Dutch Science Park market. The popularity of the Science Park concept is shown in appendix B, where there is a large amount of Science Parks venturing in the idea, starting, and growing phase (Buck Consultants International, 2014). A Science Park development can be seen as a subcategory from business parks, however, it needs to be distinctive enough with the main characteristics, mentioned in the previous paragraph, otherwise it will just be a business park (Frej, 2001). In appendix C a detailed overview is shown of the Science Park developments in the Netherlands (except the Science Parks in the idea phase), with the phase their currently in and their manifest knowledge supporter. In this table twelve Science Parks in the idea phase are left out, due to the fact these are an initiative and situated in the exploration-, feasibility-, and vision phase. Resulting in twenty-seven Science Parks in the starting, growing, or mature phase of which sixteen Science Parks have a University on their terrain or as manifest knowledge supporter. The other eleven Science Parks have businesses as manifest knowledge supporter (Buck Consultants International, 2014). These different manifest knowledge supporters have influence on the management, stakeholders and strategy of a Science Park. Therefore, two different types of Science Parks can be distinguished, Business Science Parks and University Science Parks.

### *Business Science Park*

A Business Science Park has a manifest knowledge supporter consisting of a business with large R&D facility (e.g.: Philips, NXP, DSM, etc.). There are eleven Business Science Parks in the Netherlands (Buck Consultants International, 2014). The management, stakeholders, and strategy is different from a University Science Park, however, they both contain research facilities, like: laboratories, clean rooms, pilot production units, etc. (Boers, 2013). A Business Science Park evolves mostly from a corporate

campus, where one business opens the campus for others (High Tech Campus Eindhoven, Brightlands Chemelot Campus, etc.). Besides the influence of the manifest knowledge supporter, the arrival of new businesses creates extra stakeholders that occupy (rent or possess) the real estate on the Science Park (Kooij, 2015). The ownership of a Business Science Park varies, in some scenario's it is still owned by the business that created the campus, this is mostly in the beginning phase. When the Science Park evolves a frequent occurrence is that the main company focusses on their core business and sells the real estate to a private- or institutional investor, this is called a sale and leaseback construction (Kooij, 2010; 2015). This occurred, for example, with the High Tech Campus Eindhoven that was acquired by the private equity investor Ramphastos (Ramphastos, 2016). Another scenario is that the regional or local government invests in the development of a Science Park in order to create or maintain jobs. In this case a public-private-partnership with the main company (manifest knowledge supporter) is created to divide the risk and gain extra capital through the partnership (Kooij, 2015). An example is the Brightlands Chemelot campus where DSM was planning to leave the province of Limburg, in order to prevent this the regional government invested a large capital in the redevelopment of the industrial park to a Science Park. The Brightlands Chemelot Campus currently has a public-private-partnership with the regional government and the University of Maastricht, to lower the risk and transfer knowledge and talents (Chemelot, 2016; Kooij, 2015). The focus of a Business Science Park is mainly profit, this is also implemented in the incubators that are funded through private equity, however, there still is a risk for the investment in start-ups (Grimaldi & Grandi, 2005). However, to guarantee the livability of a Business Science Park, recreational facilities (retail, hospitality, & leisure) are needed in a park landscape with open areas (Kooij, 2014).

### *University Science Park*

The University Science Park contains a University or research institution as their manifest knowledge supporter. As mentioned earlier, there are sixteen Science Parks in the Netherlands that have a University or educational institution as a manifest knowledge supporter (Buck Consultants International, 2014). This has direct influence on the management, stakeholders, and strategy of the Science Park. According to Heijer (2011) a University Science Park contains different real estate functions than a Business Science Park, thus, a University needs lecture halls, libraries, study space, and (sometimes) student housing, etc. The same applies for the stakeholders of a University Science Park that include governmental policy, University board, University department (controllers and technical managers), and the users (students, employees, etc.). The infrastructure on a University Science Park needs to comply with the students, in addition retail and leisure is acquired to keep the livability of the park (Heijer, 2011).

Universities are funded by the Ministry of Education, Culture, and Science, resulting in an ownership for almost all buildings. The maximum of real estate rented by a University in the Netherlands is 11% for the University of Amsterdam (although this is exceptional, most universities have 100% ownership). Looking at the total portfolio of the Dutch University buildings only 3% of the real estate is rented. The vacancy rate of this portfolio is only 4% due to the fact that the Universities occupy their own buildings, however, it must be noted that Universities are not focusing on a mix of owned and rental real estate making their real estate management less flexible. From the total Dutch University portfolio only 5% is rented to other parties. Thus, due to the increasing knowledge economy the physical place of a University is of less importance, resulting in a shift to a network University. In a network University education, research, and knowledge transfer is related to the businesses and society making the network between Universities, public and private parties of higher importance (Heijer, 2011). In addition the government is encouraging Universities to focus more on research instead of education, resulting in more collaboration with partners outside the universities in order to create an interdisciplinary form of research (Hansson, 2007; Langerak & Spijkerbroek, 2015). This trend explains increasing amount of businesses on University campuses, transforming the traditional university campus into a Science Park with the University as manifest knowledge supporter (Buck Consultants

International, 2014; Heijer, 2007; 2008; 2011). A University Science Park has non-profit incubators, focused on innovation and the creation of new technologies. These incubators are mainly initialized by the government (Grimaldi & Grandi, 2005).

Table 4 summarizes the different characteristics between the two Science Park typologies mentioned in the paragraphs above. The columns contain the type of Science Park and the rows contain the different subjects' stakeholders, resources, real estate facilities, and ownership.

*Table 4, differences between University and Business Science Parks.*

| Type of Science Park | Business | University |
|---|---|---|
| **Stakeholders** | - Governmental policy<br>- Manifest knowledge supporter<br>- (Board) Private owner<br>- Tenants<br>- Owners | - Governmental policy<br>- University board<br>- University department (controllers and technical managers)<br>- Students<br>- Employees (teaching staff, researchers, etc.)<br>- External stakeholders (investors, tenants) |
| **Resources** | - R&D investment (businesses)<br>- Private funding<br>- Research grants<br>- Venture capital | - Public budget resources<br>- Endowment revenues<br>- Tuition fees<br>- Research grants<br>- Venture capital |
| **Real estate facilities** | - Research facilities<br>- Incubator facilities<br>- Offices<br>- Retail & leisure (restaurants, sport facilities, supermarket, etc.) | - Research facilities (laboratories, etc.)<br>- Incubator facilities<br>- Offices<br>- Retail & leisure (restaurants, sport facilities, supermarket, etc.)<br>- Lecture halls<br>- Library<br>- Study space<br>- Student housing (optional)<br>- Academic hospital (optional) |
| **Ownership** | - Owned by main business (manifest knowledge supporter)<br>- Owned by private or institutional investor<br>- Mix ownership of private and public parties<br>- Flexible real estate due to the mix rented/owned | - 97% owned land and buildings by University (3% rented of total Dutch University portfolio)<br>- Transition into flexible real estate, rental buildings |

## 2.5 Interest and focus of parties on a Science Park

The organizational structure of a Science Park is based on the Triple Helix model (academia, industry, and government) in order to create an innovative environment (Etzkowitz & Leydesdorff, 2000). The origin (University or business) of a Science Park starts with one of these three parties or a combination of them. Within the Science Park concept new technologies are developed due to the transfer of knowledge and creation of an innovative climate by businesses and Universities, during the development of a Science Park the government mainly has a supportive function (Huang, 2013). The interest and focus of each of these parties in a Science Park development is different, resulting in three different perspectives from business, University, and government.

### *Business*

The main focus of a business is gaining profit. From a business point of view the creation of a Science Park is mostly seen as a stimulation of efficiency (cost reduction), cooperation, and to strengthen the corporate image (Kooij, 2012). These businesses are operating the real estate in order to create a solid financial cash flow. The same holds for private investors that acquire a Science Park, their focus is adding value (in case of selling Science Park) and make an improving profitability. Investing in R&D real estate has a low indirect rate of return (due to fast aging of specialized real estate), but a high direct rate of return as a result of higher risks and the rapid aging of specialized real estate, this results in higher rents for R&D real estate (Dinteren & Keeris, 2014b). The incubators on a Business Science Park are focused on profit with start-ups are funded through private equity, mostly a fund that is connected to the Science Park, which tries to avoid risk and maximize profit (Grimaldi & Grandi, 2005).

### *University*

The University is mainly focused on the enlargement of human capital with educational programs (Huang, 2013). However, due to a shift of politics Universities need to focus more on research instead of education, the so called 'knowledge-skill-jackpot' is aiming at a connection between research and the economic value chain. This results in a collaboration with partners outside the University, commercializing research for the market (Hansson, 2007; Kooij, 2014; Ministry of Economic Affairs, 2010; Langerak & Spijkerbroek, 2015). Despite this development the Universities' goal is still focused on sharing knowledge and creating new technologies, instead of making profit. Therefore, Science Parks with a University have non-profit incubators that are more focused on the development opportunities for their students, graduates, professors, and PhD's in sharing knowledge and creating new technologies (Grimaldi & Grandi, 2005). Nevertheless, the creation of a network with public and private parties is of importance for the research of a University (Heijer, 2011).

### *Governmental*

For the government a Science Park is seen as an instrument to create economic growth and employment in the region. The concept stimulates R&D activities that connect and attract different businesses on national, regional, and local level (Castells & Hall, 1994; Kooij, 2010). Governments, especially regional and local politics, support Science Park developments with incentives, grants, zoning plans, and land policies (Huang, 2013). Regional and local policies invest in Science Park developments to create and maintain employment, new businesses (spin-offs), and attract businesses to the region. In most cases a public-private-partnership is created to divide the risk and gain extra capital (Kooij, 2015). Through regional public development funds governmental institutions help to stimulate developments where banks are conservatively minded, for instance Science Parks that need capital to fund expensive R&D real estate (Dinteren & Keeris, 2014a).

The interests and focuses of the different parties (University, business, and governmental) are summarized in table 5. It must be noted that within a Science Park development these parties often create a public-private-partnership with each other to lower the risk and stimulate the transfer of talents and knowledge (Huang, 2013; Kooij, 2015).

*Table 5, interest and focus three main perspectives Science Park development.*

| Perspective | Business | University | Governmental |
|---|---|---|---|
| **Interest and focus** | - Performance of the organization (business)<br>- Cash flow focused on profit<br>- Create more value (in case of selling Science Park)<br>- Incubators focus on profit | - Performance of University's research<br>- Cash flow positive although no focus on profit<br>- Development opportunities students, graduates, professors, and PhD's<br>- Incubators focus on research | - Economic growth<br>- Create and maintain employment<br>- Attract businesses<br>- New businesses (spin-offs) |

## 2.6 Defining mature Science Parks

The Science Park development can be categorized in four different phases, namely: the idea, starting, growing, and mature phase. This research identifies the critical factors during the real estate development process towards a mature Science Park, in order to derive management implications for the real estate process of a starting Science Park. However, in order to derive these critical factors from the mature Science Parks it needs to be determined when a Science Park is mature.

The greatest added value of a Science Park in comparison to a normal business park is the knowledge transfer between occupiers. This applies for phases starting, growing and mature in a Science Park development otherwise it will just be a business park (Frej, 2001; Technopolis, 2009). In comparison to the growing phase, a mature Science Park contains a large amount of research institutions and R&D businesses. The difference between the starting and growing phase of a Science Park is the attraction of researchers and businesses, where in the starting phase the physical surrounding was realized (Buck Consultants International, 2014). The mature Science Park needs to be of national importance, as a result of the number of knowledge employees and R&D activities. In addition a Science Park needs to be distinctive and add value to the regional excellence. On local level a Science Park attracts employment and knowledge to the municipality and boosts the image, thus, this also complies for the region the Science Park is operating in (Buck Consultants International, 2009). Furthermore, a mature Science Park needs to contain all four main characteristics (see also §2.5): manifest knowledge supporter, high quality real estate, networking, and focus on R&D. The different requirements that are needed to become a mature Science Park are:

- Large amount of research institutions;
- Large amount of businesses with focus on R&D;
- National importance (result of number employees and R&D activities);
- Distinctive enough, add value to focus region;
- Four main characteristics.

### *Number of Mature Science Parks*

Buck Consultants International (2014) defines eight mature Science Parks in the Netherlands in 2014 (see factsheets appendix A). In table 6 the mature Science Parks are represented in the rows, with in the last row the ratio of the total mature Science Parks in comparison with the total of all Science Parks in the Netherlands. The columns contain the number of businesses, spin-offs, and jobs on the mature Science Parks.

*Table 6, businesses, spin-offs, and jobs on mature Science Parks in the Netherlands. Source: Buck Consultants International (2014), edited by author.*

| Mature Science Park in 2014 | Number of businesses | Number of spin-offs | Number of jobs |
|---|---|---|---|
| Kennispark Twente (Enschede) | 400 | 175 | 5,471 |
| WUR Campus (Wageningen) | 90 | 55 | 1,800 |
| Utrecht Science Park (Utrecht) | 80 | 42 | 1,675 |
| Amsterdam Science Park (Amsterdam) | 120 | 40 | 850 |
| Leiden Bio Science Park (Leiden) | 122 | 27 | 6,583 |
| Science Park Technopolis (Delft) | 219 | 192 | 5,574 |
| High Tech Campus Eindhoven (Eindhoven) | 130 | 55 | 10,000 |
| Brighlands Chemelot Campus (Sittard-Geleen) | 51 | 14 | 1,410 |
| Total mature Science Parks | 1,212 | 600 | 33,633 |
| Current operational Science Parks* | 1,709 | 827 | 41,448 |
| Ratio mature and current operational Science Parks | 71% | 73% | 81% |

**Current operational Science Parks in 2014, Science Parks in idea phase are left out.*

The eight mature Science Parks provide 71% of all businesses, 73% of all spin-offs, and 81% of all jobs on a Science Park. These ratios give an insight in how many businesses, spin-offs, and jobs the eight mature Science Parks provide in comparison to the rest of the thirty-one currently operational Science Parks. Appendix A and C contain a topographical view and background information about the eight mature Science Parks. Furthermore, appendix D contains the number of businesses, spin-offs, and jobs for Science Parks in the growing and starting phase. From the eight mature Science Parks there are two Business Science Parks, High Tech Campus Eindhoven and Brightlands Chemelot Campus, due to their manifest knowledge supporter. The rest originates from a University, and therefore, a University Science Park.

## 2.7 Conclusion

Having examined the Science Park phenomenon in this chapter, a conclusion is formed that answers the first sub research question:

*"What is a Science Park and its main characteristics?"*

The organizational structure of a Science Park is based on the triple helix model of Etzkowitz and Leydesdorff (2000). Although, a Science Park is seen as a sub category of a business park there are some differences, for instance: a Science Park is increasing the communities' wealth with the promotion of an innovative culture, the competitiveness of associated businesses, and the presence of knowledge based institution. Furthermore, a Science Park is managed by specialized professionals with a concept that has an active policy for the transfer of knowledge, capital, people, facilitation of R&D, and the acquisition of knowledge-intensive organizations.

In order to create a well-functioning Science Park there are four characteristics required. First a manifest knowledge supporter needs to be present, this is mostly the origin of a Science Park and can be a University, research institution, or (business) R&D center. In addition the real estate on a Science Park need to be of high quality containing industrial complexes, incubators (with shared facilities), and other real estate that is tailored to R&D (laboratories, clean rooms, and pilot production units), this results in a mixed use area with different functions (offices, industrial, etc.). Furthermore, a Science Park needs to have a well-established network with open innovation (adding external knowledge to the internal process and create extra R&D value), human capital, a collaboration with the region and a professional network. Finally, the businesses on a Science Park need a focus on R&D which creates an intensive innovative climate with an active policy in R&D for the transfer of knowledge and creation of innovation. To achieve this it is essential to create a theme were businesses with the same profession operate in.

Depending on the manifest knowledge supporter there can be two types of Science Parks distinguished, Business and University. The most important differences between these two Science Parks are stakeholders, resources, real estate facilities, and ownership. A Science Park is initiated from its manifest knowledge supporter, sometimes in cooperation with the local or regional government. Furthermore, there are three main perspectives in a Science Park development with each a different interest and focus, such as: a business wants to gain profit, a University want to increase the human capital, and the government wants to create economic growth in the region. In this research the critical real estate development factors of a mature Science Park are defined and in order to determine when a Science Park is mature there are several aspects required, these are: a large amount of research institutions and R&D businesses, of national importance, distinctive enough, and possess the four main characteristics. It can be concluded that main characteristics of a Science Park are of relevance for the functioning of the park, otherwise it will just be a business park. Furthermore, these characteristics are of influence on the identification of the critical real estate factors during a Science Park development.

# 3. Real estate development of business parks


*Source: wageningenur.nl*

# 3. REAL ESTATE DEVELOPMENT OF BUSINESS PARKS

In the previous chapter the Science Park phenomenon has been clarified, a phenomenon which is originally seen as a subcategory of a business park. Therefore, due to these similarities the critical real estate factors of a business park development contribute to the identification of the critical real estate factors of a Science Park development. This chapter begins with defining a business park and its different categorizations. In the next paragraph the real estate process in general is examined with the land policy, stakeholders, costs, and financing. The different developing models for a business park are elaborated in the following paragraph. After this the lifecycle of a business park is clarified in the next paragraph. The following paragraph describes the rental prices of business parks in different cities. Having examined all the different aspects in the real estate development of a business park the critical factors are identified in the next paragraph. Finally, the different critical real estate development factors of relevance for a Science Park development are defined in the following paragraph. At the end of this chapter the second and third sub-research question will be answered in a concluding paragraph:

*"How does the real estate development process of business parks in general evolve, and which stages can be distinguished?"*

*"Which of these critical factors have effect on the real estate development process towards mature Science Parks in specific?"*

## 3.1 WHAT IS A BUSINESS PARK?

Before the critical real estate development factors of a business park are clarified, the definition of a business park and its different categories need to be examined. According to Frej (2001) the definition of a business park is:

*"A business park is a multi-building development planned to accommodate a range of uses, from light industrial to office space, in an integrated park like setting with supporting uses for the people who work there. They can range from small parks on several acres to facilities of several hundred acres or more (Frej, 2001 p. 4)."*

As mentioned in the definition, the business park contains different users and real estate that varies from light industrial to office space, these functions are located in a park setting sometimes with supporting facilities (hospitality, retail, etc.). However, this is a general definition of a business park and due to the fact that this research is focused on the Netherlands a more specific definition is needed. The Ministry of Infrastructure and Environment collects data via IBIS[2] on business parks in the Netherlands. In the report of the Ministry of Infrastructure and Environment (2013) the definition of a business park in the Netherlands is:

*"A business location with the minimum of 1 hectare intended for the use of trade, manufacturing, and industry. On these terrains there can be a presence of commercial and non-commercial services (like office buildings, retail), however, these functions have a minority share in terrain size (Ministry of Infrastructure and Environment, 2013 p. 12)."*

This definition has a lot of similarities with the general definition, thus, in the Netherlands a minimum of one hectare is required and the business park needs to be used for trade, manufacturing, and industry (Ministry of Infrastructure and Environment, 2013). Leeuwen & Lentfering (2014) emphasizes

[2] IBIS (Integraal Bedrijventerreinen Informatie Systeem): integral governmental information system for business parks part of the Ministry of Infrastructure and Environment (Ministry of Infrastructure and Environment, 2013).

this definition, although, they use the term business services instead of industry. In the literature there are several categorizations found of business parks. However, different authors state that it is hard to establish a subdivision due to the fact that there are a lot of similarities between the different categories, resulting mostly in a combination of different functions (Bongenaar & Olden, 1993; Frej, 2001; Louw, Needham, Olden, & Pen, 2009; Olden & Terhorst, 1988). Table 7 contains the different categorizations in the literature combined with the Dutch report of Stec Groep (2012), whereas a gradation of the appearance is used and the application of the business park is defined.

*Table 7, categorization of business parks. Source: Frej, (2001); Stec Groep (2012), edited by author.*

| Appearance | Application |
|---|---|
| • **High quality** | • Logistics locations |
| • **Mixed modern** | • Office locations* |
| • **Functional** | • Light industrial locations |
| | • Heavy industrial locations (environmental pollution) |

** Business parks with more than 50% and less than 100% office space.*

The appearance of a business park can vary from high quality (high), mixed modern (average), and functional (low). When the quality level is determined, the application of a business park can be categorized as logistic, office, light industry or heavy industry (environmental pollution). Thus, as already mentioned a business park can contain different multiple applications. For example, there could be offices combined with light industrial activities. The Science Park concept is seen as a subcategory of a business park that consists of a high quality development with multiple applications depending on the theme of the park (Frej, 2001; Stec Groep, 2012).

## 3.2 Real estate development process in general

The real estate development process consists of different stages and costs that are defined in the literature, some in more detail than others. In figure 11 the studies of Peet (2014) and Friedman (2006) are combined resulting in a visualization of the different real estate development phases. Where the black lines represent the general real estate development process from the study of Peet (2014), and the red boxes contain the detailed real estate development process from the study of Friedman (2006).

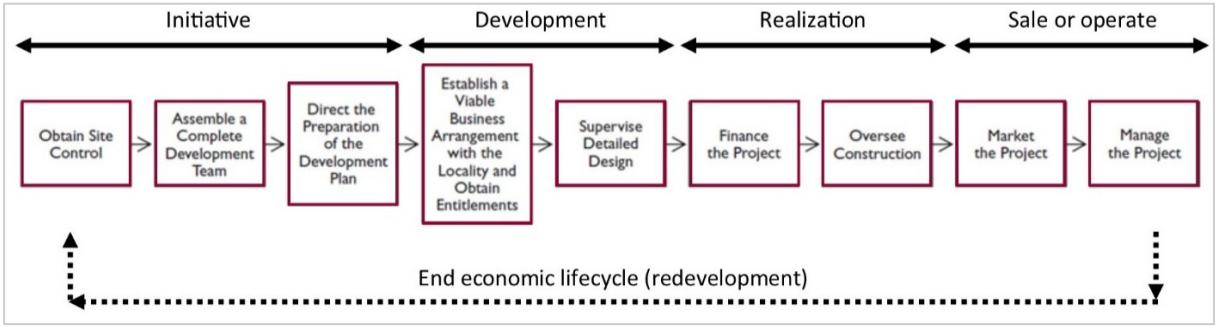


*Figure 11, real estate development process. Source: Friedman (2006), Neprom (2010), Peet (2014), edited by author.*

During the real estate development process these phases are always present: initiative, development, realization, and sale or operating phase (black lines). Furthermore, once the operating phase has ended the real estate is at the end of its economic lifecycle and will be redeveloped (transformed or demolished) (Peet, 2014). However, Friedman (2006) examined a more detailed overview of the real estate development process is distinguished (red boxes). Within this study only the real estate development process is taken into account, and not the total lifecycle of the development containing the redevelopment phase. The different phases and stages in the real estate development process shown in figure 11 are further elaborated in table 8, where a detailed explanation is given by each development stage based on several literature sources.

*Table 8, explanation real estate development stages. Source: Neprom (2010), Peet (2014), Friedman (2006), Steiner & Butler (2006), Wilkinson & Reed (2008), edited by author.*

| Development stage | Detailed stage | Explanation | Source |
|---|---|---|---|
| **Initiative** | Obtain site control | The first risk and costs of a development project. Options to obtain site: acquisition, contracts, options, and public-private partnerships. | Friedman (2006) |
| | Assemble a complete development team | Engaging architects, engineers, planners, financial consultants, and other professionals. | Friedman (2006) |
| | Direct the preparation of the development plan | Governmental- and financial approval. Basic aspects development plan: market potential, site capacity, economic feasibility, current, zoning/entitlements, and concept plan/site master plan. | Friedman (2006) |
| **Development** | Establish a viable business arrangement with the locality and obtain entitlements | Rezoning, agreements on infrastructure, agreements on site remediation, forming a price for land (if involvement of public land), confirm responsibilities for public improvements, for public improvements form development management agreements for parking, incentives, environmental issues, building permits, and zoning and plan approvals. | Wilkinson & Reed (2008), Friedman (2006), |
| | Supervise detailed design | Ensure that all issues related to regulations, marketing concerns, engineering issues, cost containment, and so on are addressed (4-7% of costs to groundbreaking) | Friedman (2006), Steiner & Butler (2006) |
| **Realization** | Finance the project | Construction loan, equity drawn from the developer or investors, Permanent financing/take-out loans, end-buyer financing | Steiner & Butler (2006) |
| | Oversee construction | Oversee architect and constructor (developer some level of construction knowledge needed) | Friedman (2006) |
| **Sell or operation** | Market project | Expertise in marketing, set strategy and approach. Sometimes arranging the financing for the tenant. | Wilkinson & Reed (2008) |
| **Operation** | Manage project | Keeping the continuity of the project. | Wilkinson & Reed (2008) |

The different development stages in a real estate development process all contain factors that are essential for the continuity and success of a real estate development. In addition the real estate development becomes less flexible when the development is further progressed (Peet, 2014). Due to less flexibility during the progress of a real estate development and the previous economic crisis, developers are more cautious with the start of the development phase. Therefore, developers more often try to find tenants or buyers for the real estate development in the initiative phase (Neprom, 2010; Peet, 2014). The real estate development process shifted from tight planning and large-scale to flexible planning and phased development resulting in a lower investment, in addition the users and owners are more involved during the development process (Neprom, 2014). The phased development and flexibility during the development are important critical factors in the real estate development process (Neprom, 2010; Peet, 2014). The different land policies, stakeholders, development costs, and financing of the real estate development will be further elaborated.

### *Municipal land policy*

The municipalities are responsible for the zoning regulation and the area development, controlling the land policy in their municipality. There are three different land policies for a municipality in the Netherlands, these are elaborated in table 9 summarizing the policy, land ownership, and its advantage or disadvantage (Rijksoverheid, 2016a).

*Table 9, different Dutch land policies. Source: Rijksoverheid (2016a), edited by author.*

| Land policy | Land ownership | Advantage | Disadvantage |
|---|---|---|---|
| **Facilitating** (developer, or other party, acquires land) | (Almost) complete ownership by market or private. Government can make demand (like, zoning plan) | Government takes no financial risk | No profit for the government. Less control in development. |
| **Partnerships** (government collaborates with private partner, i.e.: public-private-partnership) | Owned by government or private partner. | Risks are divided, joint development | Often sharing the profits. |
| **Active** (government acquires land) | Owned by government | Profit for government. Control over the development, government has leading in initiative and feasibility phase. | Government takes financial risk. |

As mentioned in table 9 there are three different forms of land policy for Dutch municipalities, these are facilitating, partnerships, and active. The facilitating land policy contains the least financial risk, however, the profit is not high and there is less control on the real estate development. In the policy of a partnership with a private party the risks are divided, profits are shared, and there is more control on the development, this form of collaboration is also called public-private-partnership. If a municipality has an active land policy there is a lot of control and possible profit on the development, but the risk is also high (Rijksoverheid, 2016a).

### *Stakeholders*

The different stages of a real estate development contain a lot of stakeholders. According to Wilkinson & Reed (2008) there are eight different stakeholders involved in a real estate development process, these are:

- Landowner;
- Private sector, development firms;
- Public sector, governmental institutions;
- Planners;
- Financial institutions;
- Architects and urban landscapers;
- Contractors;
- Affected parties.

These stakeholders have influence on the different development stages of a real estate development. However, it must be stated that these are the stakeholders in general, thus, for each real estate development there is a different tailor made approach needed. Nevertheless, the stakeholders mentioned above are found in every real estate development (Wilkinson & Reed, 2008).

### *Development costs*

The different real estate development stages all have their own costs. Steiner & Butler (2006) elaborated the different costs that are made during a real estate development. These are summarized in chronological order, thus, it depends on the real estate development if all costs are made (e.g., vacant plot results in no demolition costs):

1. Land Acquisition;
2. Site development and improvement;
3. Demolition;
4. Site grading/preparation;
5. Environmental issues;
6. Site utilities and extensions;
7. Construction costs;
8. Additional costs;
9. Landscaping;
10. Off-site costs and fees (interest charges);
11. Other costs.

Depending on the development project the highest costs are made in construction (7) and land acquisition (1). The construction costs depend on the type of building and quality level of the development (Steiner & Butler, 2006). Furthermore, from the total real estate development costs in the Netherlands 57% are construction costs, 17% land acquisition costs and the rest of the percentage is other costs (e.g.: advice, financing, and general costs) (Peet, 2014).

### *Financing*

There are different methods of financing these development costs. In general this is via the owner (private equity) or lender (debt), where the lender is paid first due to the interest on the loan. Furthermore, the private equity is only fulfilled when a project is feasible (revenues - costs = profit). The funding of a development with a public-private-partnership can be partially projected on the government resulting in a lower risk and an extra financial participant, thus, less capital that needs to be lend (Steiner & Butler, 2006). According to Steiner & Butler (2006) there can be some issues in financing a real estate development, the main financing issues are:

- Specific function buildings, specific function is harder to determine the risk or profit in case of vacancy hard to lease (experience developer of concern to lender);
- Lack of comparisons, project is not comparable to others as a result the lender focusses on expertise and experience of the developer;
- A new concept design, these designs are not yet proven, lenders are hesitant in issuing a loan.

These financing issues need to be taken into account within the real estate development. For a real estate development that contains one of these three aspects a tailor made financing is needed, however, it is difficult to obtain capital from the banks (Steiner & Butler, 2006). Nevertheless, Steiner & Butler (2006) elaborated the different financing options for a real estate development, these are:

1. Construction loan: banks provide a loan during the construction of a project. Bank and non-bank lenders can choose to take a share in the profit of a development, sometimes preleases and –sales are required to get loans;
2. Equity from developer or investor: risk capital that is only paid back if the project is successful. Lenders are paid first due to the interest on the loan, the equity providers are the owners that take the risk of the project;
3. Permanent financing, take-out loans: investments over a longer period that take out the construction loan whereby a ‘forward commitment’ is needed;
4. End-buyer financing: financing the project with mortgage brokerage companies that give out loans for the buyers (mostly on residential market).

From the different financing options mentioned above the last one is not relevant for a Science Park development and mostly used in the residential sector. Furthermore, the construction loan (1) can also be in combination with private equity (2) (Steiner & Butler, 2006). Nevertheless, in case of financing issues a tailor made financing is needed, making it a critical factor during the real estate development process (Steiner & Butler, 2006).

## 3.3 DEVELOPMENT MODELS BUSINESS PARK

The different municipal land policies in the Netherlands that are mentioned in §3.2 are of importance for the first phase in the development of a business park. Louw et al. (2009) elaborated six different development models for the realization of a business park. The major differences between the models are related to land development, construction of commercial properties, operate building, ownership, and management of public space (Louw, Needham, Olden, & Pen, 2009). Table 10 shows the different models in combination with the stages in the real estate development process of a business park.

*Table 10, models for development and management of Business Parks. Source: Louw et al. (2009), Olden (2010), edited by author.*

| Model | Land development | Construction commercial properties | Operate building | Ownership | Management |
|---|---|---|---|---|---|
| A | | | End user | | |
| B | Land developer | | End user | | Land developer |
| C | Land developer | Developer | N.A. | End user purchases | Land developer |
| D | Land developer | Developer | Investor/lessor | End user rents | Land developer |
| E | Developer is land developer | | N.A. | End user purchases | Investor/lessor |
| F | Developer is land developer | | Investor/lessor | End user rents | Investor/lessor |

As seen in table 10 the most basic model is A where the end user develops the entire business park, this model is hardly used these days. Model B is widely used in the Netherlands, within this model the municipality develops and manages the business park. The end users in this model purchase the prepared land from the municipality in order to realize their commercial property, the municipality takes responsibility for the maintenance of the public space on the business park (Olden, 2010). As mentioned in §3.2 there are three options for the land development of a municipality for a business park: public, public-private-partnership, or private (Rijksoverheid, 2016a). The municipality is mostly cooperating with the regional businesses in order to develop a business park and stimulate the employment in the area. Sometimes the entire terrain is developed by a private party, but the maintenance of the public space is done by the municipality. In the models C and D the municipality sells the land to a developer, where the developer on behalf of the end user will develop the buildings and sell or operate them. The municipality is still responsible for the maintenance of the public space (Olden, 2010). The models C and D are mostly used for business parks in the logistics sector in which, developers purchase the land and develop logistic complexes (Ministry of Infrastructure and Environment, 2013). The land development and construction of commercial properties is realized by one party in the models E and F, which after completion sells it to the end user. The difference between the models is that in model E the public space is in ownership of an investor/lessor that bought it from the developer. Where in model F the investor/lessor bought the public space and the real estate, and has total ownership over the business park. Most of the Science Parks are developed according to the latter model (Olden, 2010).

The market in the development process of business parks is dominated by municipalities. This is due to the fact that land prices are low and private developers compete with the municipality, which can be the same party that sold the land. This results in developments that are not profitable for private

developers. Private parties have a share of only 27% of the development market of business parks (Ministry of Infrastructure and Environment, 2013). Municipalities develop business parks on demand due to the economic crisis and with an active land policy. Furthermore, there are a lot of dilapidated business parks, municipalities are redeveloping or demolishing these sites. This results in a limited amount of new businesses park locations (Neprom, 2014). With business parks the municipality wants to attract businesses from outside the region in order to attract employment and economic growth. Therefore, the municipal mostly have a business liaison officer employed in the municipality real estate department to attract and advice businesses (Franken, 2009).

## 3.4 LIFECYCLE BUSINESS PARK

When a business park is realized the maintenance phase begins. The lifecycle of a business park consists of four stages: introduction, growth, consolidation, and downturn. Within the consolidation phase the municipality can keep the business park on level with simple precautions. However, if the business park reaches the downturn phase the image of the park is affected, causing the business park to end up in a negative spiral, creating vacancy and dilapidation. If a business park reaches this phase a lot of capital is needed to restructure the business park and make it up to date (Louw et al. 2004). The lifecycle of a business park is also visualized in figure 12.

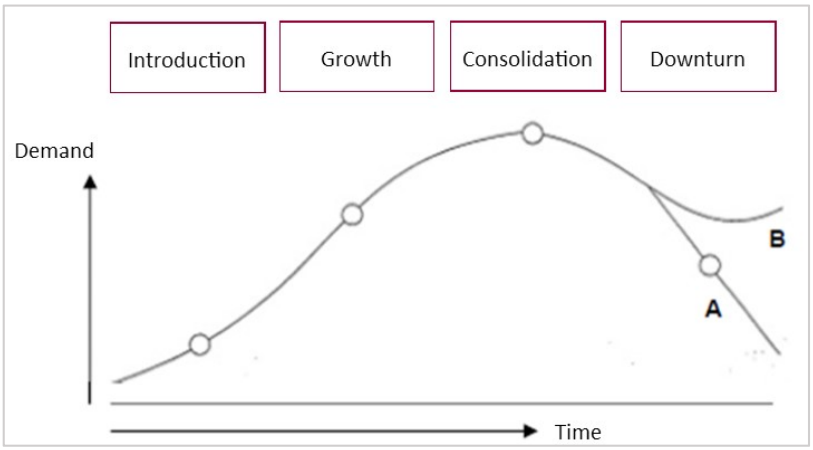


*Figure 12, lifecycle of a business park. Source: Louw et al. (2004), edited by author.*

Line A in figure 12 shows that when there is no park management implemented in the consolidation phase, there will be dilapidation and vacancy on the business park during the downturn phase. Line B represents the introduction of park management for a business park in the consolidation phase for (Louw et al. 2004). Park management enhances the quality of the business park, and with an adequate and efficient maintenance plan financial benefits can be achieved. However, in the end it is difficult to avoid that a business park becomes outdated, nevertheless, with adequate park management the lifespan can be extended (Schapendonk & Enck, 2005). The competitiveness of a business park is visualized in figure 13. The red line represents a large restructuring to keep the business park up to date. With the blue line there are multiple small maintenance updates to guarantee the quality of the business park, this is also called sustainable development (Faber, 2010).

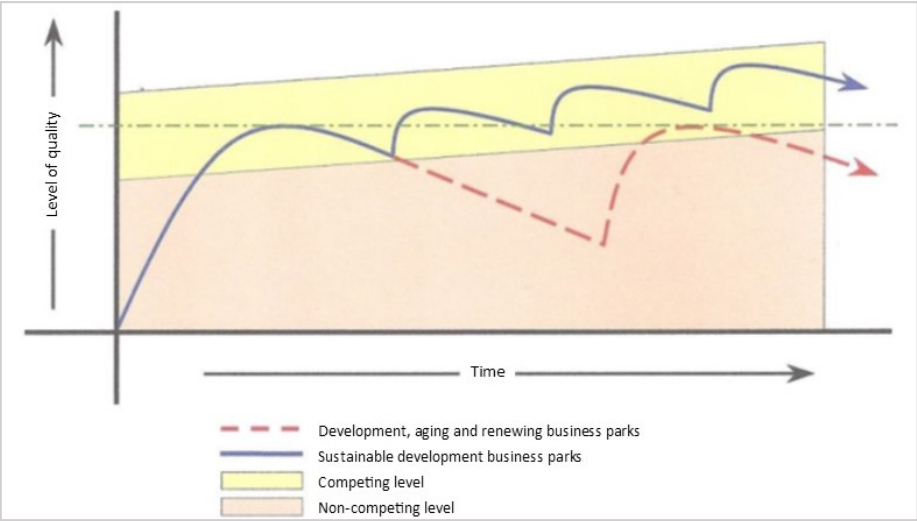


*Figure 13, competitiveness business park. Source: Faber (2010), edited by author.*

In figure 13 the business park has a higher level of quality with a sustainable business development (blue line), resulting in a better and longer competitiveness of the business park (yellow surface). This is different with the business park development that transforms only when it loses its competitiveness (red line), this business park stays longer in the non-competing zone (orange surface). With a sustainable business park development the quality of the park is enhanced, and therefore, it is possible to keep the rents on level and extent the lifespan of a business park (Faber, 2010). Therefore, applying park management to the business park can be seen as a critical factor during the development process of a business park (Faber, 2010; Schapendonk & Enck, 2005).

## 3.5 RENTAL PRICES BUSINESS PARK

The development process of a business park has several models, mentioned in table 11 (§3.3). When the development process of a building on a business park is finished, it can be exploited or sold (Leeuwen & Lentferink, 2014). The rental prices of a business park depend on the categorization of the business park as mentioned in table 7 (§3.1). For example, when a business park is situated in the main category 'high quality' than the rental prices for business space is usually higher. However, it also depends on which specific category a business park focuses, for instance: office business parks are more expensive due to the degree of finishing, than logistics, light, or heavy industrial space (Frej, 2001; Stec Groep, 2012).

Different literature sources state that the rental prices on Science Parks are higher, due to the quality of the real estate and the extra services offered. The real estate on a Science Park is mainly rental, to keep grip on the allocation of businesses and guarantee the concept of the park (Dinteren & Keeris, 2014a; Dinteren & Keeris, 2014b). However, this research determines the critical real estate development factors of mature Science Parks. Therefore, it is interesting to capture the average rental prices of business parks located in cities that contain mature Science Parks, in order to make a comparison. In table 11 an overview is given of the rental prices for business parks in the cities that contain mature Science Parks. For these cities the rental prices of office, industrial, and a combination (industrial with office) on business parks are determined.

*Table 11, rental prices for business space in the cities of mature Science Parks in 2016. Source: Cushman & Wakefield (2016a, 2016b), edited by author.*

| Cities | Office (in €/sq.m per year)* | Industrial (in €/sq.m per year)** | Combination (in €/sq.m per year)** | Science Park in the city |
|---|---|---|---|---|
| **Enschede** | 75-130 | 25-40 | 60-75 | Kennispark Twente |
| **Wageningen** | 75-130 | 25-35 | 55-75 | WUR Campus |
| **Utrecht** | 95-200 | 30-45 | 65-85 | Utrecht Science Park |
| **Amsterdam** | 80-400 | 30-50 | 80-120 | Amsterdam Science Park |
| **Leiden** | 70-150 | 30-45 | 60-80 | Leiden Bio Science Park |
| **Delft** | 70-150 | 30-45 | 60-75 | Science Park Technopolis |
| **Eindhoven** | 80-180 | 25-40 | 60-85 | High Tech Campus Eindhoven |
| **Sittard-Geleen** | 65-125 | 20-35 | 55-75 | Brightlands Chemelot Campus |

** Office space of 500 sq.m and larger*

*** Industrial space of 750 sq.m and larger, ex. laboratory space.*

Concluding from this table the rental prices for office space are the highest in Utrecht, Amsterdam, and Eindhoven. For industrial space the rental prices in the 'Randstad' area, Utrecht, Amsterdam, Leiden, and Delft are the highest. Although, the rental prices for industrial space are close to each other. The combination of office and industrial has the highest rents in the cities Utrecht, Amsterdam, and Eindhoven. Where in Amsterdam the highest rents are registered and in Wageningen and Sittard-Geleen the lowest (Cushman & Wakefield, 2016a; 2016b). The rental prices on Science Parks are higher, however, in the literature the rental prices that are available of Science Parks are only nationwide instead of per city. For a University Science Park the rental prices of office space was €195 per sq.m per year and €360 per sq.m per year for research facilities. Business Science Parks note slightly lower rental prices for office space €162 per sq.m per year and research facilities €295 per sq.m per year (Dinteren & Keeris, 2014a).

## 3.6 CRITICAL FACTORS BUSINESS PARK DEVELOPMENT

The literature sources of Frej (2001), Chan, Scott, & Chan (2004), Mondor (2014), Balout (1998), Chua, Kog, & Loh (1999), and Walker & Vines (2000) identify the critical factors during a real estate development. In combination with the different critical factors retrieved from the literature in the previous paragraphs, the critical factors during the real estate development of a business park are divided into three different categories, general and overarching, development process, and financing.

### *General and overarching*

Frej (2001) emphasizes that the flexibility of a business park is the key to success. Furthermore, before the development of a business park starts the market needs to be analyzed in order to determine the needs and functions that are needed in the region (Frej, 2001). In addition several main elements in the creation of a successful business park need to be preset, like: expertise estimate market conditions, financing, suitable design, marketing, and proper maintenance and managing plan for the finished business park. There also needs to be a connection between community and project sponsors in order to find the right balance (Mondor, 2014). This is in line with Chan, Scott, & Chan (2004) that evaluates the project management of a real estate development and concludes that the fast changing factors like environment, political, and economic need to be taken into account (DESTEP[3]). Furthermore, the communication with several parties, the planning and scheduling of a real estate development need adequate control. At the end of a real estate development the possibility to evaluate and guard the project is necessary (Balout, 1998; Chua, Kog, & Loh, 1999; Walker & Vines, 2000).

[3] DESTEP: abbreviation for analysis of external factors Demographic, Economic, Social, Technological, Ecological and Political (Chan, Scott, & Chan, 2004).

### *Development process*

The further the development of a business park is progressed the less flexible it becomes, however, it is essential to keep the development as flexible as possible in order to adapt if necessary (Peet, 2014). Despite the long term investments (infrastructure, buildings, etc.) developers have flexibility as well, they decide when to sell or lease uncompleted parcels or completed buildings in business parks. Therefore, phase development of a business park is essential in order to minimize the risk and keep flexibility. When the market is less positive parts of the development can be terminated or when the market is positive the development can be enlarged (Frej, 2001). Nevertheless, it must be noted that due to the economic crisis developments are more phased and kept as flexible as possible (Neprom, 2014). In addition Mondor (2014) states that in order to spread risk the development of a business park needs to be a mix of land sale, building sale or lease, and build-to-suit. This not only lowers the risk, it also gives the occupier of the business park more variety and thus options to choose from (Mondor, 2014). According to Frej (2001) and Mondor (2014) there are some key design elements in the development of a well-functioning business park, these are:

- Flexible master plan (future expansion flexibility);
- Flexible building design;
- On-site amenities and services;
- Attractive landscaping and public places;
- Accessibility (parking and public transport);
- Efficient circulation.

Furthermore, for the development the developer needs to take governmental regulations into account, like: jurisdictions, business or property taxes, and planning and zoning regulations (Mondor, 2014). However, in the Netherlands business parks are mostly developed on demand by municipalities (active land policy) due to the land that is owned by the municipalities, making it hard to get the development of a business park profitable for a private investor. Thus, a business park development is mostly a redevelopment instead of a new development (Ministry of Infrastructure and Environment, 2013; Neprom, 2014; Rijksoverheid 2016a).

When the development is completed, it is essential for a business park to implement park management, this expands the lifespan and keeps the business park competitive (Faber, 2010; Schapendonk & Enck, 2005). This not only counts for the physical attractiveness of a business park, but also the amenities and services provided by the developer. For an occupier these could include cleaning, maintenance, garbage collection, etc. The developer can attract other businesses as amenities to satisfy employees, these extra service facilities can be restaurants, daycare, fitness, convenience stores, etc. However, in this situation the benefits need to be in balance with the costs that are made by the developer, these amenities are mostly realized for business parks with a high amount of employees. With well-functioning business park management the developer can attract more firms, resulting in a better functioning business park (Mondor, 2014).

### *Financing*

There are three major financing issues, these are: single function buildings, lack of comparisons, and new concept design. When a business park development has one of these financing issues it could be difficult to finance the development, thus, tailor made financing is needed that is hard to obtain from the bank (Steiner & Butler, 2006). However, due to the economic stimulation of the region there could be active participation by the government resulting in tax incentives, grants, or finance assistance to developers (Frej, 2001; Mondor, 2014). In addition when a business park development is phased the developer can presale parts of the development in order to gain capital and develop the business park further. Upgrades of the business park could result in a higher quality and give the owner the option to ask a higher rental or sales level (Mondor, 2014).

The different critical factors during a business park development from the previous paragraphs are summarized in table 12. The columns contain the category and critical factor, and the rows contain the three different categories, general and overarching, development process, and financing.

*Table 12, critical factors business park development.*

| Category | Critical factor | Source |
|---|---|---|
| **General and overarching** | • Flexibility business park<br>• Analyze market needs (DESTEP) and condition<br>• Suitable design<br>• Marketing<br>• Connection surrounding region<br>• Communication all parties<br>• Adequate control on planning and scheduling (phased development) | Frej (2001)<br>Chan, Scott, & Chan (2004)<br>Mondor (2014)<br>Mondor (2014)<br>Mondor (2014)<br>Balout (1998), Chua, Kog, & Loh (1999), Walker & Vines (2000)<br>Balout (1998), Chua, Kog, & Loh (1999), Walker & Vines (2000) |
| **Development process** | • Develop as flexible as possible<br>• Phase development risk mineralization<br>• Mix of building options for occupier<br>• Flexible master plan (expansion possibilities)<br>• Flexible building design<br>• Accessibility (parking and public transport);<br>• Efficient Circulation<br>• Park management<br>• Amenities and services (maintenance, facilities, etc.)<br>• Governmental regulations | Frej (2001), Peet (2014)<br>Neprom (2014), Frej (2001)<br>Mondor (2014)<br>Frej (2001), Mondor (2014)<br>Frej (2001), Mondor (2014)<br>Frej (2001), Mondor (2014)<br>Frej (2001), Mondor (2014)<br>Faber (2010), Schapendonk & Enck (2005)<br>Mondor (2014)<br>Mondor (2014), Neprom (2014), Rijksoverheid (2016a) |
| **Financing** | • Tailor made financing for financing issues<br>• Governmental tax incentives, grants, finance assistance<br>• Phased development for capital | Steiner & Butler (2006)<br>Frej (2001), Mondor (2014)<br><br>Mondor (2014) |

## 3.7 Critical factors of interest for Science Parks

The different critical factors mentioned in table 12 are also relevant for a Science Park development due to its similarities to a business park. Frej (2001) mentioned that the flexibility of a business park is the key to success. The same counts for a Science Park that operates in a sector with rapid changing technologies that require fast adapting real estate (Dinteren & Keeris, 2014b).

However, there are some difficulties in terms of financing a Science Park development, due to the fact that a Science Park development fulfills the three major financing issues; specific function building, lack of comparisons, and new concept design (Steiner & Butler, 2006). A Science Park development consists of high quality specific real estate which requires a large investment. This results in higher rental prices than in comparison with a regular business park, however, the risk is also higher (Boers, 2013; Dinteren & Keeris, 2014a). Furthermore, communication between all parties is of high importance for a Science Parks development due to the main characteristic of networking (knowledge transfer) (Kooij, 2010). The same counts for the marketing of a Science Park and the connection with the surrounding region, these elements need to comply with the focus on R&D of the attracted businesses that need to add value to the theme of the Science Park (Dinteren & Keeris, 2014b). For a business park these elements are of less relevance. In terms of governmental regulations a Science Park has some advantages above a regular business park, due to the attraction of human talent to the region and the increased focus on the knowledge economy the local and regional governments are more willing to stimulate a Science Park development (Dinteren & Pfaff, 2011; Heijer, 2008; Huang, 2013).

Furthermore, a mix in building options is of importance for a Science Park development, due to the different specifications for each occupier in their expertise they require different facilities in their real estate (laboratories, clean rooms, etc.) (Boers, 2013). In addition there are incubators on Science Parks with shared facilities for starting businesses in order to reduce the costs and offer a flexible rental period (Kooij, 2010). These different real estate facilities have effect on the amenities and services that are offered on a Science Park, which are more specific than on a regular business park. Thus, the businesses on a Science Park also pay for the central meeting rooms, restaurant, retail, and leisure facilities in order to stimulate knowledge sharing (Dinteren, 2009; Löfsten & Lindelöf, 2002). In a regular business park development these facilities are mostly not present (Mondor, 2014).

## 3.8 Conclusion

In chapter three the real estate development process in general and for a business park was elaborated, resulting in the critical real estate development factors for a business park and the factors that are of interest for a Science Park. The conclusion in this paragraph answers the second and third sub research question:

*"How does the real estate development process of a business park in general evolve, and which stages can be distinguished?"*

*"Which of these critical factors have effect on the real estate development process towards mature Science Parks in specific?"*

The general real estate development process can be categorized in four phases: initiative, development, realization, and sale or operation. When the real estate is at the end of its economic lifecycle it will be redeveloped (transformed or demolished). However, due to the economic crisis the real estate development process shifted from tight planning and large-scale to flexible planning and phased development resulting in a lower investment. In addition users and owners are more involved in the development process. During a real estate development process there are three different forms of land policy: facilitating (low risk & profit), partnerships (public-private-partnership), and active (high risk & profit). Furthermore, sustainable park management extents the lifespan of a business park, resulting in real estate of higher quality that mostly has a higher rental price. In the real estate development process of a business park there are six development models, each of them have some differences in the land development, construction of commercial properties, operate building, ownership, and management of public space. Most of the Science Parks are developed in a way that the land development and construction is realized by one party and bought by an investor or landlord resulting in total ownership over the public space and real estate.

A Science Park can be seen as a sub category of a business park that consists of a high quality development with multiple specific categories depending on the theme of the park. Thus, as stated in the previous chapter a Science Park concept need to comply the four main characteristics (manifest knowledge supporter, high quality real estate, networking, and focus on R&D), otherwise it will just be a high quality business park. Due to the similarities between a business park and a Science Park the critical factors during the real estate development process of a business park are used in the identification of the critical real estate development factors towards a mature Science Park. The different critical real estate development factors of a business park can be categorized in the following main categories: general and overarching, development process, and financing. The different critical factor that are of relevance during a Science Park development are described in the previous paragraph, although, it can be concluded that most of the critical real estate factors are about the real estate development process, governmental policies, financing, risk management, and the differentiation of real estate facilities on a business park. Furthermore, one of the most important

critical factors during the development was the flexibility on process, area, and building level. In addition the communication between all parties on a Science Park and the connection with the surrounding region is also a relevant factor.

### *Knowledge gaps*

Nevertheless, it can be concluded that there are some knowledge gaps in the literature for the identification of the critical real estate development factors in the process towards a mature Science Park. In terms of the real estate development process, different studies state that a Science Park has some similarities with the real estate development of a business park. These studies give a general development model that is frequently used during a Science Park development, however, a more specific practical input is missing. For example, how is flexibility achieved during the real estate development of a Science Park and what are the side conditions of this development. In addition in terms of governmental policies and grants the literature elaborates the different policies and grants for innovative businesses. However, the policies and grants during the real estate development of a Science Park are only partially specified and miss elements, like: zoning regulations, zoning flexibility, the kind of incentives granted by regional or local governmental land policies, and the competition of other Science Parks due to the municipalities that only boost the image of their city.

Moreover, in terms of initiators and stakeholders it is clear that the manifest knowledge supporter is the initiator of a Science Park. Although, the literature is not describing what kind of role these manifest knowledge supporters have during the real estate development, the same applies for the stakeholders. In terms of financing and risk management the difficulties in financing a Science Park development are elaborated in the literature, mentioning that mature Science Parks already have investors and venture capital. However, there is nothing mentioned about the starting process of mature Science Parks and how they coped with financing during that time or established a solid and stable cash flow during the years. The same counts for risk management, which is marginally examined in the literature on a general level, a more specified level of risk management during the real estate development of Science Parks is missing. For example, what to do with specific real estate if it gets vacant and how is the large investment made in specific real estate earned back without a large risk. Furthermore, in terms of real estate facilities the different facilities that are present on a Science Park are clarified by the literature. However, the phasing of these facilities during the real estate development of a Science Park and the kind of rental agreements that are used for these facilities are not present in the literature.

It can be concluded that the knowledge gaps are found in the different subjects: real estate development process, policy governments & grants, initiators & stakeholders, financial & risk management, and real estate facilities. These different knowledge gaps that are found during the literature study will be answered with qualitative research (interview), clarifying the critical real estate factors during the development process towards a mature Science Park.


# 4. METHOD EMPIRICAL RESEARCH

*Source: karresenbrands.nl*

# 4. METHOD EMPIRICAL RESEARCH

In the previous chapters the main characteristics of a Science Park and the real estate development process in general and for a business park are elaborated. Furthermore, the critical real estate development factors for a business park are determined and the factors that are relevant for a Science Park development are identified. This chapter describes the data collection of this research, starting in the first paragraph with the method that will be used. In the next paragraph the different interview topics are determined, which leads to the creation of an interview guide. The following paragraph reveals the interview population. The final paragraph describes the conclusion for this chapter.

## 4.1 METHOD

Due to the lack of literature on the real estate development process of a Science Park this research is according to Baarda & Goede (2012) exploratory and consists of a qualitative analysis. The data collection of this research, as already mentioned, consists of a literature study and several interviews with professionals that have affinity with the real estate development process towards a mature Science Park. The literature study reveals the existing knowledge about the subject and the knowledge gaps, this data is used to form an interview guide and examine the knowledge gaps during the interviews. The interviews will be individual and semi-structured, based on relevant subjects and knowledge gaps found in the existing literature (Baarda & Goede, 2012). The semi-structured interviews consists of topics that are related to the knowledge gaps, these are supported with open questions in order to steer the interview and prevent the interview to stray from topic. The open questions are used to prevent the answers of the respondents getting affected, instead of presenting the critical factors which can result in biased answers. The results of the empirical research are evaluated, containing the respondents' reaction on the different topics from the committed interviews. Nevertheless, the data from the literature study and the committed interviews will be compared in order to identify the critical real estate development factors towards a mature Science Park in the concluding final chapter. From these factors management implications are derived for the real estate process of starting Science Parks.

## 4.2 INTERVIEW TOPICS

As mentioned in the previous paragraph the interview topics are based on the knowledge gaps that are identified in the literature study of the chapters two and three (see also §3.8). These topics need to steer the interview and retrieve additional information about the different important aspects during a Science Park development. In table 13 the different topics of the interview guide are identified from the knowledge gaps found in the literature (§3.8). The rows contain the different topics of the interview guide and the columns a description of the topics and its relevance.

*Table 13, topics of the interview guide.*

| # | Topic | Description | Relevance |
|---|---|---|---|
| **General introduction** | | Name interviewee, job description, business description, Science Park active on, introduction (purpose) of the research. | To clarify the purpose of the research and the relevance of the participation of the interviewee. |
| **1** | **Real estate development process** | This topic aims to answer the question if the real estate development of a business park differs from a Science Park development, its flexibility and boundary conditions. | Reveals the critical factors of the real estate development of a Science Park. |

| | | | |
|---|---|---|---|
| 2 | **Policy governments & grants** | Topic clarifies the governmental policies, like: flexibility, zoning plan, land policy. Also the policy in terms of other Science Park developments. | Policy and grants that need to be taken into account during the development process of a Science Park. |
| 3 | **Initiators & stakeholders** | Initiators of a Science Park development, cooperation with them and influence on the real estate process. Stakeholders involved in real estate process of a Science Park. | Involvement of initiators & stakeholders in real estate development of a Science Park. |
| 4 | **Financial & risk management** | Financial: investors, create stable cash flow vs. attraction risky start-ups. Specific real estate has higher risk if vacant, starting businesses still have to prove themselves. | Give an insight in the financing of a Science Park development and the intended risk management. |
| 5 | **Real estate facilities** | How the contracts of real estate facilities are formed: flexibility, high rents, expensive real estate, ratio rental/owned, shared facilities. Particular sequence in the development of real estate facilities and its maintenance. | Examine the development order of real estate facilities on SP and the rental contracts of these facilities with tenants/owners. |
| **Optional final covering question** | | Derives the fail factors that are missed, forgot or not mentioned in the answers of the other topics. | Expose critical factors that have not been discussed during the interview. |

The different topics of table 13 are supported by qualitative open questions based on the description of the topic in order to fulfill the relevance of the topic. Furthermore, the importance and relevance is asked of each critical real estate development factor that is answered during the interview. The last topic derives the fail factors that are missed or not mentioned in the answers of the previous topics. The different supporting open questions per topic are shown in table 14.

*Table 14, Topics interview guide and supportive open questions.*

| # | Topics | Supportive open questions |
|---|---|---|
| 1 | **Real estate development process** | • A Science Park is based on a business park (also seen as a subcategory of a business park), is the real estate development process of a Science Park showing similarities with the real estate process of a business park?<br>• How flexible is the real estate development process of a Science Park?<br>• What are the side conditions for a Science Park development? |
| 2 | **Policy governments & grants** | • Science Parks are often seen by governments as a boost for the local and regional economy, is this advantageous during the development process?<br>• How flexible is a zoning plan of a municipality in case of a Science Park development?<br>• What is the land policy of a municipality during the Science Park development?<br>• Are you also facing competition from the large amount of new Science Park developments? How can a Science Park development distinguish itself from the rest? |
| 3 | **Initiators & stakeholders** | • Who are the initiators of a Science Park development? And how is the cooperation with these parties?<br>• Which stakeholders are involved in the Science Park development? |
| 4 | **Financial & risk management** | • Are the businesses with a low risk profile first settled or also direct the businesses with a high risk profile? For instance, start-ups or starting businesses with few financial resources?<br>• The real estate is very specific, so hard to rent out to other parties. How is loss of income by vacancy of the real estate prevented? And how flexible is the building (transformation)?<br>• Long lag phase and high investments before the added value of the real estate translates itself into extra profit, are businesses prepared to pay high rents while the profit of the business still has to proof itself? |

| | | |
|---|---|---|
| 5 | **Real estate facilities** | • In terms of flexibility, how are the rental contracts drafted for the parties that settle on a Science Park (businesses, start-ups, incubators)?<br>• With the development of a Science Park is there a particular sequence in the realization of real estate facilities? And how is the maintenance of the real estate? |
| **Covering optional final question** | | • What are the fail factors during the development of a Science Park? |

The interview guide for the respondents can be found in appendix E, containing the different topics and supportive open questions from the tables 13 and 14. Under each supportive open question an italic text is placed to show some relevant information about the question. However, it must be noted that the respondents were all Dutch, as a result the retrieved data (transcripts from the interviews) is also in Dutch. Therefore, the data from the interviews that is used for this research is translated to English.

## 4.3 Interview population

The interview population consists of professionals that are involved in the real estate development process towards a mature Science Park. To cover all the different aspects there are two elements of relevance in the determination of the respondents:

- *The mature Science Park the respondent is active on;*
- *The profession of the respondent in the real estate development process towards a mature Science Park.*

These two elements relate to the previous chapters two and three, where the different mature Science Parks and the real estate development process is extensively studied. In the selection of the respondents there needs to be enough diversification in order to collect as much data as possible about the real estate development process of a mature Science Park.

### *Mature Science Park*

The interview population of the respondents have affinity with one or more mature Science Parks defined by Buck Consultants International (2014), which are:

1. Kennispark Twente;
2. WUR Campus Wageningen;
3. Utrecht Science Park;
4. Amsterdam Science Park;
5. Leiden Bio Science Park;
6. Science Park Technopolis Delft;
7. High Tech Campus Eindhoven;
8. Brightlands Chemelot Campus Sittard-Geleen.

From these mature Science Parks there are six University Science Parks and two Business Science Parks in the Netherlands. The ideal interview population should cover several mature Science Parks and the two different types of Science Parks (Business and University, appendix C) to collect as much data as possible. In addition it is of added value to create an interview population that is spread out over the different regions in the Netherlands, in order to clarify the different regional governmental policies.

### *Real estate profession*

Within the real estate development process there are different professions. In order to cover the whole spectrum of the real estate development process the interview population need at least one person in each role. Louw et al. (2009) and Olden (2010) examine the three different professions in the development process of a business park (table 10 in §3.3), namely:

- Investor/Landlord (owner);
- Developer;
- Lessor.

The investor or landlord is seen as the owner of the mature Science Park, according to the two types of Science Parks the owner can be public or private (Business or University). The developer can have some overlap in its profession because sometimes the owner is also the developer. The same counts for the profession of lessor, which can either be done by the owner or the developer. However, in order to lower the risk these professions are in most cases done separately. In addition it is of relevance to cover both respondents from private and public owned mature Science Parks, this also applies for the lessor of a Business and University Science Park. The ideal interview population contains each of these professions.

### *Respondents*

The respondents were approached by mail, whereas all respondents reacted positive and within a relative short notice. Which indicated that the professionals were interested in the research and willing to help. Two days before each interview the interview guide was sent by mail in order to give the respondent some preparation before the interview starts. To cover the different mature Science Parks (Business and University) as well as the different professions in the real estate development process there were seven interviews conducted. These semi-structured interviews where recorded and transcribed afterwards. Table 15 contains an overview of the different respondents that are interviewed for this research. The columns contain the mature Science Parks of the respondents and the different specifications of the respondents, like: business, name, function, and profession.

*Table 15, specifications respondents and their mature Science Parks.*

| # | Science Park | Business | Name | Function | Profession |
|---|---|---|---|---|---|
| 1 | Leiden Bio Science Park | Res&Smit | M. Smit | Director | Consultant |
| 2 | Leiden Bio Science Park | Vastgoedbedrijf Universiteit Leiden | F.F.J. Poppelier | Deputy Director | Owner |
| 3 | Amsterdam Science Park | Amsterdam Science Park | L. le Duc | Director | Owner |
| 4 | Novio Tech Campus/ Wageningen UR campus | Kadans Vastgoed (Science Partner) | C. van Dijen | Deputy Director/Partner | Developer |
| 5 | Brightlands Chemelot Campus | Brink (Brink Groep) | E. Verkooijen | Partner/Senior Manager | Consultant |
| 6 | High Tech Campus Eindhoven | Ramphastos | F. Smolders | Director | Owner |
| 7 | High Tech Campus Eindhoven | Kontek (Brink Groep) | P. Timmermans | Director | Consultant |

The seven respondents cover five of the eight mature Science Parks, whereas, three are University Science Parks (respondent nr. 1 to 4) and two are Business Science Parks (respondent nr. 5 to 7). In addition the respondents are active on mature Science Parks in different regions, resulting in an interview population that contains the following provinces: Zuid-Holland, Noord-Holland, Gelderland, Noord-Brabant, and Limburg. Looking at the functions of the respondents there are four director (respondent nr. 1, 3, 6, 7), two deputy director (respondent nr. 2, 3), and one partner (respondent nr. 5). This is beneficial for the reliability of the data collected from the interviews, thus, a more senior function is mostly the result of more knowledge and expertise. Furthermore, in case of the professions of the respondents there are three owner, three consultant, and one developer. From the respondents that have the profession owner, a diversification can be made in public (respondent nr. 2, 3) and private (respondent nr. 6) ownership. However, as previously stated the different professions of the respondents sometimes have overlap with each other, resulting in a wide range of data collection from the broad knowledge of the different professions. Appendix F contains further detailed information about the respondents and their profession. In addition the respondents are visualized in figure 14 with the mature Science Parks their active on.

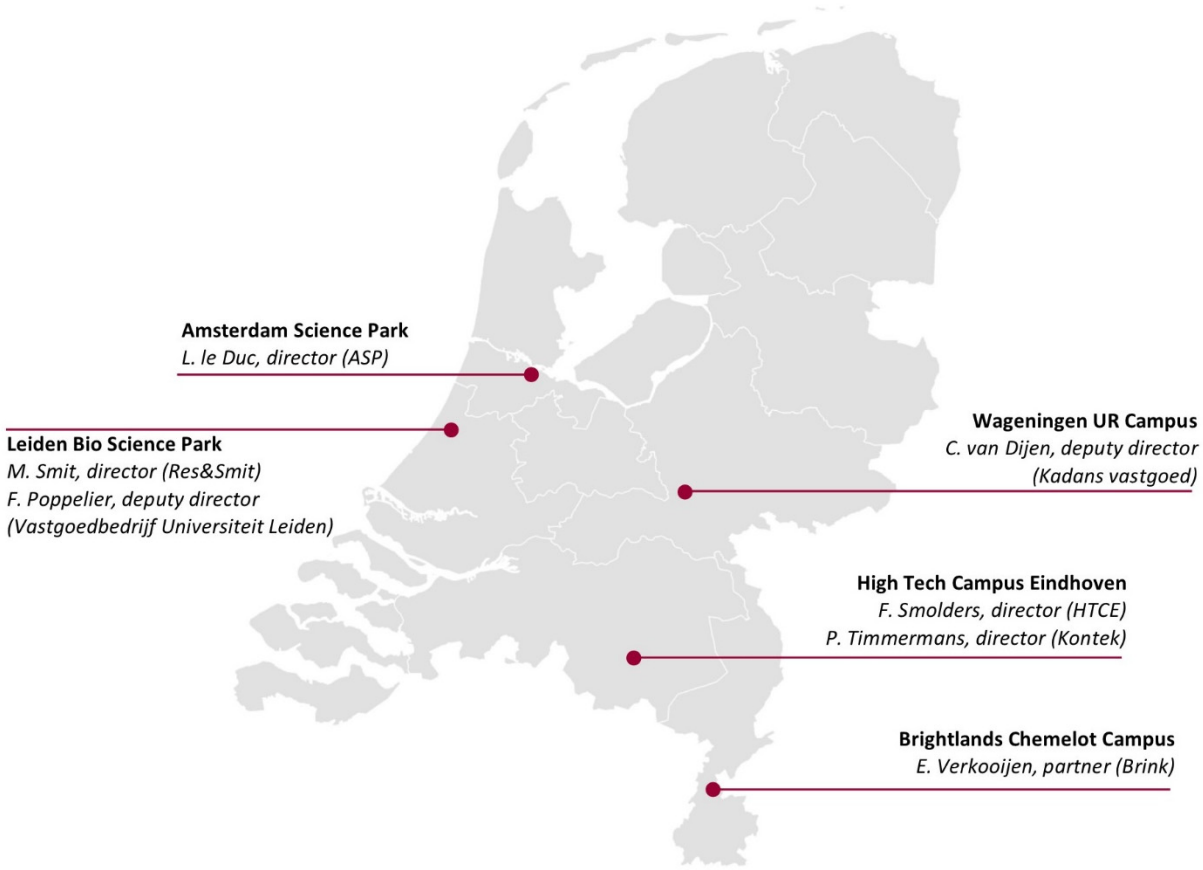


*Figure 14, respondents and the Science Parks their active on.*

## 4.4 CONCLUSION

The conducted literature study in the previous chapters two and three elaborates the different knowledge gaps for the identification of the critical real estate development factors in the process towards a mature Science Park. For the validity of this research the internal factors (literature study) are supplemented with the external factors (interviews) to identify the critical factors. The knowledge gaps are used to determine the different topics in the interview guide, which are supported with open questions to steer and prevent the interview to stray from topic. To avoid biased answers open questions are used instead of presenting the list of critical factors which can affect the answer. The interviews are semi-structured with individuals and per answered critical factor the importance is asked during the interview.

The interview population consists of seven respondents from five mature Science Parks: Amsterdam Science Park, Leiden Bio Science Park, Wageningen UR Campus, High Tech Campus Eindhoven, and Brighlands Chemelot Campus. From these Science Parks there are two Business and three University, which are located in the provinces Zuid-Holland, Noord-Holland, Gelderland, Noord-Brabant and Limburg creating a regional coverage. The different professions of the respondents cover the real estate development process of a Science Park consisting of owners, consultants, and a developer. Furthermore, the respondents had the following functions: director, deputy director, and partner. Due to the seniority of these functions the retrieved information from the respondents is more reliable. With the results from the empirical research and data from the literature the critical real estate development factors in the process towards a mature Science Park are identified.

# 5. RESULTS EMPIRICAL RESEARCH


*Source: bestemmingleiden.nl/bio-science-park*

# 5. RESULTS EMPIRICAL RESEARCH

The seven interviews that are conducted with the interview guide from the previous chapter resulted in the data collection of the knowledge gaps in the literature. This chapter describes the different statements made by the respondents. These different statements will be described based on the different topics in the interview guide. The first paragraph describes the real estate development process of a Science Park containing the amount of flexibility and boundary conditions. The policy of governments is described in the next paragraph with the advantages, flexibility, land policies and competition of other Science Parks. The following paragraph elaborates the initiators and stakeholders of a Science Park. The financial and risk management of a Science Park is described in the next paragraph with the business risk allocation, specific real estate and the large investment that needs to be made while the tenant till needs to prove itself. In the next paragraph the real estate facilities on a Science Park are examined containing the rental agreements and phasing of real estate. The final paragraph contains the fail factors during a Science Park development. The seven different interviews are summarized in appendix G.

## 5.1 REAL ESTATE DEVELOPMENT PROCESS

The real estate development process is according to the majority of the respondents not a planned process, and originated from the manifest knowledge supporter that is present on the park. One of the respondents suggests that a Science Park development is originated from a business process. In addition most of the respondents added that a clear theme is needed to develop a well-functioning Science Park. In line with this a respondent points out that the development process of a Science Park takes longer than a business park, due to the consistency that is needed in guarding the theme, however, the economic rate of return will be higher. Furthermore, there are different reasons to start a Science Park, as one respondent stated sometimes a manifest knowledge supporter returns to its core-business and invites partners for faster product development, sharing knowledge, and reduce costs. This mostly results in a clustering of businesses that are in the same R&D project located on a Science Park. Another respondent acknowledged that the development of a Science Park sometimes is a social issue to keep knowledge businesses in the region, thus, without a manifest knowledge supporter it becomes really hard to create a Science Park. For several respondents from University Science Parks (Amsterdam, Leiden) the reason to start a Science Park was more focused on the commercialization of knowledge and locate spin-offs from the University on the same park. Furthermore, most of the respondents stated that it is of essence to have a triple helix on a Science Park.

"Not starting with bricks but the manifest knowledge supporter"

### *Flexibility development process Science Park*

All respondents emphasized that the development process of a Science Park needs to be kept as flexible as possible. In addition it helps if the Science Park has a large land position, that way there are more possibilities in the development which results in more flexibility. In line with this two respondents assert that the certification of laboratories is not a flexible process because it takes a lot of time. Furthermore, several respondents state that there is a high demand for incubators buildings where start-ups can locate, in order to fulfill the demand and keep flexibility on a Science Park the High Tech Campus Eindhoven and Brightlands Chemelot Campus locate starting firms in older buildings. In addition several respondents acknowledged that when businesses get larger their real estate becomes more specific. According to one of the respondents it is essential to react fast on rapid changing technologies in order to attract businesses to the Science Park. Another respondent amplified this and points out that one owner or party needs to have the lead in order to guard the theme and maintain the flexibility of the park.

"Starting a new Science Park is a hell of a job"

### *Boundary conditions Science Park development*

An important boundary condition that is acknowledged by all respondents is the quality of the infrastructure on a Science Park. The accessibility of a Science Park with car, public transport, walking, and cycling need to be of a high level. Furthermore, the majority of the respondents stated that parking needs to be on the outskirts of the Science Park creating a car free center with retail, leisure, and hospitality facilities. In addition several respondents assert that businesses cannot have their own canteen or large meeting rooms these are all grouped in the central facilities, this stimulates people on a Science Park to meet each other and share knowledge. One of the respondents add to this subject that it is important to create a synergy between the stakeholders on a Science Park otherwise it is just a high quality business park.

## 5.2 POLICY GOVERNMENTS

### *Governmental advantages development process Science Park*

According to all respondents municipalities are positive about a Science Park development and are willing to support these. However, for regional policies level it depends where the Science Park is located. Amsterdam and Leiden received no support from the regional government, due to the fact that the provinces Noord-Holland and Zuid-Holland already have a strong economy. Nevertheless, most of the regional governments are willing to invest in the infrastructure of a Science Park (regional roads, highways, train stations, etc.). The same counts for the High Tech Campus Eindhoven that is not receiving grants or incentives from the regional governments because this Science Park is already performing well and owned by a private investor. However, it must be noted that the Eindhoven region is branded as the Brainport region of the Netherlands by national, regional, and local governments, whereas the High Tech Campus Eindhoven benefits of this marketing. Furthermore, several respondents state that the regional benefits from a Science Park (jobs, businesses, and economic growth) need to be clarified to regional and local governments for their willingness to support. For example, the province of Limburg is investing in the Brightlands Chemelot Campus in order to keep the employment in the region.

### *Flexibility zoning plan Science Park development*

All of the respondents claimed that the zoning plan needs to be as flexible as possible. Therefore, the theme of the Science Park is mostly included in the zoning plan. Some of the respondents point out that safety measures were included in the zoning plan to reduce the risk, for example, Leiden Bio Science Park has a safety zone of 30 meters around laboratories or the High Tech Campus Eindhoven has a chemical island where all dangerous substances are transported to through pipelines. Furthermore, several respondents worked with building contours in the zoning plans of Science Parks to stimulate flexibility. One of the respondents stated that it is beneficial to involve municipalities as soon as possible in the master plan and for decision-making large firms on a Science Park containing a lot of employees can exert pressure on the municipality. This is in line with another respondents who claims that a mutual agreement with the municipality is profitable, offering economic growth in the region and in return the municipality is obliged not to locate new Science Park developments or businesses related to the Science Park theme elsewhere in the region.

### *Land policy municipalities*

The majority of the respondents suggest that in most cases a public-private-partnership for the development of a Science Parks is used, mostly in the form of a foundation. In most Science Park development the situation arises that it is not the core business to invest in real estate. Sometimes public development corporations (BOM, OostNV, etc.) are involved in these foundation. These development corporations are formed by regional governments to divide the risk. The Amsterdam Science Park is a public development (University of Amsterdam, NWO, and municipality) that misses a

private party but has an investor (Rabobank) that provides loans for the incubator buildings. The High Tech Campus Eindhoven was bought by a private investor, resulting in no partnership with the government. In order to guard the theme the buildings on a Science Park are mostly rental and for the land policy leasehold is mostly applied. Furthermore, in most cases the land of a Science Parks is owned by municipalities and sometimes by other parties, for example, in the case of the Brighlands Chemelot Campus DSM still owns the ground due to pollution resulting in the permission of buildings rights for the Science Park developer.

### *Competition other Science Parks*

Most of the Science Parks experience competition from others in the attraction of businesses. Several respondents state that with a strong theme the attraction of businesses is easier. In addition it is beneficial to use the network of a business (or professor) to attract more business with the same profession. However, according to one of the respondents there is a lot of fragmentation on the Dutch Science Park market as a result of creating a positive cash flow some Science Parks attract also non-specialized businesses. Furthermore, the competition is mostly fierce for large firms, sometimes even receiving incentives from governments to locate in the region. For the smaller businesses there is less competition due to the local network these businesses they are more locally focused. Furthermore, the image of the city where a Science Park is located is of influence for the competitiveness, for instance, the Amsterdam Science Park benefits from its location where businesses want to locate in the capital city of the Netherlands. As a result the high tech company ASML from Eindhoven located a research center on the Amsterdam Science Park, partially due to the fact that the company wants to attract human talent from another pool than Eindhoven. Another example is the High Tech Campus Eindhoven which is a well-established name on the Dutch Science Park market, businesses get attracted to this campus partially because of its image. According to one of the respondents some of the professionals from the mature Science Parks meet each other every three months to share knowledge and keep each other updated.

"Unique selling point of a Science Park is the theme"

## 5.3 INITIATORS & STAKEHOLDERS

### *Initiators Science Park development*

The majority of the respondents state that a manifest knowledge supporter is still of influence in the allocation of new businesses, mostly in the form of a foundation to guard the theme of a Science Park. To establish a foundation or consortium a collaboration is formed between different parties, in most cases the manifest knowledge supporter (sometimes a University), a University or research institution, and a public or private party (regional-, local government, public or private investor). However, on the High Tech Campus Eindhoven a different situation occurs, this Science Park is bought by a private investor which guards the theme and for Philips this was a neutral party making it attractive for competing firms to locate on the park. To avoid a conflict of interest it is of importance to create one owner or foundation that guards the theme. For Science Park developments in the Randstad the formed foundation mostly has no regional government included. This is of difference with the Brightlands Chemelot Campus in Sittard-Geleen where the regional government has a large share (investment) in the consortium with DSM and the University of Maastricht, this is the result of maintaining employment and businesses in the province of Limburg.

"Make sure that the Science Park has one owner"

### *Stakeholders Science Park development*

As mentioned in the previous paragraph a foundation or consortium is formed for the attraction of businesses and the management of real estate, due to the fact that this is not the core business of the manifest knowledge supporter on a Science Park. Several respondents stated that the University Science Parks need to attract private investors to invest in the real estate, because at some point it is

not tolerated to invest large amounts of public capital in real estate. For example, on the Amsterdam Science Park the incubator buildings are developed by a foundation (University, municipality, and NWO) in a commercial way with private investment capital from the Rabobank, with the profit from one incubator the other is build and so on. The manifest knowledge supporters are mostly stakeholders of the foundation or consortium that manages and develops on a Science Park. Nevertheless, it is essential for a foundation, consortium, or private party that manages the Science Park to guard the theme and have the possibility to physically and legally control its stakeholders.

## 5.4 Financial & risk management

*Business risk allocation*

All respondents emphasize that in order to create a positive cash flow, the attraction of large firms to a Science Park is essential. This creates stability on a Science Park and as a result the development can be more focused on start-ups. One of the respondents stated that in the ideal way more large tenants (Universities, research institutions, and businesses) are attracted to the Science Park in order to spread the risk, after this smaller businesses or spin-offs from the larger firms will locate on the Science Park. According to another respondent it is hard to attract large businesses to a Science Park, therefore, another strategy could be that large firms acquire start-ups that are present on the Science Park which can result in the settlement of large businesses. In addition one respondent points out that the development starts with low risk firms and if a tenant wants a high adaptation or specialization in the real estate, premium rents are asked and a partnership is aligned for several years. Nevertheless, sometimes a Science Park development needs to locate firms that do not qualify the concept or theme but are needed to cover the cash flow. According to some respondents University Science Parks are focused on facilitating spin-offs that originate from the University on the Science Park. Furthermore, several respondents stated that these Science Parks are less focused on profit and more on the allocation of their students, offering the opportunity to start a business. However, it is not the core business of the University to invest in real estate, therefore, an investor is needed to partially carry the risk. In Leiden Bio Science Park the rental prices of the incubators are gradually increasing during time to stimulate them to eventually locate in their own building. Amsterdam Science Park and Leiden Bio Park are both attracting businesses to create a connection between their students and the business sector.

"Making businesses the ambassador of a Science Park and attract more"

*Specific real estate on Science Park*

All respondents state that there is a shortage in the following real estate functions: laboratories, clean rooms, and pilot production units. According to several respondents the vacancy rate on Science Parks is very low varying from 0.5% till 2%, this also counts for the friction vacancy on Science Parks which is needed to keep flexibility and is in some cases included in the operating prognosis. Some respondents assert that in this case more specific real estate functions (like, laboratories, clean rooms, etc.) are faster occupied due to the high demand. On the Leiden Bio Science Park the incubators are kept occupied due to the long certification of laboratories the tenants want to stay in the incubator, this leads to a rejection of new firms. Several respondents state that the flexibility of the real estate can be achieved in the circulation of buildings, locating starting firms in older buildings and develop or transform buildings for larger tenants, this way there is more flexibility due to this rotation system in buildings. Furthermore, the respondents emphasize that the laboratories of the incubators are the least flexible, however, the rest of incubator needs to be kept as flexible as possible. According to one of the respondents the buildings are being over-dimensioned and the tenant arranges the installation this way risk is lowered and flexibility stimulated. On the other hand another respondent asserts that the building is for 80% finished, and when the tenant is known the last 20% will be finished.

"Ecosystem in incubator buildings with businesses that experience the same problems"

*Large investment and high rents, while profit tenant still needs to prove*

Several respondents acknowledge that in order to cover the large real estate investment of a Science Park a diversification needs to be made in different firm sizes, resulting in a lower risk and a cover of a certain loss of rent. Incubators carry a largest risk with start-ups that possess no capital, this risk needs to be covered by larger firms with longer rental periods and more stability. One of the respondents report that with a strong theme and more facilities, businesses are prepared to pay more. In line with this another respondent points out that a total package is needed including shared facilities (offering receptions, meeting rooms, restaurant, etc.) in the service costs, by sharing these facilities the tenant is saving money. Furthermore, the large investments prevent businesses from moving, due to high moving costs. In some cases public development corporations (for instance: BOM in Brabant, OostNV in Gelderland, etc.) are willing to finance a Science Park development, although, this is depending on the region of the development. The respondents from the Amsterdam Science Park and Leiden Bio Science Park suggest that in University Science Parks there is no hard focus on cash flow, although it needs to stay positive. These Parks are focused on locating spin-offs from the University and for large investments they need to attract a private investor. Nevertheless, according to one of the respondents a Science Park development needs to keep adapting on the market, for instance on the Brightlands Chemelot Campus they are developing clean rooms and pilot production units because the demand is expected to increase.

"Total service offered, matter of plug and play"

## 5.5 Real estate facilities

*Rental agreements*

Every respondent emphasized that the incubators on a Science Park have flexible rental periods, varying from several months to several years. The Leiden Bio Science Park uses rental prices for start-ups in incubators that gradually increase until the start-up has its own building. Furthermore, several respondents point out that in most cases a start-up is flexible in the beginning phase due to few needs, resulting in rental periods that can be months. The flexibility of the rental agreement is depending on the amount of specialization that is required by the occupier, however, it must be noted that in practice businesses are not sharing laboratories, clean rooms, and pilot production units, due to the fact that there are lab setups and classified business elements that still need to be patented. One of the respondents suggested that an ecosystem of firms is needed, resulting in three different sized firms: large firms (Philips, Siemens, ASML) with contracts of 10/20 years and enough capital, middle firms (circa 150 employees) with contracts of 5/10 years that mostly need to be tempered with incentives, and small firms (start-ups) with variable rents in incubators that have almost no capital and if they gone bankrupt there is nothing to get. In addition the length of the rental agreement is flexible, however, if the rental period is shorter the rents are higher and vice versa. Another respondent pointed out that most firms choose a rental period of three year and extend it each time, due to flexibility and approval of the board of a business. On the High Tech Campus Eindhoven a clean room hotel is developed, where businesses have flexible rental periods from days till months and with or without personnel. Furthermore, some respondents emphasized that businesses can take out a loan for the required equipment of special facilities, this can be spread out over the rental period or paid as a separate loan.

*Phasing real estate functions Science Park*

Most of the respondents acknowledged that in order to create a stable cash flow a large tenant (manifest knowledge supporter) needs to be present at the start of a Science Park development. After several businesses locate on the Science Park, resulting in more people, retail, leisure, and hospitality facilities can be added. One of the respondents stated that it is hard to make these developments profitable, however, the Leiden Bio Science Park and the Amsterdam Science

"Create a 'place to be' by clustering all hotshots that are related to each other"

Park have a University on their site with retail, leisure, and hospitality facilities already present on the Science Park due to the high amount of students making use of it. These Science Parks are focused on developing business incubators in order to locate spin-offs from the Universities and making a connection for their students with businesses that are located on the Science Park. These type of Science Parks are mostly less focused on making a profit as long as the cash flow stays positive. According one of the respondents the active acquisition of businesses for the Amsterdam Science Park started the last several years, due to the main focus of locating spin-offs from the University. Another respondent suggested that the ideal situation would be, if possible, to directly place retail, leisure, and hospitality facilities on the Science Park in order to create a meeting place for the transfer of knowledge. Sometimes to cover these developments businesses are attracted that not directly comply with the theme of the Science Park, however, it is not positive if this occurs too much. Therefore, short rental periods or terminable rental agreements are entered, otherwise it will disrupt the theme of the Science Park. Furthermore, one of the respondents assert that the High Tech Campus Eindhoven has a start-up bootcamp using a rotation system where start-ups get intensive training and a period of six months of free rent, after this they move to a cheap building for three years and when this period is over they move to a mature building with specific needs.

According to all respondents the creation of a community is the most important element in a Science Park development. A simple way to achieve this is by placing the only coffee machines in a central place of the building, this way people need to walk to the coffee machine and meet others that work in the same building. Furthermore, several respondents acknowledge that it is important for the transfer of knowledge to group the retail, leisure, and hospitality facilities in a central place (courtyard) with relative short walking distances, so people on the Science Park need to go there and meet each other. One of the respondents clarified that walking routes need to be created, preferably different each time, so people meet each other on the Science Park and transfer ideas. Due to the fact that most of the innovative ideas are formed in these sharing facilities and not in the laboratories, offices, etc. This is in line with another respondent that stated that a vibe must be created facilitating as much meeting moments as possible on a Science Park. For example, on the High Tech Campus Eindhoven buildings are not higher than four floors with floor-to-ceiling glass in the façade, in order to keep contact with the ground and invite employees to go outside. In addition one of the respondents asserted that short-stay facilities (for expats, students, PhD's, etc.) can be added to the Science Park for extra livability. The Amsterdam Science Park gone further and is going to establish a hotel on the Science Park.

"Create traffic on Science Park to stimulate people sharing knowledge"

## 5.6 Fail factors of a Science Park development

One of the main fail factors during a Science Park development, according to several respondents, is creating a community feeling or place to be. In addition other important fail factors are, not consistent with the theme of the Science Park, and not unique enough. As one of the respondents stated that a clear theme and place making is really important, where the developer has to ask the following question: 'Why is a business going to locate there?' Furthermore, a manifest knowledge supporter that has a focus on R&D needs to be present on the Science Park. Another problem that most of the Science Parks had was an absence of friction vacancy as a result of almost no vacancy, which can lead in some cases in the rejection of businesses that qualify for the theme of the Science Park. In addition several respondents stated that it is important to have a connection with a University for the influx of human talent (students, PhD's, etc.). This is attractive for businesses that locate on a Science Park and creates career opportunities for (master) students, PhD's, professors, and researchers wanting to create a start-up. One of the respondents emphasized that it is also of importance to have a well-functioning infrastructure on a Science Park that facilitates walking routes as well as a regional (bus, bike, car), national (train, car), and international (airport) modes of

"Success Science Park depends on availability of human talent"

transportation. In line with this another respondent assert that a clear arrangement needs to be made with local and regional governments, in order to prevent the allocation of businesses elsewhere instead of on the Science Park. Furthermore, one of the respondents pointed out that a Science Park needs to contain four elements in order to create innovation, these are: research, development, prototyping, and marketing. Nevertheless, the respondents all stress the importance that the real estate in a Science Park development is facilitating the theme of the Science Park and its community feeling.

"Not a terrain with real estate, but a concept containing real estate"

# 6. Discussing results: critical factors Science Parks

Source: activeageing.nl

# 6. Discussing results: critical factors Science Parks

After describing the results of the empirical research the critical factors of relevance according to the respondents are combined in this chapter with the literature, to identify the critical factors during the real estate development process of a mature Science Park. The first paragraph contains the real estate development process of a Science Park. In the next paragraph the policy of the governments during a Science Park development is described. The financing of a Science Park development and the risk management is elaborated in the following paragraph. The next paragraph contains the identification of the critical real estate development factors in process towards a mature Science Park with the information derived from the first three paragraphs. Finally, these critical factors are used to derive the management implications for starting Science Parks in the last paragraph. The last paragraph will also answer the fourth sub research question:

*"Which critical factors in the real estate development process can be used to form the management implications of the starting Science Parks?"*

## 6.1 Real estate development process of a Science Park

As mentioned in the literature the real estate development process of a business park consists of the stages: initiative, development, realization, and sale- or operation. When the business park is at the end of its economic lifecycle it will be redeveloped (demolished or transformed) (Friedman, 2006; Peet, 2014). However, due to the economic crisis the development process of a business park has become more flexible, as a result of planned and phased development lowering the investment (Neprom, 2014). Louw et al. (2009) and Olden (2010) clarified the development model of a Science Park, where the investor/lessor bought the public space from the project developer and has total ownership. This is acknowledged by the respondents, however, they state that it is not a planned process but a dynamic process and that the development process of a Science Park is longer than a business park, due to the consistency that is needed to guard the theme of the Science Park. As a result of this dynamic process the respondents assert that the real estate development phases (initiative, development, realization, sale or operate) are hard to identify during a Science Park development. Furthermore, the respondents and Hansson (2007) acknowledged that the origin of a Science park development is the manifest knowledge supporter, which is also the initiator of the park. In addition, the majority of the respondents point out that to create a stable cash flow a Science Park development starts with a large tenant (manifest knowledge supporter), then attract R&D businesses and create incubators for start-ups, and after this add retail, leisure, and hospitality facilities. Some respondents emphasized that it can be hard to create the last step of retail, leisure, and hospitality facilities, due to the fact that there need to be enough businesses on the Science Park to make it profitable. In addition to enhance the livability on a Science Park, (short stay) housing facilities or a hotel can be added. In line with Dinteren & Keeris (2014b) and Frej (2001), the respondents state that it is essential to keep the development process of a Science Park as flexible as possible. The phasing of the different real estate steps during a Science Park development is visualized in figure 15. This data is retrieved from the respondents due to the fact that the phasing of the real estate during a Science Park development is hardly mentioned in the literature.

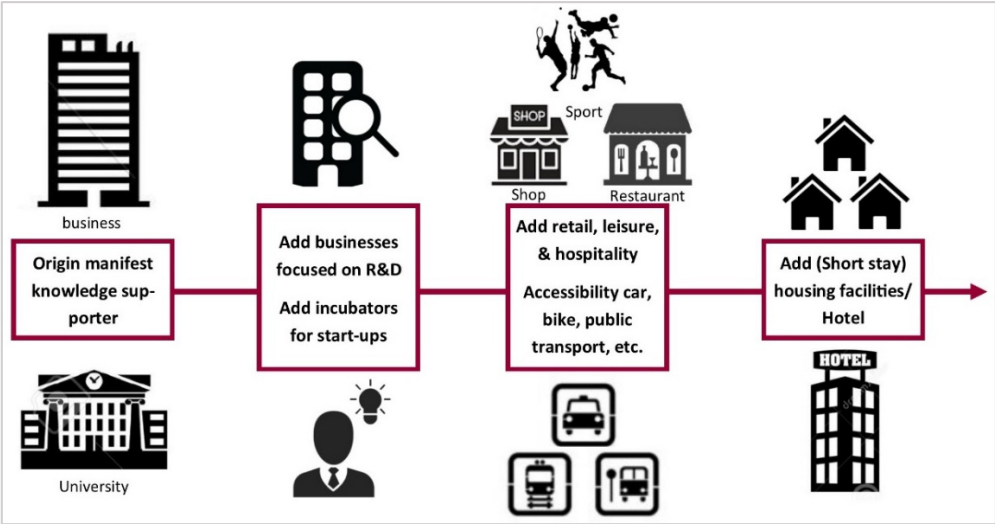


*Figure 15, phasing of real estate during a Science Park development.*

In figure 15 a note must be made that in the ideal situation the phasing of real estate functions during a Science Park development would be to directly facilitate knowledge transfer locating retail, leisure, and hospitality facilities at the start of the development according to some respondents. The manifest knowledge supporter originates from a University or Business, however, the respondents as well as several literature sources reported that there are some differences between these two types of Science Parks. The literature and respondents state that a University Science Park is focused on the facilitation of start-ups, creating a place where their students can start a business and commercialize knowledge. Therefore, the allocation of businesses on a University Science Park is of less importance than the creation of incubators that facilitate spin-offs from the University (Grimaldi & Grandi, 2005; Hansson, 2007; Heijer, 2008; 2011; Kooij, 2014). Some other respondents reported, in line with the literature that a Business Science Park is focused on the allocation of businesses. This has to do with the reason to start a Business Science Park, which is often from a business strategy that could be the occupation of vacant real estate that relies heavily on the financial balance, or the stimulation of suppliers to settle nearby to reduce costs and optimize the process, or to locate competitors nearby to start precompetitive collaborations and reduce R&D costs (Kooij, 2012; 2015).

In contrast with some of the literature sources the sharing of laboratories, clean rooms, and pilot production units is according to the respondents unusual, in the first place because of the secrecy of the product that needs to be patented and in the second place the certification process of a laboratory by a business is an expensive process that can take several years (Dinteren & Keeris, 2014b; Kooij, 2012; 2010; McAdam & McAdam, 2008). Furthermore, several respondents noted in contrast with the Greiner (1998), Lamnak (2015), and McAdam & McAdam (2008) that sometimes the problem occurs of a start-up not leaving the incubator due to this certification process. Therefore, the real estate development process of a Science Park is seen as a dynamic and continuous process by the majority of the respondents. They stated that older buildings on a Science Park are in most cases used to locate start-ups and for larger businesses the buildings on a Science Park are more specified to their demands, due to the fact that these businesses are relatively stable and have more capital.

Heijer (2011) and Kooij (2014) both emphasized that the addition of retail, leisure, & hospitality facilities on a Science Park stimulates the livability, however, there is nothing mentioned about the real estate development process to make this feasible. The respondents from the University Science Parks suggest that the creation of retail, leisure, and hospitality facilities on a University Science Park is easier, due to the large amount of students that are present and use these facilities almost on a daily basis. The same counts for the addition of (short-stay) housing facilities to a Science Park, which will be easier occupied with expats, (master) students, PhD's, and researchers due to the presence of a

University. In addition the Amsterdam Science Park is going to develop a hotel and Leiden Bio Science Park has a hotel in close proximity. The businesses on a Science Park often contain a lot of expats and get international visitors. To offer a total package adding a hotel on a Science Park can be relevant. Some of the respondents from the Business Science Parks state that to cover the development of retail, leisure, and hospitality facilities businesses can be attracted that not directly relate to the theme of a Science Park, however, these businesses help establishing a solid cash flow and bring enough employees to make the retail, leisure, and hospitality facilities feasible. Nevertheless, in order to maintain the theme of a Science Park and retain credibility in relation to other businesses, short or terminable rental agreements are advised. Several respondents assert that a Science Park needs a connection with a University, even the Business Science Parks, because it is beneficial for the influx of new human talents. This is in line with the 'buzz-and-pipeline' model of Bathelt et al. (2004), which stimulates a network shares knowledge and innovation. One of the respondents stated that the success of a Science Park depends on the availability of human talent, this is also acknowledged by some of the literature sources (Culkin, 2013; Huang, 2013; Tang et al., 2014; Weterings & Ponds, 2007).

According to several literature sources and the respondents a Science Park development needs a high quality infrastructure, accessibility by car, public transport, walking, and cycling (Dinteren & Keeris, 2014b; Frej, 2001; Heijer, 2011; Mondor, 2014). Despite, the lack of literature available about the organization of the different real estate functions on a Science Park, the majority of the respondents claimed that in order to create a sense of community on a Science Park and facilitate the transfer of knowledge the organization of real estate functions on a Science Park is of high importance. The area development of a Science Park needs to contain a central place where the retail, leisure, and hospitality facilities are located, with the businesses that are grouped around this central place. Furthermore, the parking facilities need to be on the outskirts of a Science park with no fixed parking spot, this way people need to walk each day a different route to their building which enhances the knowledge transfer. The facilitation of knowledge transfer on a Science Park with real estate is visualized in figure 16.

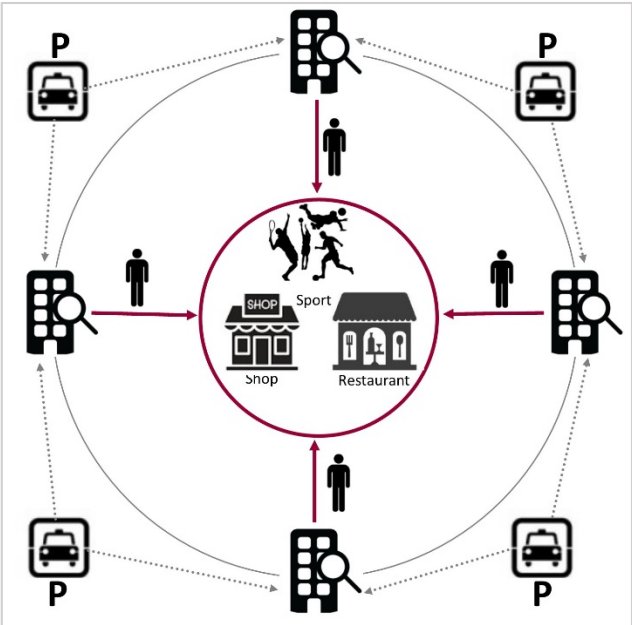


*Figure 16, facilitating knowledge transfer on a Science Park with real estate.*

In addition to figure 16 the respondents state that businesses on a Science Park are not allowed to have their own canteen or large meeting rooms, these facilities are grouped in the centralized shared facilities where according to the respondents the knowledge transfer takes place. This is acknowledged by different literature studies, however, facilitating knowledge transfer with real estate on a Science

Park is not mentioned in the literature (Dinteren, 2009; Heijer, 2011; Kooij, 2010; Löfsten & Lindelöf, 2002). Furthermore, employees from different businesses and buildings meet each other in the centralized facilities on a relative short walking distance, this can result in fruitful collaborations. Some of the respondents stated that the High Tech Campus Eindhoven even integrated in their zoning plan that new buildings are not higher than four floors and contain floor-to-ceiling glass façades to keep the connection with the ground and invite people to go outside and meet each other. Another respondent clarified that to stimulate the transfer of knowledge inside the buildings one coffee machine can be located in a central place of the building. The programming of a Science Park needs to create as many meeting moments as possible between the different knowledge workers. Eventually with a well-established community containing all the different facets the Science Park needs to become a place to be in the theme it is operating in, whereas the real estate needs to facilitate this. According to the majority of the respondents this was the most important factor in the creation of a Science Park, this is also acknowledged by the majority of the literature sources (Buck Consultants International, 2014; Dinteren & Keeris, 2014b; Huang, 2013; International Associations of Science Parks, 2016; Kooij, 2014). These literature sources also assert that a Science Park needs to distinguish itself, especially during a time where many new Science Park developments originate. In addition the respondents stated that if the theme of a Science Park is unique and a place to be is established less competition will be experienced. According to the respondents the competition is mostly fierce for the larger businesses, smaller businesses have a local network and are therefore more locally focused.

## 6.2 POLICY GOVERNMENTS

As already pointed out in several literature sources and acknowledged by the respondents the governments consider a Science Park as an instrument to stimulate the economic welfare in the region with the creation of jobs, businesses, and spin-offs (Boekholt, et al., 2014; Buck Consultants International, 2014; Ministry of Economic Affairs, 2015; Zeemeijer, 2016). In addition local governments are willing to help in a Science Park development, due to its social issue of keeping knowledge businesses in the region. However, there was no information in the literature about the relation between a regional government and the preparedness to anticipate during a Science Park development. According to the respondents from the Amsterdam Science Park and the Leiden Bio Science Park no incentives or grants were received from the regional governments, due to the fact that these Science Parks are located in the economic leading regions (Noord-Holland and Zuid-Holland) of the Netherlands. This is in contrast with the regions of the Brightlands Chemelot Campus and Wageningen UR Campus where the regional governments anticipate in the Science Park development with public development firms (like, BOM, OostNV, etc.). These regional governments want to maintain the employment and businesses in the region. A different case is the High Tech Campus Eindhoven that is not receiving incentives or grants from the regional government due to its private ownership and success, however, the High Tech Campus Eindhoven benefits from the marketing of the region by the national government as Brainport Region of the Netherlands. Nevertheless, the respondents reported that all regional governments are willing to invest in infrastructure (regional roads, highways, train stations, etc.).

In line with the literature the respondents assert that mostly a foundation or consortium is formed due to the fact that investing in real estate is not the core business of the manifest knowledge supporter (Business or University). In addition the stakeholders of a foundation or consortium during a Science Park development, consists of: a manifest knowledge supporter (sometimes a University), a University or research institution, and a public or private party (regional-, local government, public or private investor) (Dinteren & Keeris, 2014a; Heijer, 2011; Kooij, 2015). It must be noted that governments are not involved if a Science Park is bought by a private investor. Furthermore, the majority of the respondents emphasize that in order to guard the theme and to physically and legally control the stakeholders it is beneficial to have one owner (private investor, consortium, or foundation), this is not further mentioned in the literature.

According to the literature there are different land policies during a Science Park development, whereas, the majority of the respondents clarified that a public-private-partnership is often used (Rijksoverheid, 2016a). In addition the respondents stated that the zoning plan of a Science Park development needs to be as flexible as possible, mostly only building contours and safety measures are included (chemical island, minimal radius laboratory, etc.). Nevertheless, all respondents assert that it is beneficial for the Science Park development to involve governmental institutions as soon as possible. In addition a mutual agreement needs to be entered with the regional and local government, offering them economic growth and in return forbidding them of locating competing Science Parks in the region.

## 6.3 FINANCIAL & RISK MANAGEMENT

Different literature studies and several respondents suggest that the financing of real estate on a Science Park is difficult, due to the specification of real estate there is a higher risk which deter conservative minded banks (Boekholt et al., 2014; Boers, 2013; Dinteren & Keeris, 2014b; Ministry of Economic Affairs, 2015; Steiner & Butler, 2006). However, some of the respondents stated in line with Löfsten & Lindelöf (2002) that there are different funds for financing the developments depending on the type of ownership. Whereas, a private owner has own capital and a foundation or consortium needs to attract a private investor or public development firm for capital, this is visualized in figure 17.

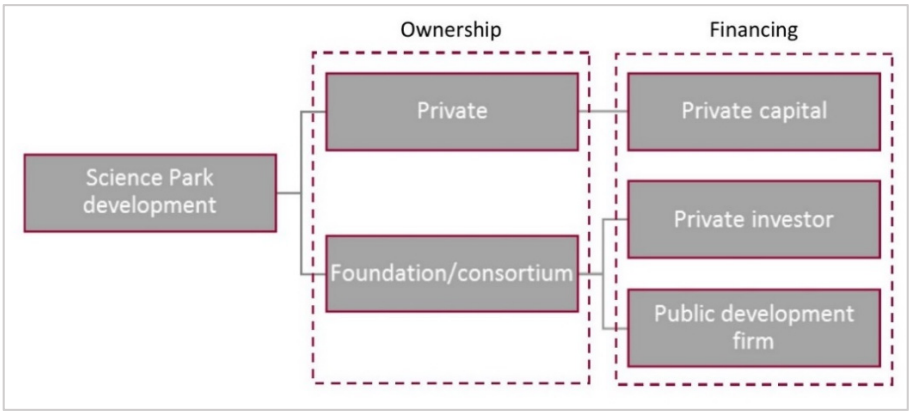


*Figure 17, financing a Science Park development.*

The literature and respondents emphasized that it is not tolerated for a public institution to invest large amounts of public capital in real estate developments (Dinteren & Keeris, 2014a; Heijer, 2011; Kooij, 2015). In addition to the literature the respondents pointed out that for a University Science Park it is essential to get a private investor or public development firm to financing the real estate, however, as mentioned before the participation of a public development firm depends on the region where the Science Park is located. In line with the literature several respondents reported that a University Science Park needs to have a balanced cash flow, although, these Science Parks are not focused on profit but more on the enlargement of human capital by facilitating students with incubators resulting in a commercialization of knowledge (Grimaldi & Grandi, 2005; Heijer, 2011; Huang, 2013).

In addition to the literature several respondents acknowledge that in order to cover the large real estate investment of a Science Park a diversification needs to be made in different firm sizes, resulting in a lower risk and more stable income. On a Science Park incubators carry the largest risk with start-ups that possess no capital, this risk needs to be covered by larger or midsized firms with longer rental periods (Boers, 2013; Dinteren & Keeris, 2014b; Grimaldi & Grandi, 2005). The respondents also assert that for the development of real estate higher risk premiums are asked or a partnership for several years is entered, this can be spread out over the rental period or seen as a separate loan. In some cases

this not only counts for the real estate but also for the equipment. Furthermore, several respondents, Boers (2013) and the Ministry of Economic Affairs (2015) point out that there is a high demand for laboratories, clean rooms, and pilot production units. According to the respondents there was almost no vacancy on the Science Parks due to the high occupier demand, with some of the Science Parks even need to deny firms because of the shortage in specific real estate. As reported by the respondents the low vacancy rate is of influence on the risk which is rather low, due to the fact that there are enough businesses willing to rent laboratories, clean rooms, and pilot production units. The high demand in specialized real estate and the high costs of moving prevent tenants in a certain way of allocation elsewhere. Therefore, according to the respondents there is a high assurance that the large investment made in real estate will be earned back. Frej (2001) and Mondor (2014) point out that the buildings in a development need to be flexible despite the specifications, however, these studies did not focus on a Science Park development and which way to keep the buildings flexible. The respondents clarified that sometimes a building is over-dimensioned, another way could be to finish the buildings for 80% and build the last 20% when the tenant is known or let the tenant invest in the installations itself. Nevertheless, the respondents assert that it is hard to keep specific laboratory space flexible, due to the specific demands.

Several literature sources acknowledge in line with the respondents that the rental prices on a Science Park are higher, due to the quality of the real estate and the amenities and services that are offered (Faber, 2010; Frej, 2001; Mondor, 2014; Stec Groep, 2012). Furthermore, the respondents added to the literature that businesses are prepared to pay more if there is a strong theme and high amount of facilities present, offering a total package for the tenant that saves money due to the sharing of several facilities. Table 16 contains the rental prices for office and research facilities on the different Science Parks where respondents were active on.

*Table 16, comparison rental prices regular real estate with Science Park real estate.*

| Cities | Office (in €/sq.m per year)* | Office on SP (in €/sq.m per year)* | Industrial (in €/sq.m per year)** | Combination (in €/sq.m per year)** | Research facility on SP (in €/sq.m per year) | Science Park in the city |
|---|---|---|---|---|---|---|
| **Wageningen** | 75-130 | 160-170 | 25-35 | 55-75 | 275-350 | WUR Campus |
| **Amsterdam** | 80-400 | 175 | 30-50 | 80-120 | 230 | Amsterdam Science Park |
| **Leiden** | 70-150 | 175 | 30-45 | 60-80 | 225 | Leiden Bio Science Park |
| **Eindhoven** | 80-180 | 150-160 | 25-40 | 60-85 | 360 | High Tech Campus Eindhoven |
| **Sittard-Geleen** | 65-125 | - | 20-35 | 55-75 | - | Brightlands Chemelot Campus |

** Office space of 500 sq.m and larger*

*** Industrial space of 750 sq.m and larger, ex. laboratory space*

The rental prices for office space in Wageningen and Leiden were significantly higher on the Science Park than in the cities. In Eindhoven the rental prices for office space on a Science Park were comparable with the regular rents in the center of the city. The rental prices on the Amsterdam Science Park were the same as the average rental prices in the city, due to the fact that Amsterdam notates the highest rental prices for office space in the country. Nevertheless, it can be stated that the rental price for office space is relatively high on a Science Park in comparison with regular office space, however, these offices are mainly combined with laboratories which is making it hard to compare. Furthermore, according to the respondents and several literature sources on a Science Park there are a lot more amenities and services offered than on a regular business park (Frej, 2001; Mondor, 2014). The same counts for the rental prices of research facilities that are hard to compare due to the fact that these are in most cases located on a Science Park. According to some respondents the rental prices on a Science Park are sometimes calculated per employee, for example, a pass fee for central services, parking or security.

In line with Kooij (2010) which reported that start-ups needs a flexible rental period, the respondents' state that rental periods for incubators are as flexible as possible, varying from months to years. What was not mentioned in the literature is that sometimes after several years the rental prices in an incubator gradually increase to stimulate the start-ups to leave the incubator and offer space for new start-ups. Furthermore, the respondents state that the flexibility of the rental period depends on the amount of real estate specifications that are needed. In addition an ecosystem of firms is needed during a Science Park development varying in rents and risks, with larger (Philips, Siemens, ASML, etc.), midsized (circa 150 employees), and small firms (start-up). This creates a stable rental income from the larger firms with a lower risk, due to the fact that start-ups are unpredictable with no capital. Sometimes according to the respondents laboratory facilities can be rent with or without employees. Nevertheless, Dinteren & Keeris (2014a; 2014b) stated that in order to guard the theme most of the real estate is rental, the respondents emphasize this but added that in the land policy of a Science Park a lot of leasehold is applied.

## 6.4 CRITICAL REAL ESTATE DEVELOPMENT FACTORS

The previous paragraphs elaborated the similarities and differences between the literature and the respondents, this led to several critical real estate development factors as an output of this research. The critical real estate development factors in the process towards a mature Science Park from the literature and interviews are summarized in table 17, containing the categories general, real estate development, policy governments, and financial & risk management with the critical real estate development factor is related to this category.

*Table 17, critical real estate development factors during a Science Park development.*

| Category | Critical real estate development factor |
|---|---|
| **General** | • Total ownership (one owner, physical and legal control stakeholders)<br>• Unique SP dev. reduces competition for larger businesses<br>• Create sense of community<br>• Facilitate knowledge transfer<br>• Connection with University for influx of human talent |
| **Real estate development** | • Keep dev. process as flexible as possible<br>• Stable cash flow SP dev.: start with large tenant (manifest knowledge supporter), attract R&D businesses, create incubators, and attract retail, leisure & hospitality facilities (optional housing & hotel)<br>• Ideal SP dev. direct facilitate retail, leisure & hospitality facilities<br>• Older buildings for starting businesses<br>• New buildings more specified for larger businesses<br>• Make retail, leisure & hospitality facilities feasible with: University SP large amount of students, Business SP attract tenants not directly related to the theme<br>• High quality infrastructure<br>• Centralize shared facilities (retail, leisure & hospitality, etc.)<br>• Parking on outskirts SP (no fixed spot) |
| **Policy governments** | • Clarify economic stimulation SP dev. to gov. (mutual agreement)<br>• Policy regional gov. depend on location SP, ownership, and success SP<br>• Regional gov. invests in infrastructure<br>• Private ownership or public-private-partnership as consortium or foundation<br>• Keep zoning plan flexible |
| **Financial & risk management** | • Private ownership, private capital<br>• Foundation/consortium ownership, private investor or public dev. firm depending on region of SP dev.<br>• Tenant prepared to pay more with strong SP theme and high amount of facilities<br>• Businesses not relate to theme SP, short or terminable rents<br>• Guard unique theme of Science Park (with rental and leasehold)<br>• Flexibility in rental prices (depending on specifications needed) |

| | |
|---|---|
| | • Large investment refunded due to no vacancy and high demand<br>• High demand and low vacancy, results in low risk<br>• Lower risk of specific RE kept as flexible as possible<br>• Ecosystem of firms, results in stable cash flow and spreading risk |

Some the critical factors in table 17 were already mentioned in the literature from the chapters two and three (see §3.6 and §3.7). However, there were several new critical factors mentioned by the respondents that were missing in the literature. In the general category new critical factors were total ownership over the Science Park consisting of one owner that can control the stakeholders physically and legally. In addition the competition is mostly fierce in locating large businesses on Science Parks. Furthermore, during the Science Park development it is essential to create a sense of community. The connection with a University is mentioned in the literature, however, the respondents assert that this counts for every Science Park and not only the University Science Parks.

Within the real estate development category there are several new critical factors mentioned by the respondents. For the creation of a stable cash flow the respondents elaborate a practical input that applies during the development process of a Science Park. They also assert that in the ideal situation the shared facilities are directly realized. In addition, the respondents suggest that older buildings are used for starting businesses and new more specific buildings are realized for larger businesses. In case of shared facilitates on a Science Park the literature acknowledges the importance of these facilities. However, the respondents clarify the practical process of realizing these facilities and create as many meeting moments as possible for Business and University Science Parks. Furthermore, the respondents state that the critical factors of centralized shared facilities and parking on outskirts with no fixed parking spot are important factors for the transfer of knowledge.

In the category policy governments there were two new critical factors mentioned by the respondents. First the support of the regional government is depending on the location of the Science Park, its ownership and success. Next the respondents assert that all regional governments are investing in the infrastructure. In the category financial and risk management the respondents mentioned several new critical factors. The respondents assert that the financing of a Science Park that is owned by a foundation or consortium is depending on the region where the Science Park is located. In addition the respondents emphasize that a tenant is prepared to pay more for a Science Park with a stronger theme. Another critical factor is the attraction of businesses that not related to the theme in order to establish a stable cash flow, however, short or terminable rents need to be applied. Furthermore, the respondents mentioned that a critical factor is the flexibility of rental prices, which is depending on the amount of specification needed for a building. The respondents assert that due to the low vacancy rate and the high demand the large investment in real estate is refunded. Finally, the respondents assert that an ecosystem of firms needs to be present.

## 6.5 Management implications starting Science Parks

The different Science Park developments in the Netherlands are summarized in appendix C, with nine Science Parks in the starting phase. Furthermore, the different manifest knowledge supporters that are present on these Science Parks and the type of Science Park (Business or University) are examined. The starting Science Parks have a relative low amount of businesses that are present on the park, varying from 1 till 15 and one Science Park containing 30 businesses (appendix D) (Buck Consultants International, 2009; 2014).

The different critical real estate development factors that are summarized in table 17 of the previous paragraph are all of relevance for the management implications of a starting Science Park development. Based on the input from the respondents there are a few elements that are of high importance and need to be implemented first if a starting Science Park wants to survive. According to

the respondents, Dinteren & Keeris (2014b) and Technopolis (2009) the two most important fundamental implications are creating a unique theme and establishing a community that stimulates as much knowledge transfer as possible, using the real estate to facilitate these factors. With these two implications a starting Science Park needs to distinguish itself and become the place to be, resulting in an easier attraction of businesses. Furthermore, the respondents, Hansson (2007), Heijer (2011), and Langerak & Spijkerbroek (2015) assert that creating a connection with a University is beneficial for a starting Science Park development for the attraction of businesses, due to the influx of human talent.

From a real estate point of view the respondents state that there are several management implications that need to be implemented during a starting Science Park development. First an overall implication that is of relevance during the development process of a starting Science Park is according to the respondents, Frey (2001), Mondor (2014) and Peet (2014) keeping the development as flexible as possible on master plan, zoning plan, and building level. This implication is stressed by the respondents due to the fact that a starting Science Park development is a dynamic process which requires flexibility. Second another implication reported by the respondents for the creation of a stable cash flow is to avoid the rejection of new businesses by monitoring the demand in specific real estate (laboratories, clean rooms, etc.). Due to the fact that a starting Science Park still needs to prove itself and become known by businesses operating in the same theme. Third the respondents emphasize that establishing a stable cash flow for starting Science Parks is achieved by creating a unique theme as mentioned earlier. However, the attraction of businesses can be hard, an implication in this scenario is according to the respondents, locating businesses that not quite fulfill the theme of the park. Although, it is essential to guard the theme and offer these kind of businesses short or terminable rents.

When a stable cash flow is realized there are two important implications for the transfer of knowledge on a starting Science Park. First centralizing shared facilities (retail, leisure, and hospitality) and second locating parking facilities at the outskirts of the park with no fixed parking spot. However, a note must be made that to make these facilities feasible enough people need to be present on the park, something that can be hard for a starting Science Park. In this scenario the centralized shared facilities and parking facilities need to be included in the master plan of a starting Science Park. The respondents clarify that these two implications for knowledge transfer are faster achieved on a starting University Science Park, due to the presence of students, than on a starting Business Science Park.

For the support of governmental policies according to the respondents clarifying the relevance in economic growth is of importance. Local governments are willing to support a starting Science Park development. However, for the regional governments it depends in which region the Science Park development is located in order to receive support (Randstad vs. rest of the Netherlands). This is of relevance to for the financing of a starting Science Park development, according to the respondents obtaining financing is depending on the region and ownership, forming a foundation or consortium, or finding a private investor. The respondents assert that to cover the large investment in real estate on a starting Science Park an implication is creating a diversification in firm sizes in order to cover rental losses and lower the risk. Nevertheless, as the respondents also stated that in most cases the flexibility in locating businesses is limited for starting Science Parks, due to the absence of older buildings.

# 7. Conclusions


*Source: universitairemasters.nl*

# 7. CONCLUSIONS

In the previous chapters the Science Park phenomenon and the real estate development process of a business park were elaborated. Furthermore, the critical real estate development factors that could be of influence on a Science Park development were derived from the literature. The different knowledge gaps that were found in the literature study were answered in the qualitative research. After this the input from the literature and respondents was combined and identified the critical factors during the real estate development process towards a mature Science Park, resulting in management implications for the real estate development process of starting Science Parks. This chapter contains the conclusion of this research that answers the main research question:

*"What are the critical real estate development factors in the process of becoming a mature Science Park in the Netherlands, and what are the implications for the real estate management of starting Science Parks?"*

In order to answer the main research question the conclusion starts with the first paragraph containing the requirements of a Science Park. In the following paragraph the critical real estate development factors towards a mature Science Park are concluded. These critical real estate development factors form the management implications for starting Science Parks, which are concluded in the next paragraph. A reflection is described in the following paragraph clarifying the relevance of this research. Finally, the deficiencies of the research and the recommendations for further research are elaborated in the last paragraph.

## 7.1 REQUIREMENTS SCIENCE PARKS

The requirements of a Science Park were examined in the first chapter of this research. It can be concluded that a Science Park concept needs to promote an innovative culture with the presence of a knowledge based institution and the competitiveness of associated businesses. For a well-functioning Science Park there are four main characteristics required, consisting of: manifest knowledge supporter (research institution, business R&D center, University), high quality real estate (mixed use area development), network (open innovation, human capital), and focus on R&D (transfer of knowledge, creation of innovation). Furthermore, businesses with the same R&D profession operate on the Science Park, creating a theme where the Science Park is specialized in. A diversification can be made for the Science Park market in the Netherlands that is consisting of two types of Science Parks depending on the manifest knowledge supporter, these are: Business and University. These types of Science Parks have differences in their stakeholders, resources, real estate facilities, and ownership. For the understanding of the different perspectives during a Science Park development there are three main parties that each have their own focus or interest, these are: Businesses with the main goal of gaining profit, Universities having interest in increasing human capital, and governments which are focused on creating economic growth in the region.

Within this research the critical factors during the real estate development process towards a mature Science Park are identified. Therefore, before identifying these factors the aspects required in order to become a mature Science Park need to be concluded. The mature Science Park needs to be of national importance and have a significant amount of research institutions and R&D businesses. Furthermore, a mature Science Park has to be distinctive enough with the creation of an own unique theme and it needs to contain the four main characteristics mentioned earlier.

## 7.2 CRITICAL FACTORS REAL ESTATE PROCESS TOWARDS MATURE SCIENCE PARK

After concluding the main requirements of a Science Park and the demands of a mature Science Park in the previous paragraph, the critical factors during the real estate development process towards a mature Science Park are elaborated in this paragraph, these factors are retrieved from the chapters three and six. First a clarification needs to be made that a Science Park is seen as a sub category of a business park, and it can be concluded that if a Science Park misses the requirements mentioned in the previous paragraph it will just be a high quality business park. Nevertheless, with the preliminary set of critical real estate development factors in the process of a business park, the literature found on Science Parks, and the qualitative data collection the critical real estate development factors towards a mature Science Park are identified.

According to the literature it can be concluded that in the development model of a Science Park the land development and construction is realized by one party and bought by an investor or landlord, which results in total ownership over the public space and real estate in order to guard the theme of the Science Park. Furthermore, most of the critical factors found in chapter three are about the real estate development process, governmental policies, financing, risk management, and the differentiation of real estate facilities on a business park. In addition the flexibility on process, area, and building level is one of the most important criteria mentioned in the literature. Another important factor in the development process is the facilitation of communication between parties and the connection with the surrounding region. It can be concluded that these critical real estate development factors in the process of a business park are of relevance during a Science Park development. Therefore, with these factors found in the literature and the input from the qualitative research there were some interesting contrasts and similarities found, however, there was also new information found during the qualitative research that was of added value for the identification of the critical factors.

It can be concluded that in contrast with the literature was the flexibility during the development process of a Science Park. The literature described that the sharing of incubators especially laboratories, clean rooms, and pilot production units was achievable for starting businesses, however, the respondents concluded that due to the certification and secrecy in patenting products it is unusual to share laboratories, clean rooms and pilot production units. The same counts for the literature which implies that a start-up leaves an incubator after a certain period of time. In practice the respondents concluded that the incubators are often kept occupied by start-ups due to the high moving costs and certification of laboratories.

In addition to the literature it can be concluded that the real estate development process of a Science Park is a dynamic and continuous process that originates from the manifest knowledge supporter. Furthermore, the phasing of the real estate facilities during a Science Park development starts with the manifest knowledge supporter, after this businesses and incubators are added, and finally the shared facilities are realized. These shared facilities are located in a centralized spot on the Science Park surrounded by the businesses and incubators on relative short walking distance, thus, from a practical input it can be concluded that most of the knowledge transfer takes place in these facilities instead of laboratories and offices. Therefore, a Science Park developer must create as much meeting moments as possible to support knowledge transfer, for instance, businesses are not allowed to have their own canteen or meeting room and parking spots are located on the outskirts of the park with no fixed places. Furthermore, the realization of shared facilities is in most cases easier achieved on a University Science Park, due to the large amount of students that are already present. A Business Science Park needs to attract enough businesses with employees to make these shared facilities feasible, which can be hard. In addition the literature and respondents conclude that the University Science Parks focus on incubators in order to facilitate spin-offs from the University, these parks are

less focused on profit. While Business Science Parks focus on profit and the locating of businesses due to the business strategy where they originated from. In addition from the input of the respondents it can be concluded that for the attraction of businesses it is beneficial that a Science Park has a connection with a University for the input of human capital.

Furthermore, from the aspect of governmental policies during a Science Park development it can be concluded that most of the local governments are supporting Science Park developments, however, the respondents added that the support of regional governments is depending on the region where the Science Park is located. In some of the regions the regional governments are active in the form of a public development firm during a Science Park development (foundation or consortium), whereas, in the Randstad region the regional governments are not supportive due to the economic strength of the Randstad. Nevertheless, the respondents conclude that all regional governments are willing to invest in infrastructure making the Science Park well-accessible. The literature highlighted that the financing of a Science Park development is hard to obtain which was acknowledged by the respondents. Therefore, from the literature and respondents it can be concluded that the financing of a Science Park development is depending on the ownership and region where the Science Park is located. A private owned Science Park relies on private capital, whereas, a Science Park that is owned by a foundation or consortium is depending a public development firm or a private investor in the Randstad region. Furthermore, it is essential during a Science Park development to keep all buildings rental and apply leasehold to the land policy to guard the theme of the Science Park. In addition the respondents concluded that the flexibility of the rental period depends on the amount of specialization to the building. They also reported that sometimes personnel can be rented with the laboratories and clean rooms. In terms of risk management the literature and respondents evaluated that due to the high demand in specific real estate functions (laboratories, clean rooms, etc.) it can be concluded that the risk of vacancy is low. Nevertheless, a diversification of firms (large, midsized, and small firms) is needed in a Science Park development to cover a certain loss of rent and lower the risk. In addition it can be concluded that this results in flexibility due to the possibility of locating starting firms in older buildings and build or transform buildings for larger more stable firms.

## 7.3 Implications starting Science Parks

In the previous paragraph the differences and similarities between the literature and interviews are concluded. Together with the new information from the interviews the critical real estate development factors towards a mature Science Park were identified. In this paragraph the critical factors are used to derive management implications for starting Science Parks, resulting in the answer of the main research question of this research. Before this main research question can be answered the starting phase of a Science Park needs to be identified. From the literature it can be concluded that a starting Science Park is roughly the first two years of a Science Park development depending on the progress, with the presence of a physical area or one that is being realized sometimes already with businesses located on the site.

During this research it can be concluded that there were two fundamental management implications of high importance in the starting phase of a Science Park development that need to be implemented first. To stimulate the survival rate of the park the literature and respondents claimed that creating a unique theme and establishing a community are essential implications for a starting Science Park. With these implications the Science Park need to become the place to be and distinguish itself. In addition it can be concluded that to stimulate these two management implications with the influx of human talent and the attraction of businesses, an implication is establishing a connection with a University.

After establishing these fundamental management implications the respondents stated that there are several implications from a real estate point of view that need to be implemented during a starting Science Park development. From the literature and respondents it can be concluded that there are three management implications for a starting Science Park in this category. First due to the dynamic process of a Science Park an overall implication is keeping the development as flexible as possible on master plan, zoning plan, and building level by phasing the development. Second, the respondents claimed that monitoring the demand of specific real estate (laboratories, clean rooms, etc.) is essential to avoid the rejection of businesses and create a stable cash flow. Third, as mentioned earlier creating a unique theme is of essence in the attraction of businesses, which is beneficial for a stable cash flow. However, this can be hard therefore an implication is attracting businesses that not quite fulfill the theme of the park. Although, it is essential to guard the theme and offer these kind of businesses short or terminable rents.

As mentioned in the previous paragraphs it can be concluded that the transfer of knowledge is essential for the survival rate of a Science Park and is facilitated through real estate, the same counts for a starting Science Park. Therefore, from the input of the respondents it can be concluded that there are two implications of importance during a starting Science Park development. First centralizing shared facilities and second locating parking facilities at the outskirts of the park with no fixed parking spot. These two implications for the transfer of knowledge can be hard to realize on a starting Science Park due to the absence of a large amount of people, in this situation these implications need to be included in the master plan and implemented in a later phase.

In terms of governmental implications it can be concluded that clarifying the relevance of the starting Science Park development in economic growth is important for the support of local and regional governments. Although, a note must be made that the support depends on the region of the starting Science Park (Randstad vs. rest of the Netherlands). An implication in obtaining the financing for a starting Science Park is depending on the region and ownership, establishing a foundation or consortium or find a private investor. Furthermore, to cover the large investment in real estate during a starting Science Park development the respondents stated that an implication is creating a diversification in firm sizes, resulting in a cover of rental loss and lower risk. However, due to the absence of older buildings the flexibility in locating businesses is limited for starting Science Parks.

Nevertheless, it can be concluded that from the input of the respondents the management implications for starting Science Parks are the following ones:

- creating a unique theme;
- keeping development flexible;
- centralizing support amenities for knowledge transfer;
- locating parking on outskirts with no fixed spot;
- phasing of the real estate development;
- creating a diversification of firms;
- clarifying relevance of the Science Park to governmental institutions;
- obtaining public or private financing.

These management implications were identified by the critical real estate development factors towards a mature Science Park that were retrieved from the literature and interviews. Furthermore, the respondents indicated the importance of the implications in general and in specific for starting Science Parks. Finally, the results of this research can be implemented by the large amount of starting Science Parks stimulating the survival rate of these parks.

## 7.4 Reflection

This research examined the different critical real estate development factors towards a mature Science Parks from the literature and interviews. Furthermore, the management implications for starting Science Parks are identified, which need to result in a better survival rate for these Science Parks. In order to create a well-functioning park starting Science Parks can implement these management implications.

During this research it can be concluded that there were some large knowledge gaps found in the existing literature, especially in the real estate development process of a Science Park. Therefore, the critical factors during the real estate development process of a business park were used to help identify the factors for Science Parks. However, even with these critical factors there were still knowledge gaps found in the following subjects: real estate development process, policy governments & grants, initiators & stakeholders, financial & risk management, and real estate facilities. In order to answer the knowledge gaps from the different subjects, interviews were held with respondents that have affinity with the real estate process of mature Science Parks.

During the interviews the relevance and importance of the critical factors were identified and insights were given on management implications relevant for Science Parks in the starting phase. However, the interviews resulted in a lot of new critical real estate development factors in the process towards a mature Science Park. Some of these factors were based on existing literature, although, often practical input was missing in the literature. Furthermore, the sharing of specific real estate (laboratories, clean rooms, etc.) and start-ups leaving incubators after five years were contrasting factors due to the fact that the respondents claimed that this was unusual in practice. To give an indication, in total there were 29 critical factors identified of these factors 9 were identified by literature and the rest through the respondents. Although, a note must be made that the respondents provided 7 critical factors that were identified through the literature study with a practical input. Nevertheless, this means that there were 13 new critical factors identified by the respondents.

Therefore, it can be concluded that this research is of relevance and from added value to the existing literature. The unfamiliarity in the literature on the real estate development process of a Science Park, let alone the process of a starting Science Park, resulted in a large amount of new information gathered through interviews. Furthermore, the respondents pointed out the factors of importance during the starting phase of a Science Park, wherefrom the management implications could be derived. The 8 management implications from the previous paragraph need to stimulate the survival rate of starting Science Parks. From these management implications creating a unique theme is one of the most important and fundamental. From the real estate development process of a starting Science Park two implications are of importance, flexibility and phasing. Furthermore, knowledge transfer is achieved with the implications of centralizing shared facilities and locating parking at the outskirts of the park with no fixed spot. In terms of financial and governmental implications a diversification of firms and clarification of economic growth is of importance. In addition financing can be obtained through public or private funding depending on the region of the starting Science Park.

## 7.5 FURTHER RESEARCH

During this research there were some deficiencies that could improve the management implications for starting Science Parks. The different deficiencies and experiences lead to the subjects that are of interest for further research.

In the first place during the literature study there were several knowledge gaps discovered, these gaps formed the basis of the interview guide. The interview guide was used to answer the knowledge gaps with qualitative research, however, due to the time aspect there were seven respondents selected trying to cover as much information as possible. The profession of the respondents was well diversified with consultants, owners, and a developer. Nevertheless, in the topographic context five of the twelve provinces were covered with two Science Parks in Noord-Holland and Zuid-Holland (Randstad), and three Science Parks in Gelderland, Limburg and Noord-Brabant. Despite this regional coverage it is of interest to interview respondents from mature Science Parks in the other regions, resulting in a total data collection with the added mature Science Parks of Utrecht Science Park (Utrecht), Kennispark Twente (Enschede), and Science Park Technopolis (Delft). Nevertheless, during the different interviews most of the critical real estate development factors were already mentioned as the interviews progressed, as a result there were less new critical real estate development factors identified. However, there would be more confirmation in the importance of some factors. For further research it might be interesting to interview respondents from Science Parks in foreign countries and make a comparison with their real estate implications.

Another aspect was the input from professionals related to starting Science Parks. After the interviews with the professionals' active on the different mature Science Parks were finished, the critical real estate development factors that were identified could be presented to the professionals from the starting Science Parks. It is interesting to see the practical input of the management implications for the starting Science Parks, however, due to time constraints interviewing professionals from starting Science Parks was not possible. Nevertheless, for further research it could be of interest to implement the management implications that were identified in this research and evaluate them with professionals from starting Science Parks to see if the management implications are of relevance.

Furthermore, during this research the different main perspectives of business, University, and government in their interest and focus during the Science Park development were examined. These three parties are frequently involved in almost all Science Park developments. In the literature of University Science Parks the user needs for the different stakeholders of the University are identified. However, these were never identified from a real estate point of view in relation to a Science Park. Therefore, for further research it could be interesting to identify the critical user need factors in relation to the real estate development of a Science Park for the three different perspectives. These can be compared with the critical real estate factors from this research to see if there is a large difference between the users on a Science Park and the managers, owners, or developers of a Science Park.

Finally, as stated by the literature and respondents during this research the financing of real estate on a Science Park is hard to obtain. The critical real estate development factors towards a mature Science Park development were identified in this research containing some financial factors. However, there is a lack of literature available for the financing of a Science Park development. In addition there is a large amount of literature available in the grants and incentives given by the government for innovative businesses. Although, these literature sources are not focused on the financing of real estate on a Science Park development. Therefore, it is interesting to investigate the different parties that finance a Science Park development and indicate the factors needed to receive capital during this development.

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# 9. APPENDICES

## 9.1 APPENDIX A: FACTSHEETS MATURE SCIENCE PARKS

| Professional Science Park<br>Factsheet #1<br>Kennispark Twente<br>Enschede | Kennispark Twente<br>Innovate & Accelerate |
|---|---|
| Originated | 2005[2] |
| Science Park area | 180.000 sqm. |
| Initiators | University of Twente, municipality of Enschede, region of Twente, province of Overijssel, Saxion[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | Foundation Kennispark Twente[2] |
| Manifest knowledge supporter | University of Twente, Saixon, MIRA, MESA+, CTIT[2] |
| Venture funding | Twente Technology Fund (TTF)[4] |
| Number of jobs[1] | 5.741[3] |
| Number of spin-offs | 175[3] |
| Number of businesses | 400[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: www.kennispark.nl/nl/over-ons/*

*3) Source: Buck Consultants International, 2014*

*4) Source: http://www.twentefund.nl/*

| Professional Science Park<br>Factsheet #2<br>Wageningen UR Campus<br>Wageningen |  |
|---|---|
| Originated | 1998[2] |
| Science Park area | 158.500 sqm. |
| Initiators | University of Wageningen, province of Gelderland, municipality of Wageningen, municipality of Ede[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | University of Wageningen, Foundation DLO[2] |
| Manifest knowledge supporter | University of Wageningen, NIOO, DLO, STOAS[2] |
| Venture funding | StartLife, StartHub[4] |
| Number of jobs[1] | 1.800[3] |
| Number of spin-offs | 55[3] |
| Number of businesses | 90[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: www.wageningencampus.nl/nl/campus/over/*

*3) Source: Buck Consultants International, 2014*

*4) Source: https://start-life.nl/, and http://www.starthubwageningen.nl/*

*5) Source: Wageningen Campus Strategy, 2013*

| Professional Science Park<br>Factsheet #3<br>Utrecht Science Park<br>Utrecht |  |
|---|---|
| Originated | 2011[2] |
| Science Park area | 300.000 sqm. |
| Initiators | University of Utrecht, province of Utrecht, municipality of Utrecht, UMC Utrecht, Hogeschool Utrecht[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | Foundation Utrecht Science Park[2] |
| Manifest knowledge supporter | University of Utrecht, Danone, UMC Utrecht, TNO, [2] |
| Venture funding | Utrecht Holdings, Economic Board Utrecht[4] |
| Number of jobs[1] | 1.675[3] |
| Number of spin-offs | 42[3] |
| Number of businesses | 80[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: http://www.utrechtsciencepark.nl/nl/over-het-park/*

*3) Source: Buck Consultants International, 2014*

*4) Source: http://www.utrechtsciencepark.nl/nl/faciliteiten/financiering*

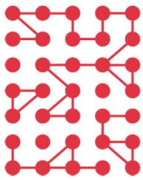
| Professional Science Park<br>Factsheet #4<br>Amsterdam Science Park<br>Amsterdam |  |
|---|---|
| Originated | 1996[2] |
| Science Park area | 70.000 sqm. |
| Initiators | University of Amsterdam, municipality Amsterdam, NWO[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | University of Amsterdam, municipality Amsterdam, NOW, Amsterdam Science Park N.V.[2] |
| Manifest knowledge supporter | UvA Faculty of Science, AUC, CWI, NIKHEF, AMOLF, NWO[2] |
| Venture funding | ACE Venture Lab, Innovation Exchange Amsterdam, Innovation Lab Chemistry Amsterdam[4] |
| Number of jobs[1] | 850[3] |
| Number of spin-offs | 40[3] |
| Number of businesses | 120[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: http://www.amsterdamsciencepark.nl/about-amsterdam-science-park/profile/*

*3) Source: Buck Consultants International, 2014*

*4) Source: http://www.amsterdamsciencepark.nl/science-meets-business/knowledge-valorisation/*

| Professional Science Park<br>Factsheet #5<br>Leiden Bio Science Park<br>Leiden |  LEIDEN BIO SCIENCE PARK |
|---|---|
| Originated | 1984[2] |
| Science Park area | 110.000 sqm. |
| Initiators | University of Leiden, Municipality of Leiden, Leiden UMC, Province of Zuid-Holland[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | Leiden Life meets Science[2] |
| Manifest knowledge supporter | LMC, LEI, Crucell[2] |
| Venture funding | Leiden TTO Luris[4] |
| Number of jobs[1] | 6.583[3] |
| Number of spin-offs | 27[3] |
| Number of businesses | 122[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: https://leidenbiosciencepark.nl/discover/*

*3) Source: Buck Consultants International, 2014*

*4) Source: https://leidenbiosciencepark.nl/media/uploads/ck/LBSP%20brochure*

| Professional Science Park<br>Factsheet #6<br>Science Park Technopolis<br>Delft |  |
|---|---|
| Originated | 2005[2] |
| Science Park area | 61.200 sqm. |
| Initiators | Technical university of Delft, municipality of Delft[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | Technical university of Delft, municipality of Delft[2] |
| Manifest knowledge supporter | University of Delft, TNO, Deltares[2] |
| Venture funding | Yes!Delft[4] |
| Number of jobs[1] | 5.574[3] |
| Number of spin-offs | 192[3] |
| Number of businesses | 219[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: http://www.sciencepark.tudelft.nl/#*

*3) Source: Buck Consultants International, 2014*

*4) Source: http://www.yesdelft.nl/*

| Professional Science Park<br>Factsheet #7<br>High Tech Campus Eindhoven<br>Eindhoven | HIGH TECH CAMPUS EINDHOVEN |
|---|---|
| Originated | 1998[2] |
| Science Park area | 103.000 sqm. |
| Initiators | Philips[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | Ramphastos Investments[2] |
| Manifest knowledge supporter | Philips[2] |
| Venture funding | Startupbootcamp HighTechXL [4] |
| Number of jobs[1] | 10.000[3] |
| Number of spin-offs | 55[3] |
| Number of businesses | 130[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: http://www.hightechcampus.com/who-we-are*

*3) Source: Buck Consultants International, 2014*

*4) Source: http://www.startupbootcamp.org/accelerator/hightechxl-eindhoven.html*

| Professional Science Park<br>Factsheet #8<br>Brightlands Chemelot Campus<br>Sittard-Geleen |  |
|---|---|
| Originated | 2005[2] |
| Science Park area | 20.000 sqm. |
| Initiators | DSM, SABIC, municipality Sittard-Geleen[2] |
| Development phase | Professional Science Park[3] |
| Stakeholders | Chemelot Campus B.V.[2] |
| Manifest knowledge supporter | DSM, SABIC[2] |
| Venture funding | Limburg Ventures[4] |
| Number of jobs[1] | 1.410[3] |
| Number of spin-offs | 14[3] |
| Number of businesses | 51[3] |
| Active open innovation | Yes[3] |

*1) Excl. Universities, R&D institutes, medical centers*

*2) Source: http://www.chemelot.nl/default.aspx?template=algemeen_image.htm&id=744&taal=nl*

*3) Source: Buck Consultants International, 2014*

*4) Source: http://www.limburgventures.com/p3/*

## 9.2 Appendix B: Topographical overview Science Parks

Topographical overview of the Science Park developments in the Netherlands.

**Growing**

9 Wetsus/ Watercampus – Leeuwarden
10 Healthy Ageing Campus – Groningen
11 Zernike Science Park – Groningen
12 Mercator Science Park - Nijmegen
13 Novio Tech Campus – Nijmegen
14 Space Business Park – Noordwijk
15 Pivot Park – Oss
16 TU/e Science Park – Eindhoven
17 High Tech Automotive Campus – Helmond
18 Maastricht Health Campus – Maastricht

**Mature**

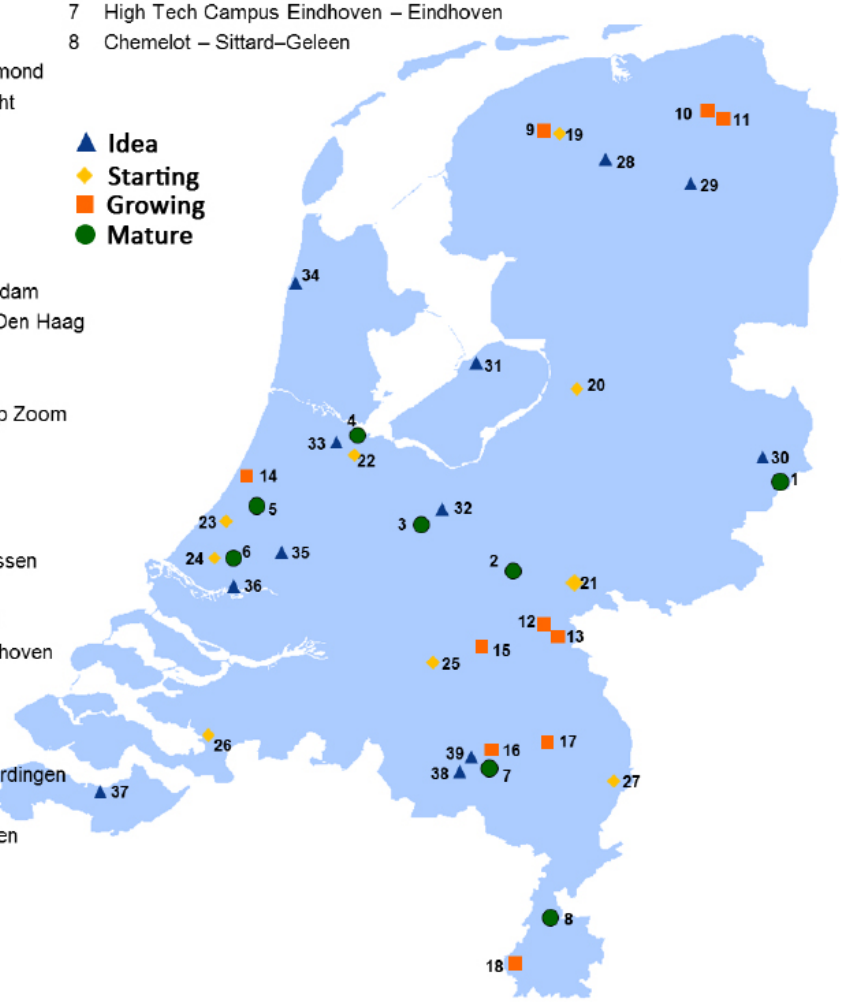
1 Kennispark Twente – Enschede
2 Wageningen UR Campus – Wageningen
3 Utrecht Science Park – Utrecht
4 Amsterdam Science Park – Amsterdam
5 Leiden Bio Science Park - Leiden
6 Science Park Technopolis – Delft
7 High Tech Campus Eindhoven – Eindhoven
8 Chemelot – Sittard–Geleen

**Starting**

19 Dairy Campus – Leeuwarden
20 Polymer Science Park – Zwolle
21 Energy Business Park -Arnhem
22 AMC Medical Business Park – Amsterdam
23 The Hague Security Delta Campus – Den Haag
24 Biotech Campus – Delft
25 Food & Health Campus - Den Bosch
26 Green Chemistry Campus – Bergen op Zoom
27 Services Valley Campus – Venlo

**Idea**

28 High Tech Campus – Drachten
29 Kenniscampus Sensortechnologie –Assen
30 Thales High Tech Campus – Hengelo
31 Emerging Disease Campus – Lelystad
32 Anthonie v. Leeuwenhoekterrein – Bilthoven
33 VU Campus - Amsterdam
34 ECN Petten – Petten
35 Horti Science Parc – Bleiswijk
36 International Food Tech Center – Vlaardingen
37 Maintenance Value Park – Terneuzen
38 Philips Healthcare Campus – Veldhoven
39 Brainport Industries Park – Eindhoven




*Source: Buck Consultants International (2014), edited by author.*

## 9.3 Appendix C: Type and knowledge supporter of Science Parks

Detailed overview of the Science Park developments in the Netherlands their phase, manifest knowledge supporter, and type: University or Business.

| Name Science Park | Phase Science Park | Manifest knowledge supporter | University or Business Science Park |
|---|---|---|---|
| **Kennispark Twente (Enschede)** | Mature | University of Twente | University |
| **WUR Campus (Wageningen)** | Mature | University of Wageningen, DLO | University |
| **Utrecht Science Park (Utrecht)** | Mature | University of Utrecht, Danone, UMC | University |
| **Amsterdam Science Park (Amsterdam)** | Mature | University of Amsterdam, CWI, NIKHEF, AMOLF | University |
| **Leiden Bio Science Park (Leiden)** | Mature | LMC, LEI, Crucell | University |
| **Science Park Technopolis (Delft)** | Mature | Technical University Delft, TNO, Deltares | University |
| **High Tech Campus Eindhoven (Eindhoven)** | Mature | Philips, Holst | Business |
| **Brightlands Chemelot Campus (Sittard-Geleen)** | Mature | DSM, Sabic | Business |
| **Wetsus/Water Campus (Leeuwarden)** | Growing | TTI Wetsus, VHLarenstein | University |
| **Healthy Ageing Campus (Groningen)** | Growing | UMCG | University |
| **Zernike Science Park (Groningen)** | Growing | University of Groningen, Hanze Hogeschool | University |
| **Mercator Science Park (Nijmegen)** | Growing | University of Nijmegen, Hogeschool Arnhem Nijmegen | University |
| **Novio Tech Campus (Nijmegen)** | Growing | NXP | Business |
| **Space Business Park (Noordwijk)** | Growing | ESA | Business |
| **TU/e Science Park (Eindhoven)** | Growing | Technical University Eindhoven, TNO | University |
| **High Tech Automotive Campus (Helmond)** | Growing | PDE, TUV, TNO | University |
| **Pivot Park (Oss)** | Growing | MSD | Business |
| **Maastricht Health Campus (Maastricht)** | Growing | University of Maastricht, UMC | University |
| **Dairy Campus (Leeuwarden)** | Starting | WUR (annex) | University |
| **Polymer Science Park (Zwolle)** | Starting | DSM, Wavin | Business |
| **Energy Business Park (Arnhem)** | Starting | DNV GL (former KEMA Tennet) | Business |
| **Amsterdam Medical Business Park (Amsterdam)** | Starting | AMC, University of Amsterdam | University |
| **Biotech Campus (Delft)** | Starting | DSM | Business |
| **The Hague Security Delta Campus (The Hague)** | Starting | TNO defense & security | Business |
| **Food & Health Campus (Den Bosch)** | Starting | JB Hospital, HAS, Avans | University |
| **Green Chemistry Campus (Bergen op Zoom)** | Starting | Sabic | Business |
| **Services Valley Campus (Venlo)** | Starting | Océ/Canon | Business |

*Source: Buck Consultants International (2014), edited by author.*

## 9.4 Appendix D: Economic effect of Science Parks

Detailed overview of the Science Park developments in the Netherlands with their phase, number of businesses, spin-offs, and jobs.

| # | Science Park in 2014 | Phase | Number of businesses | Number of spin-offs | Number of jobs |
|---|---|---|---|---|---|
| **1** | Kennispark Twente (Enschede) | Mature | 400 | 175 | 5,471 |
| **2** | WUR Campus (Wageningen) | Mature | 90 | 55 | 1,800 |
| **3** | Utrecht Science Park (Utrecht) | Mature | 80 | 42 | 1,675 |
| **4** | Amsterdam Science Park (Amsterdam) | Mature | 120 | 40 | 850 |
| **5** | Leiden Bio Science Park (Leiden) | Mature | 122 | 27 | 6,583 |
| **6** | Science Park Technopolis (Delft) | Mature | 219 | 192 | 5,574 |
| **7** | High Tech Campus Eindhoven (Eindhoven) | Mature | 130 | 55 | 10,000 |
| **8** | Brighlands Chemelot Campus (Sittard-Geleen) | Mature | 51 | 14 | 1,410 |
| | **Total mature Science Parks** | - | **1,212** | **600** | **33,633** |
| **9** | Wetsus/Water Campus (Leeuwarden) | Growing | 26 | 15 | 192 |
| **10** | Healthy Ageing Campus (Groningen) | Growing | 40 | 32 | 1,200 |
| **11** | Zernike Science Park (Groningen) | Growing | 74 | 25 | 817 |
| **12** | Mercator Science Park (Nijmegen) | Growing | 65 | 45 | 1,040 |
| **13** | Novio Tech Campus (Nijmegen) | Growing | 21 | 2 | 500 |
| **14** | Space Business Park (Noordwijk) | Growing | 35 | 12 | 750 |
| **15** | TU/e Science Park (Eindhoven) | Growing | 123 | 45 | 1,575 |
| **16** | High Tech Automotive Campus (Helmond) | Growing | 33 | 0 | 491 |
| **17** | Pivot Park (Oss) | Growing | 38 | 20 | 350 |
| **18** | Maastricht Health Campus (Maastricht) | Growing | 42 | 31 | 900 |
| | **Total growing Science Park** | - | **497** | **227** | **7,815** |
| **19** | Dairy Campus (Leeuwarden) | Starting | 1 | 0 | 20 |
| **20** | Polymer Science Park (Zwolle) | Starting | 2 | 5 | 25 |
| **21** | Energy Business Park (Arnhem) | Starting | 30 | 15 | 550 |
| **22** | Amsterdam Medical Business Park (Amsterdam) | Starting | a (1) | 0 | a |
| **23** | Biotech Campus (Delft) | Starting | 1 | 0 | 120 |
| **24** | The Hague Security Delta Campus (Den Haag) | Starting | 8 | 0 | 25 |
| **25** | Food & Health Campus (Den Bosch) | Starting | 15 | 15 | 135 |
| **26** | Green Chemistry Campus (Bergen op Zoom) | Starting | 12 | 0 | 20 |
| **27** | Services Valley Campus (Venlo) | Starting | 3 | 6 | 65 |
| | **Total starting Science Parks** | - | **72** | **41** | **960** |
| | **Total all Science Parks** | - | **1,709** | **827** | **41,448** |

*a) Foreign business decided to locate on Science Park, thus, during the research the name of the business was not yet made public.*

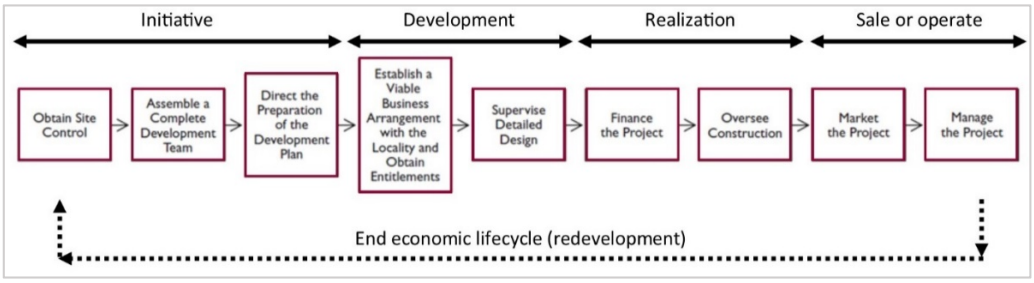
*Source: Buck Consultants International (2014), edited by author.*

## 9.5 Appendix E: Interview guide

In blue the five main topics with at the end the covering optional final question, the bold questions underneath the topics are supportive and clarified by figures or italic text underneath the question.

### Real estate development process

1. **A Science Park is based on a business park (also seen as a subcategory of a business park), is the real estate development process of a Science Park showing similarities with the real estate process of a business park?**



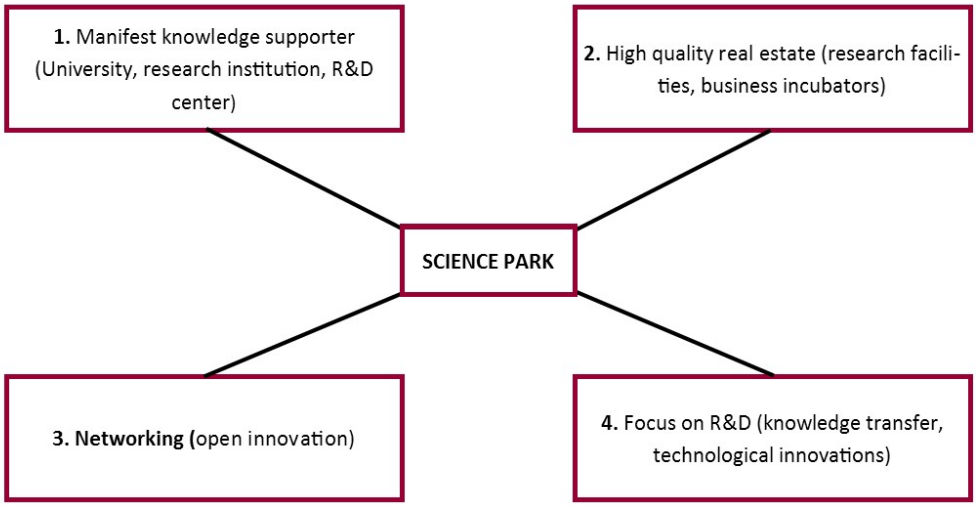

*Real estate development process.*

2. **How flexible is the real estate development process of a Science Park?**

*Real estate development takes several years, how are they handling the rapid changing market? (New laboratories/technologies, etc.)*

3. **What are the side conditions for a Science Park development?**

*Accessibility (Public transport, car, bicycle), connection with University or large businesses (manifest knowledge supporter), also see figure:*




*Characteristics Science Park.*

### Policy governments & risk management

4. **Science Parks are often seen by governments as a boost for the local and regional economy, is this bringing advantages during the development process?**

*Incentives on land price, grants for example: Peak in the Delta/Horizon 2020 (EU)/Innovation credit (NL).*

**4a. How flexible is a zoning plan of a municipality in case of a Science Park development?**

*Due to the high number of different functions, safety classes, etc.*

**4b. What is the land policy of a municipality during the Science Park development?**

*Has the municipality an active land policy? Public-Private-Partnership? Or facilitating?*

5. **Are you also facing competition from the large amount of new Science Park developments? How can a Science Park development distinguish itself from the rest?**

*Keeping businesses, attracting new ones (acquisition).*

## Initiators & stakeholders

6. **Who are the initiators of a Science Park development? And how is the cooperation with these parties?**

*Often formed by manifest knowledge supporters (e.g.: NXP, Philips, DSM, etc.), have these parties still influence on the progress of settling new businesses? Policy, zoning plans, governments, established companies.*

7. **Which stakeholders are involved in the Science Park development?**

*Government, private parties, investors, non-profit or profit organizations?*

## Financial & risk management

8. **Are the businesses with a low risk profile first settled or also direct the businesses with a high risk profile? For instance, start-ups or starting businesses with few financial resources?**

*Banks are conservative, first create stable cash flow before settling high risk businesses, higher rents for high risk businesses, kickstarter, crowd funding.*

9. **The real estate is very specific, so hard to rent out to other parties. How is loss of income by vacancy of the real estate prevented? And how flexible is the building (transformation)?**

*R&D branches with a lot of businesses versus branches with relative few businesses (e.g. new technologies on the market, few businesses are already in that technology).*

10. **Long lag phase and high investments before the added value of the real estate translates itself into extra profit, are businesses prepared to pay high rents while the profit of the business still has to proof itself?**

## Real estate facilities

11. **In terms of flexibility, how are the rental contracts drafted for the parties that settle on a Science Park (businesses, start-ups, incubators)?**

*Ratio rental/ownership, short rental periods (like concept, Regus, Seets2meet, Merin), flexibility, shared facilities.*

12. **With the development of a Science Park is there a particular sequence in the realization of real estate facilities? And how is the maintenance of the real estate?**

*Laboratories, offices, clean rooms, retail & leisure. Higher building costs due to more expensive real estate (laboratories, etc.), sharing of facilities (laboratories, clean rooms, etc.). Upgrade/renewal of laboratories, etc.*

## (Covering optional final question)

13. **What are the fail factors during the development of a Science Park?**

## 9.6 APPENDIX F: INFORMATION RESPONDENTS

| | Business | Name | Function | Profession | Science Park active on | Date |
|---|---|---|---|---|---|---|
| **Respondent 1** | Res&Smit | M. Smit | Director | Consultancy, real estate advising, development, projectmanagement | Leiden Bio Science Park | June 3, 2016 |
| **Respondent 2** | Vastgoedbedrijf Universiteit Leiden | F.F.J. Poppelier | Deputy director | Housing University Leiden, maintenance, renovation, developing, area development | Leiden Bio Science Park | June 13, 2016 |
| **Respondent 3** | Amsterdam Science Park | L. le Duc | Director | Housing businesses, maintenance, renovations, development, area development. | Amsterdam Science Park | July 19, 2016 |
| **Respondent 4** | Kadans Vastgoed (Science Parks) | C. van Dijen | Partner/Deputy director | Developing, buying, financing, building, management Science Parks | Novio Tech Campus/ Wageningen UR campus | June 6, 2016 |
| **Respondent 5** | Brink (Brink Groep) | E. Verkooijen | Senior Manager/ Partner | Housing, managing, area development, creating vision, renovation, maintenance | Brightlands Chemelot Campus | June 10, 2016 |
| **Respondent 6** | Ramphastos | F. Smolders | Director | Housing businesses, maintenance, renovation, developing, area development | High Tech Campus Eindhoven | June 22, 2016 |
| **Respondent 7** | Kontek (Brink Groep) | P. Timmermans | Director | Advice, management, maintenance, cost control, sustainability | High Tech Campus Eindhoven | July 25, 2016 |

## 9.7 Appendix G: Summary interviews

List of abbreviations that are used in the summarizing the interviews.

| Abbreviation | Definition |
|---|---|
| BOM | Brabantse Ontwikkelmaatschappij |
| BP | Business Park |
| Dev. | development |
| Gov. | government |
| HTCE | High Tech Campus Eindhoven |
| OostNV | Ontwikkelmaatschappij Oost-Nederland |
| R&D | Research & Development |
| RE | Real Estate |
| SP | Science Park |
| Uni | University |

| | Real estate development process | | | Policy governments & risk management |
|---|---|---|---|---|
| | **1. Real estate dev. process SP** | **2. Flexibility dev. Process SP** | **3. Boundary conditions SP dev.** | **4. Governmental advantages dev. process SP** |
| **Respondent 1 Res&Smit** | Not a planned process, developed from **business process** (manifest knowledge supporter), triple helix connection; University, municipality, business in surrounding area, want close proximity businesses in same profession. Clear concept/theme SP. | Startup mostly from LUMC or University. However, incubators stay occupied by businesses because their labs are finally certified (process can take 2 years for life sciences). **Real estate flexible by over dimensioning** and letting the tenant arrange the installation. One owner SP fast decision making. | Stakeholders need to have a **connection or synergy with each other**, otherwise just a high quality business park. | **Municipality is positive** about development, wants to cooperate. Sometimes province and national government involved. However, Leiden zero grants, for economy Zuid-Holland less of influence. |
| **Respondent 2 Vastgoedbedrijf Universiteit Leiden** | Dev. Process of **SP not starting with bricks, but manifest knowledge supporter** (University Leiden/LUMC). Strong concept/theme decides which firms locate on SP. Commercialization and cooperation of knowledge and research Universities, LUMC with firms. | Land position with **one owner, keeps grip and flexibility on SP dev.** Helps if there is a large land position, therefore, there are enough expansion options (Leiden University and LUMC). | Connection with public transport, infrastructure for cars, however, parking on outskirts SP. **Keep SP only for bikes and pedestrians.** Municipality and province main investors infrastructure. Thus, private investors for exploiting parking facilities. | SP is attracting firms to region, therefore, same goal as municipality increasing economic welfare. However, province/municipality not investing **public capital due to economic region** that is already good. Although, they invest in the infrastructure. |
| **Respondent 3 Amsterdam Science Park** | Started with manifest knowledge supporters, University of Amsterdam/NWO. **Attract businesses for the spin-offs from University, market the knowledge.** Establish triple helix model. | **Flexible in term of enough building permits**, however, due to success incubator development behind on schedule. Hard to keep up. Lot of start-ups from University. | Well established infrastructure, accessibility with public transport, own bus stop, train station, etc. **Parking on the side, and keep center car free**. Amsterdam SP is half a hour from Schiphol airport. | Municipality cooperate and is positive about the SP, however, in Amsterdam is enough growth, therefore, attention gets distracted. Especially on regional level, **province Noord-Holland not investing in SP dev., due to region that is already good**. Although, they invested in train station. |
| **Respondent 4 Kadans Vastgoed** | Starting new SP is hell of a job. The dev. of an SP is more a social issue. To **keep business with knowledge in the region**, province and municipality are willing to cooperate. SP concept mostly dev. from manifest knowledge supporter on SP. | Is a **continuous process, can adapt easily.** However, the certification of laboratories is long, needs to be taken into account with dev. SP | Manifest knowledge supporter present, then further dev. SP. **One owner/dev. SP, infrastructure of high quality.** | Province/municipality is positive about SP dev. due to stimulation of economy in region, incentives/grants can be given. Collaboration agreement is needed, to keep the SP dev. the concentration point of the region. **Willingness depends on province** (Randstad vs. Limburg, etc.). |
| **Respondent 5 Brink** | Not real estate or a beautiful master plan, but a **theme or concept that is highly needed is origin SP**. Create a community. Start small, when booming results change of plans. Facilitating real estate needs to comply with the firms on the SP. | Large amount of cables and pipes in ground, therefore, **changing site expensive not really flexible.** However, essential to keep master plan as flexible as possible. Technologies constantly changing, react fast, that way businesses locate on SP. | For knowledge transfer a **SP need to have a University faculty or annex on its site.** University also invests in the site due to current focus on research. For businesses it is more attractive to settle on SP due to the connection with knowledge institutions. | Government willing to help, open for SP dev. However, **heavily depending on province.** Grants for firms, only first year after this normal (high) prices SP. For expl. Limburg invested in Chemelot, to attract more firms (infrastructure, cables, pipelines, etc.) |
| **Respondent 6 Ramphastos** | **Not a planned process.** Manifest knowledge supporter returns to core-business, invites partners to locate nearby for faster product dev. + sharing to reduce costs. Create high quality facilities, attract businesses, become place to be. Businesses together in R&D project settle on SP. | Philips created top of the bill IT structure, therefore, still up to date for businesses. **Existing real estate for start-ups.** Already settled larger firms dev. new buildings more specified with pilot production, clean rooms, laboratories. | **No separate canteens/meeting rooms** only one board room (max 20 persons) per business. Central strip offers restaurant, meeting rooms, etc. in order to create traffic on SP. Parking space on outskirts SP, no fixed parking place resulting in a different walk to the office everyday. | Clarify economic- and employment growth, the attraction of new businesses to the region, then municipality willing to help with SP dev. For expl. **province Brabant not investing, due to success** HTC. However, they should for the guaranteeing the future of SP. |
| **Respondent 7 Kontek** | Large firm present, however, concept/theme needs to be present at the begin. Dev. takes longer than business park dev. **Keep consistency and flexibility, then economic rate of return higher** than normal business park. Create ecosystem. | Flexible in consistent set of a premeditated plan for SP dev. Keep **possibility to allocate businesses in other buildings**, keep flexible. Expl. Laboratories flexible layout, easily to rent to next business. Use workplaces instead of $m^2$, easier to allocate. | HTC with strip, large investment, thus, return in innovativeness, knowledge transfer. HTC buildings max 4 floors and floor-to-ceiling glass facade to **keep contact with ground** and invite employees to go outside (stimulates knowledge transfer). | National government, province, and municipality is positive, expl. They brand the region Eindhoven as **Brainport Region. HTC is taking advantage of this marketing.** |

| | 4a. Flexibility zoning plan SP dev. | 4b. Land policy municipalities | 5. Competition other SP's | Initiators & stakeholders<br>6. Initiators SP dev. |
|---|---|---|---|---|
| **Respondent 1<br>Res&Smit** | Municipalities give grants for development, flexibility in zoning plan due to economic stimulation region. However, **grants depend on the region of the SP.** | **Public-Private-Partnership** with municipality, University, and Hospital. Land policy is from University that owns the plot. Make use of **leasehold** to keep grip on park. | Leiden Bio Park has competition from Utrecht and Amsterdam, (SP's with more or less the same theme). Avoid competition by **making businesses on SP the ambassador**, network companies creates the arrival of new businesses. | **University of Leiden, LUMC, and municipality have influence on settlement** of businesses. However, businesses need to qualify the theme life sciences. Nevertheless supporting firms are also allowed (suppliers, advisors, financers). |
| **Respondent 2<br>Vastgoedbedrijf Universiteit Leiden** | Flexible zoning plan, **theme SP included in plan.** However, safety measures for laboratories, radius of 30 meter. If risk factors are embedded in zoning plan, then flexibility from municipality is high. | Municipality no land position in Leiden Bio Park. However, Municipality, University, LUMC cooperate in SP dev. with foundation Bio Partner. **SP has leasehold land policy, where theme of SP is included and grip area is guaranteed.** | Competition SP's due to fragmentation. SP's need **clear themes/concepts that settle specialized firms**. However, for a stable cash flow SP's also locate non-specialized firms on their site. | **Leiden University, LUMC, commercialization of research and knowledge, connection with firms.** Life science theme well guarded. However, foundation Bio Partner dev. manage the buildings on SP. Real estate not the core business of public institution, therefore, consortium formed. |
| **Respondent 3<br>Amsterdam Science Park** | Zoning plan flexible in terms of contours, thus regulated buildings highs (16m and higher) and theme of the park is included in zoning plan. Changing zoning plan is long process, therefore **create zoning plan that is as flexible as possible**. | Municipality owns all land, thus **land in leasehold to businesses keep grip on concept.** No public-private-partnership, only investor (Rabobank) financing the incubator buildings. | Amsterdam not a lot of competition. Businesses want to locate in Amsterdam. **Once in 3 months all 8 mature SP's come together to share knowledge.** Guard the concept of Beta Science, green campus, Nano tech. Expl. ASML locate on Amsterdam SP because other human talent than in the city of origin Eindhoven. | NWO (research institution) and University of Amsterdam, municipality facilitating function. Foundation Amsterdam SP guards the theme, and attracts businesses. Thus, **University of Amsterdam and NWO have influence on locating businesses, need to be in concept of SP**. |
| **Respondent 4<br>Kadans Vastgoed** | Flexible, however, agreement with municipality need to be made to prevent them from settle firms or SP's elsewhere in municipality. Resulting in an mutual agreement. They also want economic welfare in their region. Keep **zoning plan as flexible as possible.** | **Public-Private-Partnership** with public dev. corporation and private firm. Provinces are shareholders of dev. Corporation (BOM, OostNV, etc.), land policy is **leasehold** to keep grip on SP concept. | Competition between SP's for smaller firms is low, because they operate more on local level due to their local network. However, for **larger firms (Danone, Campina, etc.) high competition** to get on SP. Incentives from Governments for large firms to establish in their region. | NXP, or Wageningen University have some influences on housing firms. Wageningen Campus has a **ballot committee for locating businesses**, in order to create an ecosystem. Otherwise SP loses identity and transforms into normal business park. |
| **Respondent 5<br>Brink** | Communicate to municipality what concept, and how many jobs are created. **Involve them in the master plan** to create a flexible zoning plan. Also involve environmental parties in plan. Employment and large tenants can exert pressure on provinces/municipalities. | Due to pollution in the ground by Chemelot, DSM still owns the land However, the **SP dev. gets building rights** and owns the building. | There is a certain extent of competition. However, this can be **avoided when a strong concept is created,** making the SP a place to be (expl. Chemical > Chemelot, High Tech > HTC, etc.). The image of SP is very important for settlement of businesses. | Province, municipality, manifest knowledge supporter. For expl. Limburg wants to keep large firms and enlarge the employment in the region. **Consortium of province, DSM, University is formed and decides who enters the SP.** |
| **Respondent 6<br>Ramphastos** | Clear zoning- and visual plan, stay within contours of the building plot, building permission automatically granted. Different plot? **Consultation with municipality almost always approved.** For expl. HTC has chemical island, where all dangerous substances are transported to through pipelines. | HTC no municipality involved, first owned by Philips then sold to private investor Ramphastos. **All buildings on SP are rented**, nothing owned in order to keep grip on concept. | HTC due to **expertise in High Tech less competition**. TU/e sometimes gets business while better on HTC and vise versa. Furthermore, marketing of Eindhoven needs to cooperate more as Brainport (HTC, TU/e, ASML). However, TU/e has another concept where the acquisition of plots is possible. | One owner in order to guard the concept. No shredded ownership results in conflict of interest. SP origin is manifest knowledge supporter. However, for **real estate management and business allocation neutral third party needed**. |
| **Respondent 7<br>Kontek** | HTC created the zoning plan, however, municipality needed to verify the plan. **Kept the plan as flexible as possible with contours of the buildings.** | HTC was owned by Philips only **rental buildings to keep grip on the concept.** Now investor, however, uses the same concept. | Competition present, due to TU/e that has their own SP instead of locating on HTC. However, enough businesses to allocate, lot of demand (laboratories, etc.), and **being unique enough creates a image** where businesses of that profession want to locate. | Philips was initiator, however, let other businesses on SP also be of influence, creating a minority stake. **Guards the concept, one owner for efficient decision making.** Nowadays private investor guards the concept, Philips is major tenant. |

| | | Financial & risk management | | |
|---|---|---|---|---|
| | **7. Stakeholders SP dev.** | **8. Business risk allocation (risk profile business, stable cash flow)** | **9. Specific real estate SP (vacancy income loss, flexibility)** | **10. Large investments, high rents. Tenants need to prove, profits not sure** |
| **Respondent 1 Res&Smit** | University is not developing, not their core-business. However, **University, Hospital, and Municipality create consortium foundation Bio Partner**. SP still need to attract private investor for extra capital for dev. new buildings. | Leiden Bio Park has a strong support of University and LUMC (large tenants). Therefore, they can **focus on start-ups (mostly from the University)** that need to be financed. Rents are not lower in begin, however, €175 for office and laboratories €225 per sq.m per year normally. | Leiden has vacancy rate of 1%, although, need friction vacancy of 3/4%. Therefore, dev. new buildings due to the large demand laboratories. **Real estate flexible by over dimensioning and letting the tenant arrange the installation**. No investment in unsalable parts. | University focusses on research, facilitating startups therefore **no hard focus on cash flow, although it needs to stay positive.** With large investment higher rents and longer periods (10/15 years) result in positive profits. |
| **Respondent 2 Vastgoedbedrijf Universiteit Leiden** | University, LUMC, Municipality start consortium foundation Bio Partner for real estate dev./management, thus not the core-business of university. **University buildings on SP owned/managed by University rest by consortium**. Attract private investor for expansion SP. | Manifest knowledge supporters are main tenants, stable cash flow. However, University/LUMC is focused on start-ups with knowledge and innovation, therefore, **incubators low rents that increase when a firm stays longer.** Private investor hard to attract in SP dev., high risk. | Occupiers stay in incubators due the long certification of labs. **Laboratories are not flexible, however, the incubator buildings as flexible as possible** (position installations, etc.). Low vacancy, deny new firms, high need for capital and new dev. buildings. | The expansion of a University SP, not their core business, therefore, attract private investor to expand. Incubators in Leiden get low rental price, more growth results in higher rent until they locate in own building. **Business concept not based on profit, but on knowledge transfer.** |
| **Respondent 3 Amsterdam Science Park** | **NWO, University of Amsterdam, and municipality are stakeholders** of the park in foundation Amsterdam Science Park. Furthermore matrix organization facilitates startup buildings (cooperation of University of Amsterdam, NWO, municipality and investor Rabobank). | No, due to high public influences the main focus was research on Amsterdam SP. Therefore, incubators of importance. **Focusing more on innovation and transfer of knowledge than profit.** SP costs more investment is still negative. Last several years active in attraction of businesses. | No vacancy, **due to popularity of incubators and large amount of spinoffs from University of Amsterdam.** Locating businesses in last several years, these specify their building needs. 2% vacancy rate. | **Sometimes spin-off can not fulfill rent, go further in smaller size or go broke**. Investment in real estate not yet recovered, however, focus is on University spin-offs (more on innovative ideas and knowledge sharing). Thus last several years attracting larger businesses. |
| **Respondent 4 Kadans Vastgoed** | SP dev. has to guard the concept and locate firms on SP. **Involvement private dev.- and investment firms, due to not core business** University. In addition manifest knowledge (NXP) has influence on dev. SP. | Grants for start-ups, however, not for their real estate facilities. Start with firms that have a low risk profile. **Funds for start-ups in financing equipment, ask premiums.** When large investment needs to be made with tenant a partnership is entered over several years. | Future proof, **dev. Building for 80% and last 20% is finished when tenant is known.** Investing in what the tenant wants but not over dimensioning to keep rents/costs low. Large demand specific real estate, friction vacancy of 6% in exploitation prognosis for flexibility. | Large investment, however, the **high moving costs prevent firms from leaving SP**. Thus, due to high demand the risk is lower, lot of firms want to settle. Public dev. corporations help financing (BOM,. OostNV). |
| **Respondent 5 Brink** | DSM, SABIC, University Maastricht, Eindhoven, Rijkswaterstaat. **With University annex on SP. University invests also in SP**. Consortium created province/DSM/University for dev. SP one party as owner is more efficient. DSM is shareholder (30%). | **Spread risks by not focusing on one large tenant,** try to attract more (University, firms). Start with large firms, rest will come soon after. However, when developing large tenant can enter due to future stability instead of smaller tenant. Large firms also mostly have spin-offs that locate on SP. | Shortage in laboratories almost no vacancy, **older buildings for starting firms. Develop or transform buildings for larger tenants** to their demands, however, as flexible as possible. Flexibility of importance, fixed policies as late as possible. | Establish a good concept and realizing more facilities so parties prepared to pay more (expl. Chemelot, office €200 per sq.m per year) and there is a high demand. **Creating a place to be**. Adapt on changing market (expl. Clean rooms and pilot units in demand). |
| **Respondent 6 Ramphastos** | Organization that can **legally and physically control stakeholders in order to guard concept**, and prevent shredded ownership/tenants. Private investor (HTC) has ownership. Listen to manifest knowledge supporter (Philips), however, no influence on SP progress. | HTC has large businesses with low risk profiles, thus, stable cash flow. Therefore, can focus on start-ups. Mostly no effect in getting large businesses on SP, however, **start-ups on SP that are acquired by large firms can result in the settlement of large firms on SP.** | **The more specific real estate the faster it is occupied,** due to the shortage in laboratories, etc. Vacancy rate of 0,5%. Therefore, new laboratories/pilot production/etc. Older buildings for starting firms. | Offering a total package: Basic rent circa €150-€160 per sq.m per year same as city center, however, **service costs higher (tot. package** expl. State of the art IT, restaurants, meeting rooms, security, reception, garbage, etc.). Leads to costs savings by sharing restaurant, etc. However, start-ups lower rents. |
| **Respondent 7 Kontek** | Philips as largest tenant and manifest knowledge supporter. **Private investor bought SP, and added their network of potential tenants fitting in the theme (bought a concept).** Municipality only of influence on zoning plan. | First investment is larger, thus, need to have trust in the concept/theme of the SP. In the end resulting in higher profit than regular business park. However, results **sometimes in locating firms not qualifying the concept/theme but for cash flow.** Occur not too often, otherwise disrupting the concept/theme. | Vacancy low, however, **not working with m² but with workplaces. More flexible to allocate people in buildings**. Real estate is specific, fast occupied due to high shortage. Laboratories not sharing, thus, rent laboratory for flexible period and with knowhow is a selling point. | **Create ecosystem with different sized firms**. That way can cover certain loss of rents. Start-ups, small firms shorter rental periods, in incubators with shared facilities (office, reception, etc.). |

| | Real estate facilities | | (Covering optional final question) |
|---|---|---|---|
| | **11. Rental agreements (flexibility)** | **12. Periodization SP dev. real estate functions** | **13. Fail factors SP dev.** |
| **Respondent 1 Res&Smit** | Incubators, research from University, own office or laboratory. Rental **agreements can be short, but rents are therefore high**. Thus, laboratories are not shared due to the fact of patents and lab setups. | First the buildings for tenants. Create community and knowledge transfer by adding leisure, retail, & hospitality in central location. In addition short stay for expats/PhD's/(master)students. **Marketing and place making, walking routes so people meet each other**. | Low vacancy on SP, results in the **denial of businesses**. Furthermore, a lack of knowledge supporters affects the knowledge transfer and dev. of new technologies. |
| **Respondent 2 Vastgoedbedrijf Universiteit Leiden** | Incubators, offer flexible space for start-ups. **Rental prices low first year, then gradually increasing rent** until business locate in own building. | Large tenants, however focus University SP on incubators with start-ups for innovation. **No cars in center only bikes and pedestrians. Central location where retail, leisure, & hospitality is located**. Short-stay for expats and extra livability on SP. Support people meeting each other in SP. | **No clear concept/theme SP or connection with University** for facilitation of start-ups, create career opportunities for students, researchers, PhD's, etc. |
| **Respondent 3 Amsterdam Science Park** | Beginning phase of a start-up is flexible due to few needs, rental agreement months. Possibility to use shared laboratories. **However, when specified requirements needed than longer rental period required.** | First only NWO settled, University of Amsterdam added. Then SP was formed. **University of Amsterdam beta faculties on park, after this student housing, luxury apartments, leisure, hospitality and retail.** However, commercialization and active attracting businesses came after this. | **No success in attracting/finding human talent**, mostly connection with or close to University. No community or meeting facility for people. Not a good infrastructure. |
| **Respondent 4 Kadans Vastgoed** | Flexible rental periods, depending on function. **Flex office monthly terminable. Laboratories with specified demands, 5/10 years**. However, firms can have 3 years rents, and extend it each time to keep flexibility. | First large tenant. Start-ups share offices, however, not laboratories (due to patents, lab setups), **one coffee machine people meet to transfer knowledge.** Thus hard to create good business case for retail & leisure (hard to make profitable), need enough tenants on SP. | No clear communication with the municipality, resulting in **allocation of businesses elsewhere** in the municipality instead of on the SP. |
| **Respondent 5 Brink** | **Rental agreements can be long- or short term**. Depends on the tenant. Start-ups in business incubator can rent short term. | Major tenants (DSM/SABIC/etc.) then create vibe, shortage on clean rooms laboratories, pilot plans. However, meeting rooms, hospitality, retail, & leisure on **central courtyard, with short walking distances. Community feeling**, create as many meeting moments as possible. | No knowledge institution on site, Universities focus more on research, attractive for businesses and knowledge transfer. However, most important is knowledge supporter with focus on R&D. Central question: **Why is a business going to locate there? Concept important!** |
| **Respondent 6 Ramphastos** | **Clean Room Hotel, flexible rent from days till months/with or without lab employees**. For specific facilities (laboratories, etc.) loans are provided or rental agreement 10/15 years with loan spread out over monthly rent. However, with three years and flexibility, own investment needed. | Large firms first. Startup boot camp, 6 months free rent /intensive training. Business move to cheap building for max. 3 years then move to mature building. Building types for all phases, rotation system. **Retail, Leisure, & hospitality no direct profit, but for success SP in central location**. | Not succeeded in **establishing a community** |
| **Respondent 7 Kontek** | Large firms (Philips, Siemens, ASML) contracts of 10/20 years, middle firms (150 employees, temper with incentives) contracts of 5/10 years, and small firms (no capital, if bankrupt nothing to get from) incubators variable rental levels. **Clean room facility with employees flexible rents, positive for starting firms** | Large firm needs to be present or willing to settle on SP dev. **In the begin directly place retail & leisure for share of knowledge.** Sometimes to cover this, attract firms that are not directly involved in theme with shorter rental periods. However, important not too much, is disrupting the theme/concept. | Not consistent, theme not well guarded, not unique. Being unique is not real estate but theme and program. **Real estate is facilitating the theme or program of the SP.** Missing one of four elements creating innovation; research, development, prototyping, and marketing. |

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