Supporting start-ups and mature firms on science parks
an explorative study on different types of science park tenant firms

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Colophon

Master Thesis
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An explorative study on different types of science park tenant firms.

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Preface

This thesis addresses the relationship between start-ups and mature firms on science parks. The amount of science parks has been increasing in the Netherlands and so have the expectations of a science park concept. This study will explore what science park managers can do in order to contribute to the synergy between start-ups and mature firms. This has been done by both a literature study and a set of interviews.

This thesis is the closing part of my graduation program in the Urban Systems & Real Estate mastertrack at the Eindhoven University of Technology. I have learnt a lot about the science park topic but I also learnt a lot about how to tackle a research all by yourself. The course of this project has not been a straight line but in the end the final result is something worthwhile.

I want to thank my supervisors, Benny Ng, Rianne Appel-Meulenbroek and Myriam Cloodt for their constructive feedback during the length of this project. I want to thank everyone that participated in the interviews, everyone that participated was showing much willingness to conduct an interview which is much appreciated by me. I want to thank my fellow graduate students at the university for hearing me out and keeping me on track. And lastly, I want to thank my friends and family who supported me throughout the entire project.

Enjoy reading,

Guus van den Berg
Eindhoven, 21 November 2018

Abstract

This thesis focused on the use of services and facilities of both start-ups and larger mature firms on science parks in the Netherlands. A lot of literature has been written about how science parks operate and the reasons why firms reside on science parks. The organizational differences between start-ups and mature firms and how they engage in open innovation has been addressed in literature although their different needs on a science parks has not been covered by literature yet. Literature has also hinted towards a synergetic relationship between start-ups and mature firms. This thesis addresses this relationship and how science park managers can stimulate this relationship through provision of services and facilities.

A literature review has been conducted in order to compile a proper overview of all services and facilities science parks can offer to tenant firms. As an extension on this literature review, expert interviews have been held with six managers from Dutch science parks and three resident firms on those science parks. Based on both the literature review and the interviews, a list of valuable services and facilities has been compiled that science parks can offer to both start-ups and mature firms and which are valued highly for their mutual relationship. The following facilities were deemed important in creating a link: Laboratories, meeting rooms, conference rooms, eating facilities, auditoria and sport centers. Networking events, training and venture capital access are services that were identified as important. Based on this study, science park managers can focus on adding or improving the before mentioned services and facilities in order to stimulate the synergy between start-ups and mature firms.

Keywords: Science parks, open innovation, start-ups, mature firms, management, real estate

Summary

Introduction

The interest of Dutch companies in the science park concept has risen over the past decade as can be seen in the amount of Dutch science parks and science parks initiatives (Buck Consultants International, 2012 & 2018). Simultaneously, the size of the International Association of Science Parks (IASP, 2017) and the literature that has explored this concept has grown as well. Settling on a science park has different reasons for different stakeholders (Phan, Siegel & Wright, 2005). Universities settle on a science park so they can expand their research opportunities and attract more students, for companies the benefits of a science park are the availability of excellent Research & Development facilities and good labor force (European Commission, 2007). For the government a science park can contribute to the development of an economy on a regional or national scale. The core business of a science park management team is providing a superb accommodation in a science park environment for their tenants. Different companies on science parks have different needs. Young start-ups have other needs and demands on a science park than older, more experienced mature firms (Westhead & Batstone, 1998; Iglesias Torres, 2016).

The differences in needs for both start-ups and mature firms is captured in the offered services and facilities on a science park. These services and facilities differentiate science parks from regular industrial business locations (van Geenhuizen & Soetanto, 2008). An important service science parks offer is facility management. Facility management destresses firms from management on strategical, tactical and operational level and grants them more space to focus on their core business (Chotipanich, 2004). In literature it has been summarized what the concept of facility management entails (Dettwiler, Lindelöf & Löfsten, 2006; Mian & Hulsink, 2009). An important notion is the importance of shared facilities which lowers the need for firms to invest in these facilities themselves. This is where science park management teams can add value to a science park.

Up till now it has been discussed in literature what science park management teams offer to both start-ups and mature firms (Westhead and Batstone, 1998; Groen, Harms & Ratinho, 2010). The possible synergy that science park managers could create between start-ups and mature firms has also been implied by some studies. Iglesias Torres (2017) described the mutual benefits of locating on a science park for start-ups and mature firms. Benefits such as specialized labor for mature firms, extensive knowledge and skills available for start-ups and services and facilities science parks can offer.

So far, literature has not paid much attention to how science park management can support the differing needs of their tenants. This study addressed what science park management can offer to both start-ups and mature firms and how science park management can contribute to a mutually beneficial relationship between start-ups and mature firms on a science park. This study attempts to capture the role a science park management can play in this process and it has been captured for different kinds of science parks with regards to size, sector and management style.

The main research question this study addressed therefore is:
'How does science park management support start-up firms and mature firms with facility management and is it expected to strengthen a relationship between them?'

Defining science parks

Multiple definitions have been given to the science park concept in literature. Bottom-line in most studies is that a science park adds value to the firms residing on their parks (Annerstedt, 2006; United Kingdom Science Park Association, 2018; Buck Consultants International, 2018). For science parks this mostly revolves around a Higher Education Institution (HEI) or a knowledge carrier. Additionally, the concept of open innovation as described by Chesbrough (2003) is vital for improving the performance of science parks residents. Chesbrough described open innovation as a way of collaborating between firms in order to create innovations which would have been impossible to achieve alone.

Four ways of open innovation can be identified (Dahlander & Gann, 2010; Gassman & Enkel, 2004). Firstly, acts of open innovation can involve financial expenses or can be done on a free basis. Secondly, firms can be on the receiving end of open innovation or at the giving end. Giving and receiving should not be a one-way street when done on a freely basis. This can be prevented by forming a strategic alliance or a joint venture in which ideas can be shared (Gassman & Enkel, 2004).

Besides applying open innovation within sectorial boundaries, the concept of open innovation can also be applied outside sector boundaries. This is type of open innovation is called cross-pollination (Hargadon & Sutton, 1997). Firms that are unrelated to one another, can achieve a breakthrough which profits both firms. The chances of achieving a breakthrough are improved by creating a better understanding of both fields for the opposing firm and by bringing experts together that are rooted deeply in their fields (Fleming, 2004).

Science parks can be categorized in different typologies. Annerstedt (2006) divided three generations of science parks. First generation science parks were described as parks that could be seen as an extension of a HEI. Science parks that are more revolved around business activity and with a less dominant role of a HEI are labelled second generation science parks. Science parks that were initiated by the government and were intended to serve a wider public than the other two science parks were labeled third generation science parks. Another perspective was taken by Link & Link (2003). They discriminated among science parks that applied tenant selection criteria and those that did not apply those criteria. A third perspective to view science parks is the way these are managed. Science park management can be given shape in roughly three forms (Siegel et al, 2003; Westhead & Batstone, 1998). The smallest management form of operating a science park is the use of informal teams in which representatives from the firms run the science park together. A fulltime on-site manager that is not directly related to any of the firms or an on-site management company are larger forms of management types on a science park.

In order to guard the concept of a science park, science park managers can apply tenant selection criteria (van Winden & Carvalho, 2015). It steers on gathering a selection of firms on a science park that show similarities with each other. More similar firms are more likely to have the same needs in terms of services and facilities on a science park. Important criteria that science park managers enforce on potential science park residents are firm similarities, sector firm is active in, if the firm is R&D and/or technology based, the absence of heavy manufacturing, the hiring of graduates and interaction with universities (van Winden & Carvalho, 2015; Link & Link, 2003).

As half of all science parks have an incubator program running on their parks (Link & Scott, 2006), the selection criteria of incubators have been reviewed as well. Incubators are aiming to accommodate business growth for start-ups firms. Potential for growth is an important aspect incubators are selecting their tenant firms on. Both the potential of the idea and the entrepreneur can be leading in this (Peters, Rice & Sundararajan, 2004).

Table 1 Overview services and facilities defined by literature

		Ng et al. (2017)	Siegel et al. (2003)	Westhead & Batstone (1998)	Junker (2018)
Research & Development	Clean rooms	X			X
	Laboratories	X			X
	Pilot rooms	X			X
	Other				X
	Equipment				X
Work-related facilities	Meeting rooms	X	X	X	X
	Conference rooms	X		X	X
	Eating facilities	X		X	X
	Library	X		X	X
	Auditorium	X			X
	Exhibition rooms	X			X
Leisure facilities	Sport centers	X			X
	Sporting grounds	X			X
	Hotel	X			X
	Cinema	X			X
Personal facilities	Shops (Food)	X			X
	Child Care	X			X
	Medical	X			X
	Banking	X			
	Residential housing	X			X
	Shops (non-food)	X			X
	Travel agency	X			X
Services	Networking events	X			X
	Training	X	X	X	X
	Consultancy	X	X	X	X
	Venture capital access	X			X
	Information access	X			X
	Management support	X	X	X	X
	Administrative	X	X	X	X
	Marketing	X			X
	Accounting	X		X	X
	Graphical design	X			X
	Cleaning and maintenance	X		X	X
	Safety and security	X		X	X

Furthermore, the fit between the concept of the science park an incubator is located on and the firm should be there (Cullen & Chandler, 2014; Peters et al., 2004; Bergek & Norrman, 2008). Van Winden & Carvalho (2015) argued that different levels of tenant selection can be enforced. This depends on the position of the science park. If the science park is successful and has a lot of new firms willing to reside on the campus it can reject firms easier than science parks that are struggling to find enough firms to keep the science park up and running.

Science parks have a variety of services and facilities they can offer to their tenants which might improve their performance directly or indirectly. In Table 1 an overview of possible services and facilities a science park can offer is shown based on a literature study (Ng, Appel-Meulenbroek, Cloodt & Arentze, 2017; Siegel et al., 2003; Westhead & Batstone, 1998; Junker, 2018). The science park facilities have been divided in four categories: R&D facilities, work-related facilities, leisure facilities and personal facilities. Lastly a separate category for services has been included. R&D facilities include clean rooms, laboratories, pilot rooms, other R&D facilities (e.g. common licensing, wind tunnels, 3D printers etc.), and equipment. Work-related facilities that a science park can offer to their tenants are meeting and conference rooms, eating facilities (dining and catering facilities), libraries, auditoria and exhibition rooms. Leisure and personal facilities do not serve firms as an entity but rather focus on individuals. Leisure facilities that can be located on a science park are sport centers, sporting grounds, hotels and cinemas. Personal facilities science parks can provide their tenants are shops (both food and non-food), child care, medical care, banking, residential housing and travel agencies. Additionally, the different services a science park can offer to their tenants are network events, training, consultancy, venture capital access, information access, managerial support, administrative support, marketing, accounting and graphical design. Lastly, cleaning and maintenance and safety and security are services science park offer to their tenants.

Comparing start-up firms with mature firms

In order to properly draw the comparison between the needs of a start-up and a mature firm, the definition of start-ups and mature firms should be addressed first. In literature a lot has been written about what start-ups are and how they operate. The red line in most literature studies is that start-ups should live up to three qualifications in order to be labeled start-ups (Luger & Koo, 2005; Luggen & Tschirky, 2003; Cunha, Silva & Teixeira, 2013). A start-up should be new, active and independent. The criteria 'being new' can be interpret in various ways. This study uses the threshold the Kamer van Koophandel (2017) has set for small firms as threshold for start-ups. This implies that a start-up should have less than 50 full-time equivalent employees in order to be labeled start-up. Start-ups can be labeled new when they are less than five years old (Luggen & Tschirky, 2003; Rijksdienst voor Ondernemend Nederland, 2014; Kamer van Koophandel, 2016). 'Being active' requires a start-up to actually contribute to the economy and not merely exist on paper. Luger & Koo (2005) suggested that the hiring of the first employee is a sign that a company is active. Thirdly, a start-up needs to be independent. This means that they should not be connected to a bigger firm on a legal, financial, functional or market-wise level (Luger & Koo, 2005; Cunha et al., 2013).

This study focuses on the comparison between larger, mature firms and start-ups. Therefore small-medium enterprises (SMEs), companies with less than 250 full-time-equivalent employees (Kamer van Koophandel, 2016), are not taken into consideration in this study. Firms larger than 250 employees generally have more capital, more research capacity, stronger brand presence, better organizational structures in comparison to start-ups (Freeman & Engel, 2007).

Start-ups and mature firms have different ways of applying open innovation (Freeman & Engel, 2007; van de Vrande, De Jong, Vanhaverbeke & de Rochemont, 2009). Start-ups are more agile due to their smaller organizational structures than mature firms.

Creativity is more stimulated in start-ups than in mature firms. Lastly, start-ups are less affected by the Not-Invented-Here syndrome than mature firms which makes them more open to embracing new innovations that are not created within company boundaries (Katz & Allen, 1982).

Other differences between start-ups and mature firms are their benefits from residing on a science park. The shared R&D facilities that science parks offer are mostly useful for start-ups whereas mature firms mostly have their own R&D facilities (Westhead & Batstone, 1998; Chan & Lau, 2005). Furthermore science parks are mostly beneficial for start-ups as a lot of services are offered that helps them in their non-core business and enables them to focus on their core business. Mature firms on the other hand profit from the concentration of knowledge which helps them in keeping in touch with new trends and innovations.

Methodology & research design

In order to fully answer the main research question, a set of interviews has been conducted with people rooted in science parks. This will cover the gaps that could not be answered by the literature study. A qualitative approach has been chosen as this suits the explorative nature of this study better than a quantitative approach (Baarda & de Goede, 2001). This study has an explorative nature due to the lack of available knowledge on the link between start-ups and mature firms.

To cover all sorts of science parks, six people from science park management teams from six different science parks have been selected. These science parks differ on whether a university is involved, maturity of the park and the sector on which the science park focuses. These science park managers all have expertise on the real estate of a science park. Next to these science park managers, three people from tenants firms on these science parks have been interviewed. For participating start-up firms, CEOs have been approached. For mature firms either R&D managers or corporate real estate managers have been approached. The interviews have been conducted in a semi-structured manner. Unforeseen points could therefore still be taken into the results but the gap that was discovered on beforehand has been covered mostly (Baarda, de Goede & Teunissen, 2005).

The interviews covered questions in three topics: management structures on the science park, the use of services and facilities on science parks and the use of open innovation. These questions were both asked from a science park manager perspective and a science park tenant perspective.

In order to improve the reliability and the internal validity of this study, science park tenants have been interviewed in order to back up the data gathered from the science park managers. The interviews with the science park tenants have backed up the statements made by the science park managers or completed their statements. Additionally, the use of semi-structured interviews further enhances the reliability of this study according to Baarda et. al. (2005). The external validity of this study is enhanced by including different types of science parks in the sample. This makes the conclusions from this study also applicable for other science parks in the Netherlands.

Due to the homogeneity of the interview data, the data could be labeled. Using labels makes it easier to compare the raw data from the different interviewees. The labels used for the interview data from the science park managers are management structure, operational structure, ownership, incubation programs, selection criteria, exit criteria incubator, benefits of the incubation program, interaction between the firms on-site, cross-pollination, stimulation of open innovation by the science park management and lastly a separate label has been made where the additional remarks from the science park managers have been summarized.

The labels used for the interview data from the science park tenants are reasons to reside on a science park, what services and facilities they deemed missing, incubator program, open innovation, cross-pollination, interaction with other firms, relationship with management and lastly a separate label has been made where the additional remarks from the science park tenants have been summarized.

Results

The interviews with both science park managers and tenant firms gave some valuable insights. The results have been structured in the line of the earlier defined labels. The size of the management structures of the interviewed science parks varied from three employees to over 30. Most mentioned management activities were business development, marketing & communication, acquisition, financial administration and community development. Especially for smaller parks, some of these activities tend to be outsourced. The amount of outsourced activities did not seem to have a correlation with the size of the science park management. The frequency of contact of the science park management with the tenant is regularly but not too often. Ownership of the science park real estate can be settled in various ways. All real estate can be owned by one party which gives more control over the science park concept. This party can either be the science park management or a university. For some parks the ownership of the real estate is more scattered among different parties.

Most science parks offered almost all R&D facilities with the exception of pilot rooms which only two science parks offered. The other four R&D facilities are predominantly used by start-ups according to the science park managers with the exception of laboratories which are also deemed useful for mature firms. Laboratories were therefore also deemed the most likely R&D facility where a link between start-ups and mature firms could be realized.

All work related facilities, meeting rooms, conference rooms, eating facilities, libraries, auditoria and exhibition rooms, are offered on most of the interviewed science parks. Exhibition rooms forms a minor exception as only half of the interviewed science park managers stated that one was present on their park. Some managers indicated that meeting rooms, conference rooms and eating facilities were useful places for creating a synergy between start-ups and mature firms.

Sporting centers and grounds were offered on half of the science parks or more. It is remarkable that sport centers are claimed to be more important in creating a link between start-ups and mature firms than sporting grounds. Most science parks did not have a hotel or cinema on their campuses so whether these were used by start-ups or mature firms and if this was stimulating a link between them cannot be concluded from this data. The personal facilities offered are primarily utilized by individuals rather than entire firms. The most commonly offered facilities according to the science park managers were shops (both food and non-food), child care and medical facilities. Only one science park manager claimed that these facilities were contributing towards the link between start-ups and mature firms.

The interviews pointed out that the most valued service science parks offer is the network events. These are beneficial for both start-ups and mature firms and also create a link between them. Other frequently mentioned services that are both beneficial for start-ups and mature firms are training, consultancy, venture capital access and information access. These are deemed less vital for creating a link between start-ups and mature firms by the science park managers. Almost all science parks offer cleaning and maintenance and safety and security services as well. These are used by both types of firms but are not considered to contribute to the synergy between them.

With the exception of the Dairy Campus Leeuwarden, all science parks offered either an incubation or acceleration program. These programs were in all cases ran by a third party and not by the science park management themselves. For such programs, tenant selection criteria determine which firms can participate. In the view of the science park managers, both the idea and the entrepreneur needed to be excellent. Despite that, the quality of the idea was favored over the qualifications of the entrepreneur.

The science park tenants that had been interviewed indicated that the networking events was the most valuable service or facility that science parks offer. Other facilities that were thought to be valuable in creating a link between start-ups and mature firms were not considered as valuable by the tenant firms. It is debatable what causes this discrepancy.

Another way science park can contribute towards their residents, is by stimulating them to get involved in open innovation. Interaction between firms on science parks happens on both formal and informal basis. Science parks can stimulate interaction among firms by assigning clusters where specific sectors are allocated. Some science park managers stressed that the coincidental meeting is vital and can be encouraged by the addition of leisure and personal facilities. These managers also stated that mature firms can learn from the innovating ways of start-ups. This learning process can also be captured in incubation or acceleration programs specified towards mature firms.

Sometimes open innovation crosses the boundaries of the sector a firm operates in. This effect of cross-pollination is primarily serendipitous. Despite it depends mostly on luck, it is something science parks managers can steer on as well. Networking events can bring firms in touch with each other that did not know of each other's existence before.

Conclusions

The different ways science park management can support start-ups and mature firms and the ways a science park management can establish a relationship between these two types of firms has been examined in this research. The most utilized services on science parks are networking events. This was also deemed important for the synergetic relationship between start/ups and mature firms. This was deemed important by all participants of the interviews. In line with the networking events, the creation and maintaining of a community on science parks is deemed important. Both start-up and mature firms profit from this. Start-ups can expand their network more easily, whereas mature firms can keep up with recent innovations in their business.

The incubation programs that are ran on science parks are beneficial for both types of firms as well. Start-ups get schooled in how to run a business and mature firms can join in in order to learn from the innovation process that start-ups apply. This is mostly faster for mature firms than innovating purely at their own pace (Freeman & Engel, 2007; Katz & Allen, 1982).

The list of services and facilities that was based on a literature study including the studies of Ng et al. (2017), Siegel et al. (2003), Westhead & Batstone (1998) & Junker (2018) had been presented to the interview participants. Based on their opinions a list of services and facilities has been compiled that are deemed to be most contributing towards the link between start-ups and mature firms.

These services and facilities included:

- Laboratories
- Meeting rooms
- Conference rooms
- Eating facilities

- Auditoria
- Sport centers
- Networking events
- Training
- Venture capital access

During the definition of the research design, choices have been made in order to generate relevant and useful results from this study. Nevertheless, some other options might be interesting for further research. This study has a qualitative approach due to the limited knowledge on this subject. The importance and effect of services and facilities that have been identified as vital for creating a link between start-ups and mature firms could be further quantified in a quantitative study. Additionally, it can be examined which services and facilities can support the relationship between start-ups and SMEs, as SMEs were not included in the scope of this research.

Creating a benchmark for science parks in order to measure their performance would be worth investigating as well. It would open up ways to evaluate the usefulness of services and facilities on science parks and their contributions to open innovation. Lastly, new studies could investigate what would be the optimal design of the public space in order to improve the levels of open innovation on a science park. This would form an interesting topic for science parks that are in their starting phase or science parks that consider undergoing transformations.

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Chapter 1: Introduction

1.1 Context

Dutch companies are gaining more interest in the concept of a science park as can be seen in the rise of Dutch science parks and science park initiatives: from 24 in 2009 to 35 in 2018 (Buck Consultants International, 2012 & 2018). The Netherlands is not alone in this as can be seen by the rising number of members of the International Association of Science Parks (IASP) over the last decade(IASP, 2017) (from 250 in 2002 to 373 in 2017), the literature about science parks has been extended extensively as well in the past few years. Science parks come in different sizes and forms which are related to the aims of a science park. Phan et al. (2005) pointed out various aims of science parks which lead to different kind of science park structures. The objectives for settling on a science park also differ for each actor that has settled on the science park. Universities mostly participate in a science park in order to expand the research opportunities of the university and to attract more and better students with it. The objective for high-tech companies lays primarily in having excellent R&D and a good labor force in order to maximize profit (European Commission, 2007). The government's use of a science park is beneficial as it raises the amount of applied research and ultimately the amount of technology transfer in a country. This also applies on a regional scale. Science parks can contribute to the regional economy by providing an attractive environment for high-tech companies to settle in. A science park can also be interesting location for investors and developers that are looking for promising technology and services to invest in.

Science parks are areas which aim at an increased level of open innovation and knowledge sharing. The IASP (2017) defined science parks as:

"*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*."

From this quote it can be concluded that, IASP sees a science park management as a facilitator of an environment in which companies can settle. There are different ways how a science park can be managed. Firstly, the way the management team is designed can differ between science parks (Siegel et al., 2003). A science park site can either be managed by an informal team in which a number of the science park partners take a seat, by a single on-site manager or by an on-site management company. Each of these management types differ in size and operating capacity, therefore the management type determines the amount of activities each of these science park management teams can fulfill.

The concept of open innovation has been defined by Chesbrough (2003). The concept of open innovation entails the collaboration of firms in order to strive for new innovations instead of trying to realize innovations singlehandedly. If companies share ideas with each other, the odds of creating breakthroughs are bigger than operating solo. Open innovation is a two-way street, firms have to both contribute and receive ideas in order to make it worthwhile for everyone to participate in open innovation (Dahlander & Gann, 2010; Gassman & Enkel, 2004).

The act of open innovation mostly occurs among firms operating in the same sector although this is not necessarily required. Hargadon & Sutton (1997) mentioned the existence of cross-pollination among firms.

Cross-pollination is the act of collaboration among two firms that do not operate within the same sector. These collaborations might not seems as logical combinations at first sight but can contain successful breakthroughs.

There is a variety of tasks the science park management team has to fulfill. Firstly, they have to accommodate the science park's tenants in real estate that suits theirs wishes and needs. The needs and wishes of smaller, fresh start-ups are different than the needs and wishes of bigger, more mature firms. Whereas start-ups are more interested in the availability of small, flexible lease contracts, the linkage to a higher education institution (HEI) or the overall prestige of a science park (Westhead & Batstone, 1998), mature firms are more interested in the specialized labor force that is gathered on science parks(Iglesias Torres, 2017).

Next to these perks of locating on a science parks, both start-ups and mature firms highly value the services and facilities that science parks offer them (van Geenhuizen & Soetanto, 2008). The presence of these services and facilities is an important factor in the reasons why firms prefer science parks over regular industrial park sites. Additionally, science park management teams offer facility management towards their tenants. Offering facility management supports firms on a strategical, tactical and operational level to focus more on their core business (Chotipanich, 2004). Dettwiler, Lindelöf & Löfsten (2006) summarized the various definitions of facility management in literature. They stressed it is used to plan, provide and manage a working space, which has as main goal to boost the productivity of employees. As science parks strive to provide an optimal working environment for their tenants, facility management can be vital in achieving this.

Among the concept of facility management, the concept of shared facilities is also an important factor for science parks (Mian & Hulsink, 2009). Providing facilities that can be shared among users grants tenants the opportunity to flexibly use facilities such as a lab or conference rooms with the possibility to easily up- or downscale the use of such facilities. Using such shared facilities removes the threshold for companies of making a large investment up front. This applies especially for facilities of which the future use cannot be predicted beforehand by firms.

In literature it has been discussed what the services science park management teams can offer to either starting firms or more mature firms (Westhead and Batstone, 1998; Groen et al., 2010). It has also been described in literature that the presence of bigger firms and start-ups on a science park site has mutual benefits (Iglesias Torres, 2017). The start-ups can provide specialized labor to the mature firms, whereas the mature firms can share their extensive knowledge and skills with the start-ups. Although start-ups and mature firms use a lot of the same facilities on a science park, some facilities and services science parks offer to start-ups are differing from what services and facilities are offered to more mature firms.

Up to this point, not much has been written about how the science park management can contribute to the relationship between the smaller start-ups and the mature firms. Creating shared facilities and organizing meetings and events will stimulate interaction between all members of the science park (Koçak & Can, 2013) but this is not specified towards the relationship between start-ups and mature firms.

1.2 Research aim

This study aims to explore the link between start-ups and mature firms. The scope of this study is specifically on larger, mature firms that have outgrown past the SME (small and medium-sized enterprises) bandwidth.

Firms that have more than 250 full-time equivalents employed, are considered mature firms (Rijksdienst voor Ondernemend Nederland, 2014) and form the target group mature firms in this study. Van de Vrande et al. (2009) discussed the differences in how both SMEs and MNEs (multinational enterprises) approach open innovation. As the differences between SMEs and MNEs are too big on how they are engaging in open innovation, this study focused on addressing the link between start-ups and MNEs, the possible link between start-ups and SMEs or the possible link between SMEs and MNEs has not been investigated in this study and is therefore not discussed in this research.

The services science park managers offer to both start-ups and MNEs differ. This difference might be related to the different ways a science parks is being managed. Different management types also have different levels of manpower and therefore the management type might also influence the successfulness of a science park in terms of growth and company survival. Unfortunately, this has not been proven by literature yet and might also be related to the competences of a science park management team and how capable they are of carrying out management tasks efficiently.

The main aim of this research will be to explore the ways a science park management team can support start-up firms and mature firms on their science park and in what way they can provide firms in order to strengthen the relationship between start-up firms and mature firms. This knowledge can be used by both tenant firms and science park managers for making future decisions regarding science parks. The main question this research will be addressing therefore will be:
'How does science park management support start-up firms and mature firms with facility management and is it expected to strengthen a relationship between them?'

This main research question will be addressed by answering a number of sub questions in order to formulate a well-founded answer.

Sub questions:

- What different types of science park management can be distinguished and how do they operate?
- What type of services and facilities can science park management teams offer to firms?
- What are the organizational differences between start-ups and mature firms?
- How can science park managers stimulate the act of open innovation and cross-pollination among start-ups and mature firms?
- Which services and facilities might strengthen the relationship between start-ups and mature firms?

1.3 Relevance

Scientific relevance

As stated earlier in the paragraph Research aim, not much has been written about the differences in science parks in how they approach either starting firms or more mature firms. Especially the policies and actions a science park management team could use in order to assist both start-ups and mature firms for an optimal performance has been an underexposed field of literature. Therefore, this study will explore in which ways science park management can support both start-up firms and mature firms. Additionally, this research will explore if a link between start-up firms and more mature firms on science parks can be strengthened through offering certain services and facilities.

Practical relevance

Due to the rise of science parks initiatives, more and more science park management teams have been formed. This study will give more insights for science park managers in what services and facilities they should offer to both start-ups and mature firms. These insights can help science park managers to decrease the chances of pitfalls that might occur during the growth phase of a science park and to minimize the risks they have to take. This will ultimately lead to an increased chance of survival of a beginning science park. It will also be useful for companies that are consulting science park developers.

For tenant firms, the contribution of this research will be that these firms can settle themselves on science parks that are less likely to collapse after initiation. Therefore they will not face the financial losses and possible image loss due to a failing initiation phase of a science park. Additionally, tenant firms can use the insights of these studies to criticize science park management on their functioning with regard to how these management teams operate towards both start-ups and mature firms. This can be useful for firms in determining whether they want to locate on a science park location and more importantly on which science park they should settle eventually.

1.4 Research method

The main research question will be addressed by the answers to the earlier mentioned sub questions. These sub questions will be addressed by partially a literature study and partially by expert interviews. The expert interviews will be held with science park managers and firms that are settled on a science park. The interviews will give insights in how the participants view the relevant topics concerning how science park management teams should operate and whether there is room for improvement.

A deeper literature review will form a basis for the topics the expert interviews will cover. The interviews will point out what measures and policies are mostly successful for science park managements to pursue success for both start-ups and mature firms. Additional input from the interviews that has not been covered by the literature study will also be incorporated in the final recommendations on how to strengthen relationship between start-ups and mature firms.

1.5 Thesis structure

The structure of this thesis is shown in Figure 1.1. The first chapter introduces the reader in the topic of science parks and progresses towards the aim of this thesis, the main research question that will be addressed, a brief description of the applied methodology and research design and lastly a planning of the entire thesis. In Chapter 2, a deeper literature study will be conducted in order to provide a definition of the science park concept. Chapter 3 explores by the terms of literature how start-ups and mature firms differ in terms of their uses and needs of science parks. Then the used methodology and the research design of the interviews will be discussed in Chapter 4. In Chapter 5 the results from the interviews will be displayed and discussed. In Chapter 6 conclusions based on both the literature study and the interviews will be drawn. The practical implication of these conclusions will also be discussed. Lastly the limitations of this thesis along with suggestions for further research will be described in Chapter 7.

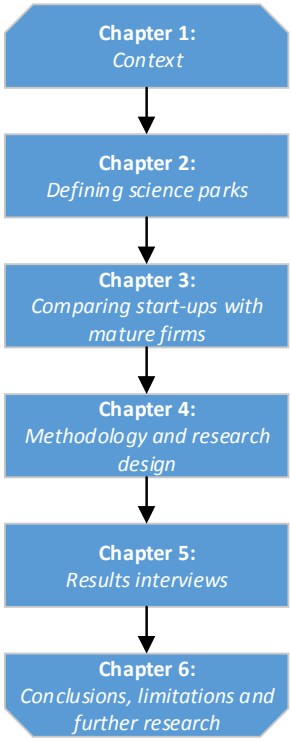

Figure 1.1: Thesis structure

Chapter 2: Defining science parks

In this chapter the forms and functioning of science parks will be explained by an extensive literature review. Firstly, a more detailed description of a science park will be formulated. Secondly, the different types of science park managements will be addressed and the ways they operate will be discussed. Then the criteria that science park managers use to select their new tenants will be described and lastly the type of services and facilities science park management can offer to their tenants will be discussed.

This study focuses on science parks located in the Netherlands. The last decades, the amount of science parks has increased rapidly and most science parks themselves have also grown a fair amount (Buck Consultants, 2012 & 2018). Kooij, van Assche & Lagendijk (2012) addressed this to the success of the High Tech Campus Eindhoven. The science park concept on the High Tech Campus is one of the major reasons why Eindhoven has been labeled as a 'Brainport' (Kooij et al., 2012). Due to this Eindhoven gained more appeal nationally and internationally. This went beyond the original branding of Philips. Eventually, Brainport was labeled as the third mainport of the Netherlands, the first two being Schiphol and the Rotterdam Harbor (VROM, 2004). According to Buck Consultants (2018), there were six science park initiatives preparing their launch in 2018 and 29 science parks that were up and running.

2.1 The science park concept

As described in Chapter 1, the definition of a science park provided by the IASP (2017) 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*." This definition implies that science parks should be treated as a community, whose management offers more to firms than just a convenient location to do their business. This is also stressed in multiple studies, like Annerstedt (2006) stated that science parks offer value-adding services along with high-quality spaces and facilities. In the views of the United Kingdom Science Park Association and Buck Consultants International (2018), a science park is a property based initiative which is linked to either a higher educational institution, a research institution or a large research & development department from an international firm. Secondly, a science park should encourage open innovation. The concept of open innovation entails a wider scope of the internal R&D which expands beyond the needs of a single company. R&D departments should have access to all knowledge that is widely available outside the company, namely at universities, start-ups and other companies. In the concept of open innovation, companies should not try to re-invent what already has been made, when they can access the original technology as well. Therefore, companies can save on efforts and money (Chesbrough, 2003). This can be done by stimulating the interaction of firms operating on the site, which can be achieved by both the science park's design and the level of engagement of its management team (Quintas, Wield & Massey, 1992; Hansson, Husted & Vestergaard, 2005).

2.1.1 Open innovation

Multiple studies have assessed open innovation in different ways. In most literature, several ways of open innovation are either labeled as financial or non-financial or as inside-out or outside-in. Whether open innovation is financial depends on the fact if a financial transaction is involved in the transfer of knowledge or that the transfer of knowledge is done on a freely basis. Open innovation works two ways, when a company disposes their knowledge, the direction of open innovation is inside-out.

When a company uses open innovation to generate new innovations, it is labelled as outside-in innovation (Dahlander & Gann, 2010; Gassman & Enkel, 2004). Dahlander & Gann (2010) did an extensive literature study and identified four types of open innovation. Acquiring innovation can be done by a firm buying off ideas and inventions externally from the market. Advantages of using this way of open innovation are that the acquiring firm has more control over their innovation process and has a better market position towards their competitors. A drawback of this way of applying open innovation is that it will be difficult to keep up good ties with firms that operate in the same sector. This is a reason why firms gather new ideas by sourcing them in. This method will grant a firm access to more ideas and knowledge. Finding outside the box solutions will therefore become easier although the amount of knowledge can be overwhelming and it is hard to determine which sources are useful and which are not.

The previous two methods described how firms could gain ideas. Open innovation also occurs in the opposing direction in which firms have ideas or innovations that they will not further develop but which have potential to be developed into a successful product by other firms (Dahlander & Gann, 2010). Firstly a company could sell their ideas to make profit on these ideas. Another company might be more capable of developing an idea into a successful product. One drawback of this process is that, at times it can be hard for an inventor to let go of his invention. This might cause some resistance within a firm. Another option besides selling ideas is to reveal them freely. This might seem less beneficial but it might speed up the total innovation process within a sector which might benefit the firm in a later stage. Next to that it will also increase interest from other companies (Dahlander & Gann, 2010). Gassman & Enkel (2004) described besides the outside-in and inside-out open innovation a third option of open innovation: the coupled process. In the coupled process, a number of firms form a strategic alliance or joint venture in which new ideas are shared more easily. In order for such an alliance to function properly there should be a balance among all companies in contributing ideas to the network and receiving ideas. In some markets this type of open innovation is a necessity. In the telecom industry for example, technological innovations are not likely to make it to the market if they are not picked up by the larger telecom firms. Therefore the promotion of innovation in such alliances is critical in order for such ideas to enter the market (Gassman & Enkel, 2004).

A concept that stimulates open innovation is 'cross-pollination' which was pointed out first by Hargadon & Sutton (1997). Cross-pollination entails the idea of exchanging knowledge between two unrelated fields of technology that leads towards new breakthroughs that would have been impossible or at least take much longer to discover by normal ways of innovating within a sector. A good example of cross-pollination is the nanobiotechnology sector (Gülzow, 2015). This sector arose by the cross-pollination of the nanotechnology sector and the biotechnology sector, which were unrelated sectors at first but due to their cooperation an entire new field of nanobiotechnology had been developed in which numerous breakthroughs have been realized.

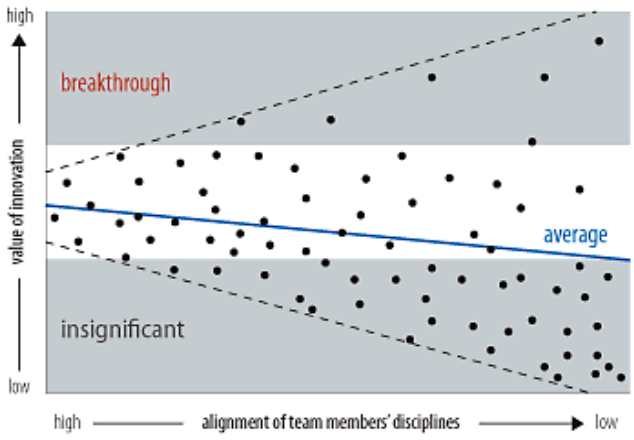

Figure 2.1: Failure/success ratio cross-pollination (Fleming, 2004)

Fleming (2004) analyzed over 17.000 patents in order to capitalize the effect of cross-pollination. He indicated that on average, applying the effect of cross-pollination leads to lower financial gains as most efforts results in failures. The attempts that succeed are a major success though in comparison with collaborating efforts between experts operating in the same fields (these results are displayed in Figure 2.1). Fleming (2004) described a few measures that could be applied in order to boost the chances of success when combining two apparently unrelated fields. Firstly, if the two fields are both established and well-understood, chances are higher that huge breakthroughs will be found. Secondly, people of both fields that work together should have a rather deep understanding of their field than a broad understanding. People with a deep understanding of a subject are more stubborn in terms of collaboration but are more likely to see potential use from another field for their own as they are more rooted in their field than more broadly orientated people that might collaborate quicker and connect more concepts but these are less likely to contain a huge breakthrough.

2.2 Science park typologies

The first science parks mostly were linked with a university or any other higher education institution. In literature, multiple science park typologies have been discussed. Annerstedt (2006) for instance distinguished three generations of science parks. The first type of science parks has been described as 'The first generation' science parks. In these science parks, the science park is predominantly an extension of educational institutions like universities which cooperate with startups and related business services. These kinds of science parks are primarily focused on carrying out research.

The second generation science park has been described as more market driven. Educational institutions are still involved in the science park but in a less dominant manner than in first generation science parks. The research done at the science park is mostly focused on businesses and its growth. Lastly, the third generation science parks has been described as science parks that have been initiated mostly by the government and which were intended to serve a wider public than the other two types of science parks.

Another perspective to science parks has been taken by Link & Link (2003). They argued that science parks can be classified by parks with no connection to a HEI, parks with a connection to a HEI that use tenant selection criteria and parks with a connection to a HEI that do not use tenant selection criteria. The viewpoint on different types of science park ownership is also taken in various literature studies. Etzkowitz & Zhou (2017) argued that science park operate better if they are initiated in a triple helix form, in which a university, industry and government operate together as one organization rather than a science park management that is not tied to any of these three. They stated that the triple helix format contributes to the knowledge-based economic and social development ecosystem on a science park. In a so-called triple helix model each the university, the industry and the government take place in a board that determine the development course of a science park.

2.2.1 Science park ownership

According to Link & Scott (2006), one third of the science parks is operated by a university. These parks could all be classified as a first generation science park. The other parks are operated by a private sector organization. In the situation of a university park, a university has roughly three options of how to divide ownership and control of the science park (Rowe, 2005). If the university keeps the entire ownership of a science park, it is in full control of running the science park. This includes topics like tenant selection (this will discussed more in-depth in paragraph 2.3) and what kind of services and facilities have to be realized (paragraph 2.4).

The height of the costs, especially in the initiative phase, are a risk not every university is willing or able to take. Another option could be to form a joint venture company with other parties. This will share a large proportion of the costs among other parties but the influence the university has on both policies and tenant selection will be divided. Lastly a local authority could get engaged in a science park project among other parties. Often a private sector developer is present in such a construction. The leading role of the university will lean more towards either the private developer or the local authority. In this construction the university therefore has the least influence on science park policies and tenant selection.

If science parks are falling under private ownership, there are various ways of how this can be structured. A science park can be owned by a developer, investor or a joint-venture between such parties. A research institute could also be involved in ownership of a science park like universities can partly have ownership of a science park (van Dinteren & Keeris, 2014). Finding an investor can be difficult for a science park due to the non-generic real estate that often is realized on a science park. If real estate on a science park is facing vacancy it is difficult to transform it to another functionality. Due to these difficulties, creating investment funds is a solution to fund the realization of science parks. Private parties can participate in such investment funds (van Dinteren & Keeris, 2014).

2.2.2 Science park management types and goals

Next to the earlier described typologies among science parks, science parks also have different typologies when it comes to the way the parks are managed. Siegel et al. (2003) & Westhead & Batstone (1998), described the presence of three types of science park management styles in the U.K. being the informal team, a single on-site manager and lastly an on-site management company. The informal team is the cheapest form of managing a science park as it only requires a number of science park partners, which can be a selection of the total entity, to divide the managerial tasks that are necessary to keep the science park running.

The single on-site manager is another way of managing in a science park (Siegel et al., 2003). In this management type, the manager is full-time dedicated to facilitating the needs from the science park tenants. In order to stimulate the development and well-being of the science park and its firms, the on-site manager should have a wide variety of skills, ranging from technical, financial and marketing related skills. The third type of science park management is an entire on-site management company instead of a single manager. This brings more expertise and a better foundation for a science park to grow than a single manager might deliver (Siegel et al., 2003).

Science park managers are striving for a flourishing campus. Den Heijer (2011) mentioned what university campus managers see as their top goals. The most important goals they were trying to accomplish were supporting user goals more effectively, attracting more students and staff members, achieving or maintaining minimum quality the workplace has to live up to, to be granted a use permit, accommodating campus growth and increase occupancy rates, both in terms of space utilization and the amount of vacancy among spaces on a campus. Most of these goals are also applicable for science parks on which no university has settled. Ng et al. (2017) described science park goals from a wider, non-managerial point of view. From this perspective, next to the earlier mentioned goals, the creation of new firms, technology and knowledge transfer, knowledge creation and contributions to regional and/or local development are important.

Siegel et al. (2003) described a few goals science park managers can have in order to contribute to the quality of a region. A science park is a huge economic development which could also create a number of jobs within a region. On top of that it also enhances the image of a certain location which might attract other developments as well.

Eindhoven for instance benefits a lot from the label 'Brainport' (Kooij et al., 2012). According to the municipality of Eindhoven (2016), the region, and the High Tech Campus in particular, attracts a high number of companies towards the region. These are not only firms specialized in high-tech but also other sectors like retail, building sector and food sector profit from this indirectly. The total unemployment in the region of Eindhoven has declined due to Brainport (Municipality of Eindhoven, 2016).

2.3 Tenant selection

Science park management teams are selective on which firms can settle on their science park and which firms are rejected to settle on their park. The motivations to either accept or reject a firm can be based on various tenant criteria. Link & Scott (2006) pointed out that science parks that attract more information technology companies grow in a quicker pace than other parks. In other words, a science park can benefit from carefully selecting which tenants can settle on the park as it will lead to a greater overall success for the park. This also affects the success of the individual firms located on the science park.

Applying tenant selection on a science park can have various reasons for science park managers (van Winden & Carvalho, 2015). Firstly, proper tenant selection might help to increase the chances that tenants collaborate and benefit from each other's presence. This physical proximity can stimulate open innovation. Additionally to support the concept of open innovation on a science park, tenant selection also helps science park managers to create a selection of firms that show more similarities with one another and thus will need the same sort of facilities and services being present on the science park. Lastly, tenant selection helps in creating a specified prestige towards a certain sector for a science park. If a science park for instance only selects tenants that operate in the bioscience industry, more companies that are also operating in this field will be interested in this science park.

Different degrees of tenant selection can be enforced (van Winden & Carvalho, 2015). At the High Tech Campus Eindhoven in the Netherlands for instance, the tenant selection procedure is rather strict. Only larger, prestigious clients, smaller technology firms with the need for specialized facilities and technology start-ups that can contribute and benefit from the High Tech Campus will be taken into consideration. On some locations, like IT City Katrinebjerg, no form of tenant selection is applied. At these locations a mechanism of 'self-selection' takes over. As at IT City Katrinebjerg for instance, the park attracts mostly IT companies as a large number has already settled on the park. Contracting a tenant can also be tied with the lease duration. In order to make a science park grow and sustainable, a science park has find tenants that are willing to commit to the science park. At times this might require a long term contract (e.g. 10 years) which can be a risky commitment for a potential tenant. In that scenario the science park has to make such a contract attractive for the tenant as well.

Link & Link (2003) discussed the most important tenant criteria science park managers are applying on tenant firms. These were (among others): being active in R&D or technology, being committed to hiring graduate students, have interaction with a university facility and the absence of heavy manufacturing. Ng et al. (2017) underlined these statements and added the importance of human capital and commercial capabilities of tenants. Westhead (1997) stated that science park management teams can choose to loosen up their tenant selection criteria at times to generate a more stable rental income. This is affected by the state of the economy and the overall amount of applicants for science parks.

Two studies have been found that mainly addressed the way science parks select their new potential tenants and on what criteria they check these potential tenants. Van Winden & Carvalho (2015) described tenant selection criteria from a viewpoint in which tenant criteria is essential in order to stimulate a good synergy among firms on a science park. The tenant selection criteria they describe as vital can be different for each science parks as these criteria focus mostly on the scope of a science park. This is different for the criteria that Link & Link (2003) stated in their research. They have compared parks that apply selection criteria upon their tenants to parks that do not enforce such criteria. Therefore the criteria they denoted to science parks are more general and are less likely to differ among science parks.

In order to back up the literature among tenant selection criteria on science parks, two literature sources that described the way tenant selection procedures are being tackled on incubators have been discussed. Half of all science parks have an incubator program running on their parks in which start-up firms can participate (Link & Scott, 2006). The role of an incubator is to stimulate start-ups to grow. This is not necessarily in terms of employees but mostly in terms of business development (OECD, 1999). Incubators mostly provide services and facilities from which mostly new technology based firms profit (Chan & Lau, 2005). As Link & Scott (2006) identified, one in two science parks has an incubator facility located on its park. It is therefore likely that tenant selection criteria that are described in science parks literature show a lot of similarities with the selection criteria of incubators that are described in literature that is addressing incubator programs. Therefore the studies of Cullen & Chandler (2014) and Peters et al. (2004) have been analyzed in this thesis in order to assess the selection criteria that are used on science parks more accurately. Peters et al. (2004) developed a model that evaluated the impact of a set of services offered by different types of incubators. In this model the use of tenant selection criteria is also addressed and in their interviews with directors, it had been stressed that tenants had to demonstrate a good innovative idea which can develop into a successful business. The suitability of tenant firms in the science park was also deemed important. Cullen & Chandler tested if a South African business incubator could meet international performance standards compiled by literature. In this study the importance of an optimal tenant mix is stressed as well as corporate governance, staffing, financial management and marketing & facilities management on science parks.

On many science parks, an accelerator program is offered for start-ups besides an incubator program. An accelerator program is a usually shorter program (around six months) in which a start-up gets to learn quickly on how to operate its business (The Birdhouse, 2017). An acceleration program is therefore more intensive than an incubation program and also has a clearer exit than an incubator. Additionally, most accelerators are more specialized towards a specific sector whereas an incubator can be orientated more broadly.

Another point addressed by Cullen & Chandler (2014) is the moment when participating tenants in the incubation program are ready to exit the program. This can be done by a periodical evaluation, like annually, once in two years in which the participants are subjected to exit criteria. These exit criteria consist of achievements like having a complete management team, having enough investors to scale up their business or when their needed space grows beyond the facilities of the incubator. Many incubators use a certain timeframe after which the participating firms have to exit the incubation program. Although this way of exiting is easier for incubators to execute, there is less room for customization. Some firms mature faster than others. This might cause some firms to only participate in the incubation program partly whereas other firms would need a longer stay in an incubation program in order to grow to a next phase.

Incubators can apply several criteria in order to pick the firms that can participate in the incubation program. Bergek & Norrman (2008) described two perspectives into the criteria that incubators apply to their tenant firms. Firstly, tenants can be selected by an incubator based on the potential of their idea or their entrepreneurship. Secondly, another view on the selection procedure incubators can apply is 'picking the winners' only in which only the firms are chosen that expected to be very successful. In contrast to the 'picking the winners' tactic is the 'survival of the fittest' tactic. In this tactic more firms can enter the incubation program which results in a wider variation of ideas and firms in the incubation program. This tactic is more likely to result in firms failing to complete the incubation process. Bergek & Norrman (2008) combined these two views into four tenant selection concepts that incubators can apply to potential tenants. Firstly, the concept of survival of the fittest combined with tenant selection based on their business idea. In contrast, this is the concept of survival of the fittest combined with tenant selection based on entrepreneurial experience. Both ways of selecting tenant firms result in a fairly large pool of participating firms with the difference being that in the first concept, all ideas are having a good potential whereas in the other tenant selection concept the people that are driving the firms are deemed to be successful in realizing the potential of their ideas. The other two ways of tenant selection is combining the 'picking the winners' tactic with either promising ideas or with promising entrepreneurs. If 'picking the winners' is combined with promising ideas, the incubation program will be filled with a few, highly niched ideas that are often related to research departments of universities. Combining 'picking the winners' with promising entrepreneurs will result in an incubation program filled with a handful, carefully picked entrepreneurs that mostly had ideas coupled to nearby universities. In most cases, accelerator programs apply the stricter 'picking the winners' approach whereas in most incubators there is space for more companies so the 'survival of the fittest' approach can be applied there more often (The Birdhouse, 2017).

Table 2.1 Selection criteria defined by different literature sources

	Van Winden & Carvalho (2015) Science parks	Link & Link (2003)	Cullen & Chandler (2014) Incubators	Peters et al. (2004)	Bergek & Norrman (2008)
Firm similarities	X			X	
Firms in same sector	X		X	X	
R&D and/or technology based		X			
No heavy manufacturing		X			
Hiring graduate students/interacting with university	X	X			
Potential for growth			X	X	X

Determining if a new potential tenant fits within a science park community is a difficult process that has no exact answer. Potential tenants that are operating in the same sector as the tenants that are already located on the science park are most likely to create a synergetic relation in which they both benefit from each other's presence (van Winden & Carvalho, 2015). On the other hand, tenants that might seem unfitting at first might be able to form refreshing combinations with the firms that are already located on the science park (Frenken, van Oort & Verburg, 2007).

2.4 Services and facilities

There is a wide variety of services and facilities a science park can offer to its tenants. This paragraph will describe the variety of services and facilities a science park can offer to its tenant firms.

As can be seen in Table 2.2, there are also a lot of offered services and facilities that cannot be directly linked to the core businesses of science park tenants. These services and facilities can be seen as a tool for science parks to stimulate spontaneous meetings between individuals on a science park.

Firstly, science parks offer their tenants facilities that support their R&D activities. The accessibility of a larger HEI on a science park grants the other firms on a science park a lowered need to invest in R&D facilities themselves and also lowers the risk that would come along with investing in R&D facilities as these firms can be encouraged to use their technical and commercial infrastructures (Westhead & Batstone, 1998). Facilities assisting R&D development that are mostly mentioned by companies are clean rooms, laboratories and pilot rooms (Ng et al., 2017). Also several other types of facilities and services that facilitate R&D departments from firms are mentioned by firms (e.g. common licensing, wind tunnels, 3D printers etc.) (Junker, 2018). The presence of such on-site facilities is greatly valued by firms on a science park (Chan & Lau, 2005). All firms can use these shared facilities, although some facilities are more specific than others which leads to some of these R&D facilities only being used by companies that have very specialized needs. Such facilities can only be shared among firms that operate in the same field.

Next to the presence of R&D facilities, science parks offer work-related facilities. The most important work-related facility for a science park to provide to its tenants is the supply of office spaces. Most science parks choose to set their office spaces in the market with flexible lease contracts. With these flexible lease contracts, tenants can quickly adapt to changing needs during either growth or shrinkage of their business. This flexibility within leasing contracts is mostly valued as a good asset by tenants on science parks (Dabrowska, 2011). Other work-related facilities that are mostly offered by science parks are meeting rooms, conference rooms, libraries and eating facilities. Going beyond usual standards, science parks can also offer auditoria or exhibition rooms although these two types of spaces are not offered by all science parks.

On a lot of science parks also non-work-related facilities are offered. In Table 2.2 these facilities have been divided in leisure facilities and personal facilities. All these are not directly related to any sort of business activity but provide extra services for the employees that are active on a science park. The leisure facilities that are mostly offered on science parks are sport centers, sporting grounds, hotels and on some parks cinemas can be present as well (Ng et al., 2017; Junker, 2018). The personal facilities are mostly utilized individually by people that are on the science parks. The most common personal facilities that science parks offer are shops, both food and non-food, child care, medical care, a bank, residential housing and a travel-agency.

Next to the facilities science park managers can provide on their science parks, they can also offer a variety of services that are useful for tenant firms. These are services like management support (ICT-support, HR-management, logistic services, handling public relations etc.), network events (symposia, business courses, informal meetings or celebrations, sport events, etc.), information access (library, information system, databases for science and business, online platforms, etc.) trainings (lectures, workshops or incubator programs), assistance on company marketing, accounting or graphical design (Junker, 2018; Ng et al. 2017). Facilitating such services enables firms to focus more on their core business instead of their business on organization level (Westhead & Batstone, 1998).

In Table 2.2, the most important services and facilities science park management teams can offer to their tenants are summarized based on the findings of Ng et al. (2017), Siegel et al. (2003), Westhead & Batstone (1998) & Junker (2018).

Table 2.2 Overview services and facilities defined by literature

		Ng et al. (2017)	Siegel et al. (2003)	Westhead & Batstone (1998)	Junker (2018)
Research & Development	Clean rooms	X			X
	Laboratories	X			X
	Pilot rooms	X			X
	Other				X
	Equipment				X
Work-related facilities	Meeting rooms	X	X	X	X
	Conference rooms	X		X	X
	Eating facilities	X		X	X
	Library	X		X	X
	Auditorium	X			X
	Exhibition rooms	X			X
Leisure facilities	Sport centers	X			X
	Sporting grounds	X			X
	Hotel	X			X
	Cinema	X			X
Personal facilities	Shops (Food)	X			X
	Child Care	X			X
	Medical	X			X
	Banking	X			
	Residential housing	X			X
	Shops (non-food)	X			X
	Travel agency	X			X
Services	Networking events	X			X
	Training	X	X	X	X
	Consultancy	X	X	X	X
	Venture capital access	X			X
	Information access	X			X
	Management support	X	X	X	X
	Administrative	X	X	X	X
	Marketing	X			X
	Accounting	X		X	X
	Graphical design	X			X
	Cleaning and maintenance	X		X	X
	Safety and security	X		X	X

Locating on a science parks also provides some benefits that are not directly offered in the form of a service or facility provided by the science park management but are factors that make science parks attractive for firms. The largest advantage science parks have that make them stand out from regular business sites is the large availability of skilled labor (Siegel et al., 2003).

Junker (2018) has explored the services and facilities that science parks in the Netherlands state to offer to their tenants on their websites and what the differences are between the offered services and facilities according to the science park websites and according to literature. It turned out that among the eight largest science parks only human resources and social events were mentioned more frequently by science parks and could thus be seen as an important service or facility granted by a science park (Junker, 2018).

2.5 Conclusion

This chapter has taken a closer look at the early defined sub questions that needed to be addressed in order to properly answer the main research question. The sub questions that have been addressed in this chapter are:

- What different types of science park management can be distinguished and how do they operate?
- What type of services and facilities do science park management teams offer to firms?

Three types of management styles can be distinguished. The informal team in which all managerial tasks are divided among the firms that are located on the science parks, the on-site manager which dedicates his full time onto fulfilling all managerial tasks that are needed to keep the science park up and running and the third possibility is the on-site management company.

Next to these different types of management styles, all science park management teams have a set of goals they wish to accomplish. The most important goals science park managers were trying to achieve were supporting tenant goals, attracting more students and staff members, achieving or maintaining minimum building quality for use permit, accommodating campus growth and increasing occupancy rates (Den Heijer, 2011). From a non-managerial point of view, next to the earlier mentioned goals, the creation of new firms, technology and knowledge transfer, knowledge creation and contributions to regional and/or local development are important (Ng et al., 2017). In a wider view the contributions of a science park to regional development can also be quite important as it stimulations job creation and can make a region more appealing (Siegel et al., 2003).

Science park managers can influence the setup of their park by selecting which firms can settle on the park. It is deemed important whether a firm's profile fits within the science park profile. Additionally, science parks have to determine what standards is expected from tenant-firms performance-wise (van Winden & Carvalho, 2015). This is partly related to the success of a science park. If a science park is growing well and can attract new tenant firms that blend in well with the tenants that are already located on the science park, the science park management team can apply a more strict form of tenant selection which will result in only more successful firms being granted lease contracts on the science park.

On the other hand, if a science park is facing potential vacant sites, science park managers will be more willing to loosen up the tenant criteria that are forced upon new potential tenants as having vacant spaces on a science park will result in more losses in the long term.

The concept of open innovation is valuable for both start-up and mature firms (Chesbrough, 2003) and science park management can steer on the levels of open innovation on their parks. This can be done by both the design of the science park and the level of engagement of the science park management team (Quintas et al., 1992; Hansson et al., 2005). Which services and facilities contribute to higher levels of open innovation or how science park managers can specifically improve the open innovation levels of either start-ups or mature firms will be addressed in the interviews. This also applies for the concept of cross-pollination which can be valued as the act of open innovation outside sectoral boundaries. Science park managers can achieve successful attempts of cross-pollination if they succeed in connecting people with a deeper understanding of their field together and not people that are more broadly orientated on numerous fields (Fleming, 2004).

In order to determine what services and facilities are mostly offered by science park management teams, this chapter has analyzed what science park literature has pointed out as the most important facilities and services science parks offer. Based on the findings of Ng et al. (2017), Siegel et al. (2003) & Westhead & Batstone (1998) a list of important services and facilities has been assembled. This list includes R&D facilities, work-related facilities, leisure-related facilities, other types of facilities, services offered by science parks and other amenities that science parks have to offer to their tenants. As can be seen in this list, science parks offer services and facilities that assist firms on putting more focus on their core activities, that enable them to perform better in their core activities and some non-working facilities and services that do not provide anything for an entire company but for the individual employees.

Chapter 3: Comparing start-up firms with mature firms

This chapter will examine the differences in services and facilities that science park managers offer to both start-ups and mature firms by the terms of a literature review. Firstly, the characteristics of both starting firms and mature firms will be analyzed. Secondly, the differences between both types of firms will be discussed. Lastly, the relationship between both start-ups and mature firms will be analyzed. The mature firms analyzed in this study are larger than 250 full-time equivalent employees and exceed the SME threshold. This study therefore does not analyze the possible link between start-ups and SMEs, only the link between start-ups and larger mature firms.

According to the study of Buck Consultants International (2016) on the top eight science parks of the Netherlands, ten percent of all companies of science parks could be defined as corporates, 48% were defined as SMEs and 42% were defined as start-ups. Outliers in terms of amount of corporates in the Netherlands were High Tech Campus Eindhoven and Brightlands Chemelot Campus on which respectively 43% and 18% of the tenants were considered as corporates. This is interesting as these are the only two science parks that do not maintain any formal relationships with a university, whereas all of the other examined science parks in this study are connected to a university in one way or another.

3.1 Exploring start-ups

In order to draw a good comparison in the differences between start-ups and mature firms in terms of facilities and services, a good understanding of how start-ups function in general is required. This paragraph will explore how start-ups can be defined and will therefore look at multiple characteristics of start-ups. Lastly, why start-ups are eager to settle on a science park will be discussed.

The concept of a start-up company has not been clearly defined yet in literature. Start-ups have been discussed extensively by multiple literature studies but the exact definition of start-ups based on literature is vague. Spender, Corvello, Grimaldi & Rippa (2016) defined a start-up as a company, partnership or organization in which creating a business model that has potential to grow bigger is the main aim. Recurring in most literature are three aspects that are essential to be labeled a 'start-up'. A startup has to be new, active and independent (Luger & Koo, 2005; Luggen & Tschirky, 2003; Cunha et al., 2013). These three aspects are all prone to subjectivity. Luggen & Tschirky (2003) for example suggested that a firm is 'new' for its first ten years. This definition was given to new technology-based firms (NTBFs). Not all start-ups can be classified as a NTBF due to the fact that not every start-up is operating in the technology sector. NTBFs and start-ups have three main aspects in common, being new, being active and being independent.

The criterion of being active is important as firms that exist on paper but are not making any innovations at all would not be an addition to any type of business park. Luger & Koo (2005) defined the hiring of a company's first employee as the threshold to be labeled 'active'. The fact that home-based firms were ignored by this definition is refuted by the authors by stating that according to Mason (1982) only 7.7% of all home-based firms grow into major firms which would only be a small proportion of all firms. Additionally, if a home-based firm grows into a major firm, sooner or later these firms will hire employees to keep up with the firm growth. When this occurs, these firms can be labeled active after all.

Thirdly the criterion of independency is needed in order to define start-ups as well. As Luger & Koo (2005) stated in their study, firms that are connected to a bigger company should not be assessed as firms that just started their business as these have unfair advantages over those that do not have a link to a bigger company. Spin-off companies from bigger companies are in a gray area as they still can have links to their parent companies. If they are operating independently from the parent company, on a legal, financial, functional and market-wise level, a spin-off can still be classified a start-up according to Luger & Koo (2005) & Cunha et al. (2013). It is debatable if the presence of informal ties between the initiator of a start-up and its former firm, which are likely to be present, influences the success of a start-up. This has yet to be evaluated in science park literature.

In the Netherlands, Rijksdienst voor Ondernemend Nederland (2014) & Kamer van Koophandel (2016) defined innovative start-ups as companies that are five year old or younger, have proven that they are independent with a focus on a new product or they add significant improvements to an existing product and lastly they have an extensive focus on R&D which is quantified in a minimum of 10% of the exploitation costs has to be dedicated to R&D activities. If a start-up does not qualify to these definition rules, it will not be qualified to get financial support from the Dutch government. Rijksoverheid has not set a size limitation for start-ups. This implies that defining a firm as a start-up judging on firm size might not be correct in some cases. In this study it will be assumed that start-ups do not grow beyond small firm boundaries in terms of employees. According to Kamer van Koophandel (2017), firms in the Netherlands qualify as a small firm when the firm has fewer than 50 employees. The maximum size of SMEs that can apply for the subsidiaries is defined by Rijksoverheid on a maximum of 250 employees.

The way start-ups have to set themselves on the market is by creating something new that makes them stand out from their competitors. Therefore start-ups should focus on ways that are useful to generate potential innovations. One way of doing so is by the means of open innovation. Spender et al. (2016) argued that open innovation is needed for start-ups in order to overcome their weaknesses of being a small and new firm. The concept of open innovation helps start-ups to further develop the ideas they have but are lacking the funds or expertise to properly refine it into a working product or service. Secondly, the focus on a creative working environment is also important for start-ups in order to come up with innovations that make them stand out (Freeman & Engel, 2007). Freeman & Engel (2007) described two stages of innovation: first the part where a creativity outflow is needed. This mostly implies less strict organization structures, responsibilities and formal communication. The use of teams is higher among such companies. In general, to think outside the box, employees should be allowed to make errors in order to increase chances of coming up with an innovative idea. The second stage of innovation is the part in which the innovations needs to be executed. In this stage of innovation more clarity is required which involves more visible organizational structures (Freeman & Engel, 2007). Not only communication within an organization is important, the communication between user and customer is vital as well. This is underlined by the study of Gasmann (2016) which stated that communication of start-ups to both users and customers is essential to find out in an early stage if a concept is in market demand or not. And if so, how it could fit the user needs better. A lot of start-ups tend to keep their innovation to themselves as they are scared of potential competition that might arise if they share their ideas with others.

Start-ups that settle on a science park are primarily interested in the financers, suppliers and customers that are involved or located on the science park. The networks that revolve around their business model they mostly have built up already or can do that on their own (Järvelin & Koskela, 2004). Koolhoven (2015) indicated in their study that of all start-ups, only five per cent per year do not survive.

Massey, Quintas & Wield (1992) stated that a lot of start-ups do not entirely qualify to the earlier given definition to start-ups. Science park managers might tend to select firms that are not entirely independent. These firms can be backed up financially or strategically by a larger firm when their existence is endangered and thus have higher chances of survival than firms that are completely independent.

3.2 Exploring mature firms

As the previous paragraph has explored how start-ups can be defined and what their characteristics were, this chapter will cope with the exploration of mature firms by firstly defining what mature firms are and then identify the characteristics that mature firms possess like size and their ways of innovating. Lastly the question why mature firms are eager to settle on a science park will be discussed by the terms of literature.

In comparison to start-up firms, a mature firm generally has more capital, more research capacity, has a stronger brand presence, less strategic alliances, better organizational structures and their business processes are better designed whereas start-ups mostly have incomplete or non-existent business processes (Freeman & Engel, 2007). According to the definitions from Rijksdienst voor Ondernemend Nederland (2014) and Kamer van Koophandel (2016) companies can be defined as large, when companies have over 250 full-time equivalents of employees.

On 84% of the European science parks, the share of large firms is less than 10% (IASP, 2007). This only applies to the amount of firms, due to large firms are usually renting more space on a park.

Large firms tend to be less efficient at making innovations as they lack the flexibility start-ups have which allows them to loosen up their organizational structure and boost the creative output of a start-up (Freeman & Engel, 2007). Loosening up organizational structures mostly contradicts with the solid organizational structures that are mostly present in larger firms. Freeman & Engel described two possible methods a larger firm could use in order to cope with the problems a larger firms face when they aim at innovating. Firstly companies can set up different organizational units within the firm boundaries with each different levels of freedom. Organizational units with higher levels of freedom are thought to be more able to develop new innovations than organizational units with lower levels of freedom. Another organization unit could form a counterweight to this part in order to enable a fast process of optimizing and bringing a promising innovation on the market. A different approach could be switching roles within a firm over a period of time. In the innovation process, a lot of creativity is needed in the early stages of the process and more decisive power is needed at later stages in order to finalize innovations.

Van de Vrande et al. (2009) shed light on the differences in the use of open innovations between larger multinational enterprises (MNEs) and small, medium enterprises (SMEs). They stated that for MNEs the use of open innovation is two-fold, open innovation allows MNEs to exploit otherwise untouched technologies and to acquire new knowledge from outside sources. Acquiring new knowledge can be done by three ways: venturing new organizations based on internal knowledge, the insourcing of intellectual property (IP) and thirdly by capitalizing ideas of current employees, both R&D and non-R&D.

Internal innovation can be ventured to the market in three ways (Freeman & Engel, 2007). Firstly, a company can keep the innovation inside the company boundaries during the entire development and venturing process. Secondly, an individual could create a separate, independent venture. This is labeled a spin-out in literature (Nikolowa, 2014).

A spin-out is operating independently from the originated firm where the actor(s) that set up the spin-out only brought along their innovation they came up with at the firm they previously worked for. A third option is a spin-off. Like a spin-out a separate venture will be founded for a new technology to be developed. The difference in both strategies is that a spin-off is not operating independently but is backed up by the parent company. The advantage of a spin-off is that a firm can monitor the development progress of the innovations and decide in a later stadium if the company is profitable enough and fitting within the core business of the company and that they want to insource it into the mother company or to sell the company off (Vanhaverbeke, Van de Vrande & Chesbrough, 2008).

In paragraph 3.1 the benefits of a start-up locating themselves on a science park had already been discussed. That does not imply that there are no advantages for larger companies. According to Narasimhalu (2013), large companies profit from the training the science park can provide to their individual employees, both due to formal and informal interaction.

In paragraph 3.1 and 3.2 different characteristics of both start-ups and mature firms have been described. In Table 3.1 these characteristics have been compared to one another. When comparing start-ups with mature firms, the difference in experience is noteworthy. In literature and by the Dutch government (Luggen & Tschirky, 2003; Rijksdienst voor Ondernemend Nederland, 2014; Kamer van Koophandel, 2016) the usual time span in which a company is still considered as a start-up is five years. After that it will be either considered as a small, medium or large sized company. Mature firms will most likely be older than 5 years as they need to grow beyond the 250 employee threshold. This is also intertwined with the financial means both type of firms have. Due to the newness of start-ups, they mostly have limited financial means, whereas the mature firms are able to afford more expenses. The limitation on resources also makes science parks appealing for start-ups. This is due to the facilities science parks provide that the start-ups individually would not be able to afford on their own. Mature firms are more likely to be able to afford their own customized facilities which might fit their firm better than more broad science park facilities.

Table 3.1: Differences between start-ups and mature firms

Start-ups	Mature firms	Source
Small in size (<50 employees)	Larger companies (>250 employees)	Rijksdienst voor Ondernemend Nederland (2014) & Kamer van Koophandel (2016)
New firms (<5 years)	More experienced firms (>5 years)	Luggen & Tschirky (2003), Rijksdienst voor Ondernemend Nederland (2014) & Kamer van Koophandel (2016)
Less financial means	More financial means	
Less structured organizationally	Better defined organizational structures	Freeman & Engel (2007)
Creative output is stimulated	Creative output is mostly not stimulated within company boundaries	Freeman & Engel (2007)
Use science park facilities in order to reduce costs	Are selective on which park facilities they use	Westhead & Batstone (1998), Chan & Lau (2005)
Science park services contributes to their non-core business	Concentration of knowledge contributes to the process of innovation	Chan & Lau (2005)
Not affected by the Not-Invented-Here syndrome	Affected by the Not-invented-here syndrome	Katz & Allen (1982)

3.3 Link between start-ups and mature firms

As both start-ups and mature firms are located on science parks, the question rises whether they share mutual benefits from each other's presence. Start-ups located on science parks profit from the presence of larger mature firms due to access to international markets these larger firms can possibly provide. Additionally, most start-ups hope to gain a better reputation and more publicity from cooperating with a mature firm (Hora, Gast, Kailer, Rey-Marti & Mas-Tur, 2017).

The benefits of the presence of start-ups for mature firms on science parks are different. Mature firms gain easier access to the new innovations that start-ups develop on science parks than elsewhere. Like discussed earlier in this chapter, start-ups tend to be better at creating innovations as there is more space for creativity in start-ups and thus start-ups can explore and experiment more in terms of creating new ideas (Freeman & Engel, 2007). Mature firms can collaborate on these innovations from start-ups in order to expand their business model or further develop their own product (Hora et al. 2017). Mature firms can learn from the innovation pace start-ups have due to their organizational structures. This can help mature firms to speed up their own innovation processes as well. Another thing which does not affect start-ups is the 'Not-Invented-Here' syndrome (NIH-syndrome). The NIH-syndrome has been extensively discussed by Katz & Allen (1982). The NIH-syndrome is a phenomenon in which researchers that have worked as a group over a longer period of time, tend to be reluctant to accept new innovations that are created by others. Start-ups are not operating in the same field for a shorter time span and therefore are more likely to embrace expertise outside their firm boundaries regarding new innovations, whereas researchers at mature firms might be more stubborn in embracing external expertise regarding new ideas.

Phillimore (1999) pointed out that besides the bonds firms form with a manifest knowledge carrier on a science park, the bonds they form with each other are also a vital contribution science parks can offer to their tenants. Phillimore identified three types of bonds that firms could form. Firstly a primarily formal bond in which two firms are formally committed to one another for carrying out research or tests. Secondly, firms can form bonds in which they exchange human resources. Lastly, firms can maintain informal links such as contacts between individuals among firms or attending social networking events. Basile (2011) argued that the value of the ties that companies form at science parks can differ among varying types of science parks. On parks that focus on biotechnology for instance, collaboration between companies is much more required due to the heavy competition within this industry. If firms specialized in biotechnology would have to create innovations solely based on their own R&D capacity, they expose themselves to the risk of falling behind on their sectoral competitors. According to Skardon (2011) a start-up should not become too attached to a mature firm as the mature firm might play a major role in how they operate whereas for a mature firm a collaboration with a start-up does not entail that much risk. Skardon stressed that trust between individuals from start-ups and mature firm is essential in order to obtain a mutually beneficial relationship and that this is something a community facilitator like a science park could assist in. They can act as mediator between start-ups and mature firms.

3.4 Conclusion

This chapter has taken a deeper look at the early defined sub questions that needed to be addressed in order to properly answer the main research question.

The sub questions that have been addressed in this chapter are:

- What are the organizational differences between start-ups and mature firms?
- Which services and facilities might strengthen the relationship between start-ups and mature firms?

- How can science park managers stimulate the act of open innovation and cross-pollination among start-ups and mature firms?

The main differences that distinguish start-ups from mature firms as described in paragraph 3.1 and paragraph 3.2 are the lower levels of experience, the shorter time-period the start-up is active, the financial means are smaller, more usage of science park facilities and lastly receive more support from the science park on non-core business activities.

The range of services and facilities science parks offer on their parks has been discussed by literature extensively (Ng et al., 2017; Siegel et al., 2003; Westhead & Batstone, 1998 & Junker, 2018). The services and facilities that either start-ups, mature firms or both utilize has not been discussed thoroughly in science park literature yet. This also applies to the question which facilities and services contribute to the links between start-ups and mature firms. The measures science park managers can take in order to improve open innovation and cross-pollination among firms has also been underexposed in science park literature. These literature gaps have been addressed in the interviews.

Chapter 4: Methodology & Research design

In order to find answers to the questions that were raised at the initiation of this research and have not been answered by the literature review, a set of interviews has been designed. A qualitative research method like interviews has been chosen as a qualitative approach is more fitting to the explorative nature of this research than a quantitative approach (Baarda & De Goede, 2005). Persons interviewed are those involved in services and facilities on science parks, either from a managerial point of view or a tenant point of view.

The literature review showed what services and facilities are mostly provided by science parks for their tenants. Uncertain is which of these services and facilities are used by what firms and how these services and facilities contribute to a synergetic relation. The existence of this relation has been mentioned a couple of times in science park literature (Hora et al, 2017; Freeman & Engel, 2007; Phillimore, 1999) but has not been related to any of the offered services and facilities by science parks. The data collected in this study addresses the link between science park attributes and contributes to additional insights.

4.1 Data Collection

To cover all facets of science parks, both university and non-university science parks will be examined through the interviews. For both types of parks a selection will be made varying from fully grown parks to parks that are still exploring their possibilities to grow. Each science park has been labeled with either an “Adult”, “Growth” or “Initiation” phase. This is based on the study of Buck Consultants (2018). As the research question is focusing on the way science parks are currently managed, the science park initiatives will not be included in the interview sample. On the science parks, two types of people will be interviewed. First, someone who is involved in the park management of the science park. This will be someone in the management team of the real estate. This person should be responsible or involved in managing either the facilities onsite or selection of the tenant firms that are residing on the park. As an addition to the data gathered from the science park managers, three science park tenant firms have been interviewed as well. This will make the data collected from the science park managers more complete.

Based on the different types of qualitative research described by Baarda et al. (2005) the interviews will have a semi-structured character. This way unforeseen points can still be discussed during the interviews but the gaps identified in the literature review will be covered by the interviews. Semi-structured interviews will also most likely give less variation in answers from respondents (Baarda et al., 2005). For these semi-structured interviews, questions related to the literature gap have been formulated. These interview topics have been sent to the interviewees on beforehand. The participants need to be familiar with the topics in order to get useful results. This research aimed to interview CEO’s from start-ups. As these firms are smaller than more mature firms, a CEO will probably be involved in the decision making regarding location choice and therefore be rooted in the reasoning why a certain science park has be chosen to reside on. For mature firms the CEO will most likely be out of reach and less familiar with the reasoning behind the choice of a certain science park. Therefore it will be more interesting to interview people with less decisive power but more familiar with the reasoning for the location choice. R&D or corporate real estate managers will probably be familiar with the benefits of a science park location and could hopefully share their experiences on science park during the interviews.

In order to make the interview sample representative for all science parks in the Netherlands, all science parks have been analyzed on sector, size, number of employees, growth stage, presence of a knowledge manifest and services and facilities, whether the science park has connections to a university or not and if known the management type of a science park has been stated. This analyses is displayed in Appendix A. For gathering this information the websites of the science parks have been examined and for the eight biggest science parks the overview from Buck Consultants International (2016) has been used as a reference. In Table 4.1 the relevant information of the science parks that form the sample has been displayed.

As mentioned, the interviews will be semi-structured. The interview guide that provided the common thread that was discussed during the interviews is enclosed in Appendix B1 for the interviews with the science park managers and Appendix B2 for the interviews with the tenant firms.

Table 4.1 Selection interviews science parks

Name	Phase	Sector	Region	Companies on park	Employ-ment	Knowledge manifest	Focus on R&D	University /business
Utrecht Science Park – Utrecht	Adult	Medical	Utrecht	103	26169	Yes	Yes	University
High Tech Campus Eindhoven – Eindhoven	Adult	Techno-logical	Noord-Brabant	165	11500	Yes	Yes	Business
Novio Tech Campus – Nijmegen	Growth	Techno-logical	Gelder-land	48	1511	Yes	Yes	Business
Brightlands Maastricht Health Campus – Maastricht	Growth	Medical	Limburg	73	9174	Yes	Yes	University
Brightlands Smart Services Campus - Heerlen	Starting	Techno-logical	Limburg	46	335	Yes	Yes	University
Dairy Campus – Leeuwarden	Starting	Food	Fries-land	2	75	Yes	Yes	University

4.2 Sample description

In this paragraph a brief description from all science parks from which managers have been interviewed and all tenant firms that have been interviewed will be provided. In Table 4.2, the interviewed science park managers, their function and their parks have been stated.

Table 4.2 Summary participants interviews

Name park	Phase	University /business	Function	Sector
Utrecht Science Park	Adult	University	Account manager companies	Medical
High Tech Campus Eindhoven	Adult	Business	Director Business Development	Technological
Novio Tech Campus – Nijmegen	Growth	Business	Director NTC	Technological
Brightlands Maastricht Health Campus	Growth	University	Community Development Manager	Medical
Brightlands Smart Services Campus - Heerlen	Starting	University	Chief Technology & Innovation Officer	IT
Dairy Campus – Leeuwarden	Starting	University	Manager Dairy Campus	Food

4.2.1 Description of the interviewed science parks

Utrecht Science Park
The Utrecht Science Park is one of the largest science parks in the Netherlands where 22.000 people work or study on a daily basis (Buck Consultants, 2018). The park resides the Utrecht Medical Centre as well as both HEI's; Utrecht University and Hoge School Utrecht. All these parties are focused on improving health care for both humans and animals and create a healthier environment (Utrecht Science Park, 2015).

High Tech Campus Eindhoven
The High Tech Campus Eindhoven is a science park located at the verge of Eindhoven which primarily focusses on high-tech technology. It has over 160 companies and more than 11.000 researchers, developers and entrepreneurs all focusing on technological innovations. Together they are responsible for almost 40% of Dutch patent applications (High Tech Campus Eindhoven, 2018).

Novio Tech Campus Nijmegen
The Novio Tech Campus in Nijmegen is a growing campus that focusses primarily on the digital health sector. It is founded in 2013 and has been growing ever since. In 2018, 48 companies have settled on the campus site which is twice as much as in 2014. Half of the residing firms are start-ups (Buck Consultants, 2018).

Brightlands Maastricht Health Campus
Brightlands Maastricht Health campus is one of the four Brightlands campuses in Limburg. It has a scope on medical and biomedical sciences and is has the academic hospital and Maastricht University on its site. It also attempts to facilitate research and company activities with regard to cardiovascular disease and new innovations in electrical pulsing technology (Brightlands Maastricht Health Campus, 2018).

Brightlands Smart Services Campus Heerlen
The Brightlands Smart Services Campus in Heerlen is also part of the four Brightlands campuses in Limburg. It is the youngest out of all four and focuses on IT. It has been founded in 2016. APG also played a major role in initiating the Smart Services Campus. Since it came into existence it has been growing quickly.

Dairy Campus Leeuwarden
The Dairy Campus is located in Leeuwarden, is a science park that focuses on research in the agricultural sector. Its size is over 740 acres and has been initiated in 2015. The campus has over 550 cows that are used for research. On the Dairy Campus both research and companies meet each other (Dairy Campus, 2018). The Dairy Campus is considered a starting science park (Buck Consultants, 2018) and is still trying to grow. The science park is initiated by Wageningen University and also has close ties with other educational institutions in the region of Leeuwarden. This is also visible on the campus itself as a lot of students are carrying out research on the Dairy Campus.

4.2.2 Description of the interviewed firms

In Table 4.3, the interviewed tenant firms along with some background information has been stated.

Table 4.3 Fact sheet interviewed firms

Firm name	Title interviewee	Year of establishment	Employees (worldwide)	Employees on science park	Sector	Residing science park	Reference
ABB	VP Manager Standardization & Public-Private Partnership	1988	35500	30	Electrical engineering	HTC Eindhoven	ABB (2018a & 2018b)
Usono	CEO	2016	10	10	Electrical engineering	HTC Eindhoven	Interview
Nexperia	Head of Communications and Branding	2016	11000	250	Semiconductor manufacturer	NTC Nijmegen	Nexperia (2017)

ABB – High Tech Campus Eindhoven
Asea Brown Boveri (ABB) is a company that is leading in creating fast chargers for electric vehicles. The firm is a global player and has offices in numerous countries all over the world. In the Netherlands they are residing on the High Tech Campus Eindhoven.

Usono – High Tech Campus Eindhoven
Usono is a start-up that founded a few years ago by a graduate from the TU/e. It got accommodated by the HighTechXL. Usono utilizes ultrasound for healthcare purposes. The firm focuses on easing the utilization of ultrasound by professionals in the health care sector in order to reduce RSI conditions and enable the possibility to fixate ultrasound steadily on a human body.

Nexperia – Novio Tech Campus
Nexperia is a global leader in chip producer with a specialization in Discretes, Logic and MOSFETs devices. Nexperia originates from Philips and was later included as a department from NXP. In 2017 it established itself as an independent company under the new name 'Nexperia'. Since then it resides on the Novio Tech Campus in Nijmegen.

4.3 Data analyses

The raw data that has been gathered from the interviews will be used to fill up the gaps that could not be clarified by literature. In order to make this data insightful for the questions that this research is trying to answer to, the data has been labeled. As the interview is semi-structured, a number of answers are already more homogenous and therefore the results from the interviews are easier to compare than the results of an open interview. This labelling will also make it easier to compare the answers science park managers give with the answers the representatives from the tenant firms give. Based on the ideas of Baarda et al. (2005), the labels categorized into phrases that are related to the research questions. The data from the interviews with the science park managers has been divided into eleven labels and this data is displayed in Appendix C. The labels have been defined based on the data gathered by the interviews. Due to the semi-structured questions, the answers were easier to compare. Most labels are therefore related to the questions that have been asked. These labels are Management structure, operational structure, ownership, incubation programs, selection criteria, exit criteria incubator, benefits of the incubation program, interaction between the firms on-site, cross-pollination, stimulation of open innovation by the science park management and lastly a separate label has been made where the additional remarks from the science park managers have been summarized.

The data from the science park tenants has been divided into eight labels and this data is displayed in Appendix D. The labels have also been defined based on the data gathered by the interviews. Due to the semi-structured questions, the answers were easier to compare. These labels are reasons to reside on a science park, what services and facilities they deemed missing, incubator program, open innovation, cross-pollination, interaction with other firms, relationship with management and lastly a separate label has been made where the additional remarks from the science park tenants have been summarized.

Trends might be found, based on the data. These could contain similarities among all science parks as well as differences. For the differences in the answers, it is important to analyze how these differences could arise. Therefore patterns will be explored in the data example in order to check what characteristics might be related to each other. As this research is only exploratory, no correlations can be confirmed, only an expected relation can be articulated which could be confirmed by further research.

4.4 Reliability

As Baarda et al. (2005) pointed out, it is vital that a research is reliable. Without reliability, the drawn conclusions contain less value. Although it is impossible to gather replicable results with a qualitative research in the form of interviews, as it is impossible to recreate the exact same setting, the results from the interviews have to be verifiable and comprehendible. In order to improve the reliability of this research, the decision has been made to not only interview science park managers but the science park tenants as well. This in order to support the findings of the interviews with the science park managers or grant valuable additions that did not come up during these interviews with the science park managers.

Furthermore by taking a semi-structured interview, all participants will give answers that are more in line with each other which also enhances the reliability of the interviews. All participants allowed on recording the interview, which makes the data more reliable than if this were not possible and notes had to be taken (Baarda et al. 2005). This is due to the less data that is captured in notes as it is a summary of the interviewee´s answer by the interviewer. Processing such a summary on a later point might be prone to subjectivity in terms of prioritizing the important parts of the answers and the less important parts.

4.5 Validity

The results from the data collection have to be valid both internally as externally (Baarda et al. 2005). Internal validity reflects whether the chosen methodology warrants the usefulness of the data for answering the research questions. The external validity indicates how well the results of the research are applicable on similar situations.

The internal validity of this research is improved by backing up the literature review with external input in the forms of interviews. Both people from the supplying side on science parks, the science park managers, as the demanding side on the parks, the tenant firms, have been interviewed. As some interviews have been conducted from the demand side, the internal validity will be enhanced as the results will be less biased than would have been the case when solely science park managers had been interviewed.

For the external validity, the choice has been made to interview science parks that differ on several aspects. These aspects are the maturity stage of the science park, the sector on which most activity of the science park is focused and lastly, both science parks that are connected to a university as well as purely business focused science parks have been interviewed. This makes the conclusions drawn from the interviews better generalizable to other science parks in the Netherlands.

4.6 Conclusion

In chapter 2 and 3 the literature review has been conducted and in order to elaborate on the main research question in more depth, interviews have been adopted in this research design. Six science park managers and three tenants on these science parks have been interviewed in order to gather insights on the contribution of different services and facilities on science parks towards the link between start-ups and mature firms. Interviewing the science park tenants provides a check on whether the information provided the science park managers is complete or that some aspects that are deemed important by the science park tenants are left out. A variety of different science park has been selected as the science parks differ on age, sector and engagement of a university. To guard the internal validity of the interviews, the questions were semi-structured. This provided comparable answers from all participants. The data gathered from the interviews has been labelled and presented in Appendix C and Appendix D.

Chapter 5: Results

This chapter will state an overview from all data gathered during the interviews. The interviews that had been conducted form an effort to fill up the knowledge gaps that could not be answered by the literature study. This chapter will discuss the answers both science park managers as well as representatives from tenant firms have given on various questions. This will more likely result in more unbiased conclusions than when solely science park managers had been interviewed. The output from the interviews has been summarized for each respondent by the labels, as defined in the previous chapter, in Appendix C and Appendix D for respectively the science park managers and science park tenants. Firstly, the different styles of science park management structures will be discussed. This also includes different types of ownership and operational structures on the science park. Next, the opinions with regard to the offered services and facilities will be discussed. For each service and facility it will be stated whether it is utilized by a start-up and/or mature firm and whether the service or facility stimulates a synergy between these two. Furthermore, it will be discussed whether services and facilities are missing on the science park. Appendix E summarized how science park managers indicate the usage of their services and facilities and how much each service or facility contributes to a link between start-ups and mature firms and in Appendix F it is summarized how the individual science park tenants that participated in an interview view their usage of the different services and facilities and the usefulness of them for stimulating interaction between their firm and other firms. Lastly, the practice of open innovation on the science parks had been discussed. Both with regard how firms directly interact with each other on science parks as well as how science park management can influence the frequency and the ways of interaction between firms.

When reaching out for tenant firms willing to participant in the interviews, a few companies stated that they did not utilize much services and facilities on the science park they were residing on. It was therefore doubtful on beforehand if interviews with these firms would grant useful results.

5.1 Organizational structures

One of the three topics that had been discussed during the interviews was how the science parks were organizationally structured by the management and how this affected the tenant firms on the park.

Management structures

All the science park managers that participated in the interviews stated that the science park management on their campuses was shaped in a separate venture that was not directly tied to one of the companies. The size and the amount of tasks a science park management carries out turned out to differ among the science parks. The size of the management teams of the science parks that participated in the interviews varied from three employees on the Novio Tech Campus to over 30 on the Brightlands Maastricht Health Campus. The most mentioned functions a science park management fulfills were business development, marketing & communication, tenant acquisition and financial administration. Some parks stressed the community development as a part of their management activities. This implied that within the management structure, a department was allocated for the development of a science park community onsite.

Some science parks, especially the ones with a smaller science park management team, tend to outsource some management functions. Functions that are mostly outsourced are additional business support functions, catering and hospitality functions and cleaning and maintenance.

The size of a science park did not seem to be related to the size of the science park management team in the interview sample as some of the bigger science parks had a rather small organization in comparison with the smaller science parks.

"We should look more at how other science parks operate, in order to improve."

It was mentioned by the manager from the Utrecht Science Parks that they were trying to improve their own park by looking at other science parks. Utrecht Science Park tries to form collaboration bonds with science parks from Toronto and Hong Kong in order to share knowledge which is profitable for both parties. The Hong Kong science park for instance tries to penetrate the European market, Utrecht Science Park can assist them in setting up such a penetration by either sharing their expertise about the European market or by bringing them in touch with their network that is involved in the European market. Utrecht Science Park and the Kennispark Twente the only two Dutch science parks that are connected to the IASP. During the interview it was mentioned that the frequency of sharing knowledge with other parks was not high enough for the Utrecht Science Park.

The tenant firms that participated in the interviews indicated that the frequency of contact with the science park management was regularly but not too often. During these moments of contact mostly general activities (e.g. placing road signs, updates on regulations, updates on a possible expansion of a science park) were being discussed regarding the practical management of the park itself. Contact with the science park management in some cases is also useful to stay updated on new developments and events that take place on the science park. Science park management can also use these moments of interaction to gauge the interest of tenants for the creation of new facilities (like a hotel or larger conference rooms for instance).

Ownership

Among the interviewed science parks, there were multiple variations of how the ownership of the science park grounds and real estate had been handled. The High Tech Campus Eindhoven for instance has the full ownership over the entire campus captured in one separate venture. This makes it easier for the management of the High Tech Campus to keep the campus close to the vision that has been enrolled for the High Tech Campus. Other campuses, mostly the ones in which a university was involved, have a more scattered division of land- and real estate ownership. Either the university owns the entire campus (like Wageningen University has full ownership over Dairy Campus Leeuwarden) or owns a major part of the campus alongside other major parties (Utrecht Medical Centre and the municipality of Utrecht on the Utrecht Science Park, academic hospital and province of Limburg on the Brightlands Maastricht Health Campus).

The Novio Tech Campus has been founded by multiple parties in Nijmegen. These parties settled the ownership of the Novio Tech Campus site in a separate venture, Novio Tech Campus BV. Separate real estate development parties that are specialized in creating R&D facilities like Kadans and EPR rent the grounds of the science park from the Novio Tech Campus BV and realize their own real estate on these grounds. The campus does not handle directly which firms settle on the campus grounds but still has control on how the concept is regulated and what firms fit within that concept. All shares of the Novio Tech Campus venture are in hands of the Novio Tech Campus Foundation, which has been founded by Oost NL (Development Firm for Eastern Netherlands).

5.2 Services & facilities

The second topic that had been laid down for the interviewees was the present services and facilities on science parks. The science park managers had been asked which services and facilities they offer and how they think they are being used by both start-ups and mature firms. Tenant firms had been asked whether they utilize the services and facilities that are being offered on a site. The different types of facilities have been divided in four categories: Research & Development, work related facilities, leisure facilities, and secondary facilities. Lastly the services were part of this part of this interview. In Table 5.1 the abbreviations used in all tables in this chapter are explained.

Table 5.1 Abbreviations tables science park

Abbreviation	Science park
H	High Tech Campus Eindhoven
U	Utrecht Science Park
N	Novio Tech Campus Nijmegen
M	Brightlands Health Campus Maastricht
S	Brightlands Smart Services Campus Heerlen
L	Dairy Campus Leeuwarden

Research & Development

The research and development facilities form one of the most vital parts of a science park. The availability of facilities that are necessary to engage in research & development is something that is valued by many companies on a science park with start-ups in particular. This also came to light during the interviews with the science park managers. As shown in Table 5.2, most parks had most types of the enlisted R&D facilities available on the site. And most of them were used by both start-ups and mature firms. During the interviews it was stated that on the Novio Tech Campus sharing labs was not preferred as this would result in difficulties regarding IP. On top of that in the digital health sector sharing labs is more difficult due to contamination issues that can arise if two firms operate in the same lab space. Other parks stated that especially laboratories are useful for establishing a link between start-ups and mature firms at science parks. Utrecht Science Park for instance, the HEI has a lab space that is not being used fulltime. During the times HEI is not using the lab space, start-ups can use the labs. When those start-ups use these labs, co-creation with students or teachers of the HEI is mostly taking place. This can be realized by students taking an internship at such a start-up.

Pilot rooms were a bit less available on most science parks (only High Tech Campus Eindhoven and Dairy Campus Leeuwarden stated that a facility was present that could be used as a pilot room). As stated in Table 5.2, a few science park managers indicated that if they offered clean rooms, these were mostly used by start-ups. None of the science park managers indicated that a pilot room is useful for mature firms. All science park managers stated that this can be explained due to most larger firms owning their own laboratory spaces and clean rooms as they have the capital to create their own facilities. Start-ups on the other hand do not have such financial resources and are less certain on their needs with regard to clean rooms and laboratory facilities. It is therefore beneficial that they can book a laboratory facility for a short time span and extend their booking if needed. Equipment is a facility that most science park managers deemed useful for both start-us as mature firms. Especially offering larger or more expensive equipment that is not used often by a single firms, is highly valued by tenant firms according to the science park managers. Some parks offer also special R&D facilities and services like a 3D printer or nearby research institutes. Multiple science park managers stated that lab equipment is shared easily between firms, this is mostly done by direct informal interaction between two firms. A science park is not involved in these interactions.

For the Brightlands Smart Services Campus, the offered R&D facilities were not physically present on the science park site but were all virtual environments. These virtual environments are useful for both start-ups and mature firms to test new innovations within the IT sector. The Brightlands Smart Services Campus does not own the hardware of such a virtual environment but assists companies in setting up their innovative framework within such an environment.

Table 5.2 Presence of R&D facilities on interviewed science parks

Research & Development	Start-ups	Mature firms	Link
Clean rooms	H,U,N,M	U,M	M
Laboratories	H,U,N,M,S,L	U,M,S,L	U,M,S
Pilot rooms	H,L		
Other	H,U,N,M	U,M	U
Equipment	H,U,M,L	U,M,L	U

During one of the interviews it was stated that the absence of a workshop was something that the CEO would like to see changed. A workshop where start-ups could work and experiment with their innovation.

Work-related facilities

In Table 5.3 it is shown that most science parks offer the same work-related facilities. All science park managers mentioned that their science parks offered spaces for both start-ups as well as mature firms that could be used as meeting rooms or conference rooms. All parks also had eating facilities present on campus. The size of such eating facilities differed among these parks as some parks had numerous restaurants settled on their science parks whereas some parks did not have any restaurants on their campus and could offer their tenants a catering service. Most science parks also offered a larger space that could function as an auditorium where larger crowds could be gathered. Some science park managers mentioned that meeting rooms, conference rooms and eating facilities were useful places for both start-ups and mature firms to meet each other. Libraries, auditoria and exhibition rooms did not serve purpose to such a link. Only three out of six science park managers stated that there as an exhibition room present on their science park. Some science park managers mentioned that the concept of a library is a bit outdated and offering online based library functions (e.g. search engines, databases and platforms) is more useful.

Table 5.3 Presence of work-related facilities on interviewed science parks

Work-related facilities	Start-ups	Mature firms	Link
Meeting rooms	H,U,N,M,S,L	H,U,N,M,S,L	N,M,S
Conference rooms	H,U,N,M,S,L	H,U,N,M,S,L	N,M,S
Eating facilities	H,U,N,M,S,L	H,U,N,M,S,L	U,N,M,S
Library	H,U,M,S,L	H,U,M,SL	U,S
Auditorium	H,N,M,S,L	H,N,M,S,L	N,S
Exhibition rooms	H,M,L	H,M,L	

Leisure facilities

Leisure facilities offered by science parks are a bit different than the work-related and R&D related facilities as these types of facilities focus on a firm as an entity, whereas leisure facilities are primarily focused on individuals that work on a science park. In Table 5.4, it is shown what leisure facilities science parks offer to their tenants. Most science parks offer either sporting centers or sporting grounds, in most cases both are available on the park. Especially sport centers are mentioned as a place where interaction between start-ups and mature firms is taking place. One of the respondents indicated that this could be allocated to the presence of a canteen on a sport facility which is more likely to encourage interaction than would happen on sporting grounds. Sporting grounds require much space and are therefore mostly located on the edge of a science park whereas a sport center can be more centrally located on a science park.

Hotel(s) or cinema(s) are only offered by a few science parks and a hotel and a cinema were not present on nearly all campuses. Something that plays a role in having a cinema or hotel on the campus is the critical mass that is needed to be profitable for these facilities to locate themselves. In most cases there are enough hotels located nearby the science park. Locating a hotel onsite would form direct competition of these already existing hotels. Those science parks that offered a hotel or cinema on their science parks did not expect that these facilities had a valuable contribution to linking start-ups and mature firms with each other. The participating tenant firms mentioned that leisure facilities are mostly used by individuals from a firm, not by a firm as a whole entity.

Table 5.4 Presence of leisure facilities on interviewed science parks

Leisure facilities	Start-ups	Mature firms	Link
Sport centers	H,U,N,M,S	H,U,N,M,S	U,N,M,S
Sporting grounds	H,U,M	H,U,M	U
Hotel	M	M	
Cinema	H,M	H,M	

Personal facilities

Just like leisure facilities, personal facilities are rather focused on the individuals that are active on a science park than on entire firms. As shown in Table 5.5, mostly food shops are offered by four out of six interviewed science parks. Furthermore, facilities like child care, medical care and non-food shops are offered by the three same science park in the interview sample. Banking, residential housing and travel agencies were all only offered by one science park. All secondary facilities are deemed less important for creating a link between start-ups and mature firms. Except for the Utrecht Science Park, where most shops were concentrated together with other public facilities like restaurants. This way a more open environment is created where coincidental meetings are more likely to happen. Alongside with this statement of the Utrecht Science Park during some of the interviews with tenant firms it was indicated that they would think it is valuable if the science park community exceeded the regular office hours of a science park. One tenant firm indicated that it would be easier to create such an environment if students are more involved as students tend to start their activities later and end their activities later. Interaction among students is mostly informal. Additionally it was mentioned that a science park could setup more facilities that individuals can use so they can do more non-work related activities on a science park during out of office hours.

Secondary facilities like restaurants and shops are deemed important in this by a science park manager. This also leads to unexpected combinations.

The physical proximity of firms towards these facilities is also deemed important in this, it must be attractive for individuals to move towards these centered facilities. According to several science park managers, having shared facilities increases the likelihood of coincidental meetings between firms. Coincidental meetings was said to lead to the creation of new ties and possibly new collaborations among firms.

Table 5.5 Presence of personal facilities on interviewed science parks

Personal facilities	Start-ups	Mature firms	Link
Shops (Food)	H,U,N,M	H,U,N,M	U
Child Care	H,U,M	H,U,M	U
Medical	H,U,M	H,U,M	
Banking	H	H	
Residential housing	M	M	
Shops (non-food)	H,U,M	H,U,M	U
Travel agency	H	H	

Services

Services provided by a science park are mostly focused on business development. Since the main aim of most science parks is adding value to firms onsite, these services are mostly present on all science parks. Most services are very useful for start-ups which is also indicated by almost all respondents. Nonetheless, also mature firms use a lot of the services provided by science parks. As stated in Table 5.6, networking events was stressed by all participants of the interviews as most important service that they provided for both start-up as well as mature firms. Organizing events is also vital in creating a link between start-ups and mature firms.

Table 5.6 Presence of services on interviewed science parks

Service	Start-ups	Mature firms	Link
Networking events	H,U,N,M,S,L	H,U,N,M,S,L	H,U,N,M,S,L
Training	H,U,N,M,S,L	H,U,N,M,S	H,U,N
Consultancy	H,U,N,M,S,L	H,U,M	U,N
Venture capital access	H,U,N,M,S	H,U,N,M	H,U,N
Information access	H,U,M,S	U,M,S	U
Management support	H,N,M		
Administrative	H,N,M		
Marketing	H,N,M,L	M	
Accounting	H,U,M,L	U	U
Graphical design	H,M,L	M	
Cleaning and maintenance	H,U,N,M,S,L	H,U,M,S	N
Safety and security	H,U,M,S	H,U,M,S	H

Other important services for both start-ups and mature firms as mentioned by science park managers are offering training, consultancy, venture capital access and information access systems. A few parks also mentioned these services as a valuable contribution towards the link between start-ups and mature firms. Other services that science parks can offer like management, administrative or accounting support, accounting and graphical design. These services were mostly utilized by start-ups according to science parks.

Incubation program

Most of the science parks that participated in the interviews offered either an incubation program, acceleration program or both. Out of the six science parks only the Dairy Campus Leeuwarden stated that they did not offer any incubation facilities despite it could be something that could be beneficial for the Dairy Campus in the future. All the science parks on which such programs were run, the programs were run by external parties and not by the science park management teams themselves. These external parties could have a focus that specifies towards that science park, like the HighTechXL acceleration services are only offered to firms that are located on the High Tech Campus. On other parks there are acceleration and incubation programs run by companies that do not limit themselves to a certain science park or campus.

The global consensus among the science park managers is that both the idea and the entrepreneur need to be of a good level. Both are considered vital selection criteria for an incubation program. Most of the managers agreed as well on that the idea should be leading and that entrepreneurship can still be trained. Unanimously all the science park managers agreed upon that the idea of the entrepreneur should fit within the theme of a science park. For science parks that are tied to each other by means of an joint venture (like Maastricht Health Campus and Smart Services Campus Heerlen are both connected to the Brightlands campuses grid) firms can be located on another science park location where the fit between the start-up's idea and the science park theme is better than on the science park the start-up originally wanted to reside.

The length of accelerations programs is usually four to six months. Incubation programs are mostly shorter and less intensive than acceleration programs and can last a few years. The time span of an incubator seems to be less set in stone also due to the less active support that usually is present in acceleration programs. Therefore some start-ups might need more time than others to grow their business and find investors. The start-up that participated in the interviews expressed that if they participated in an acceleration program, they valued it as a big contribution to the development of their firm. The mature firms that participated in the interviews both stated that they did not experience any direct profits from an incubation or acceleration program. Despite the absence of such a direct profit, they all felt that the presence of such programs stimulated the science park indirectly. It boosts the atmosphere that is present on a campus and it brings more activity towards the science park.

Link start-ups and mature firms

During the interviews with both the science park managers and the science park tenants, both sides were asked whether each listed service and/or facility would contribute to a synergy between start-ups and mature firms. These results have been summarized in Table 5.7. Only services and facilities that are deemed important for the link between start-ups and mature firms by a minimum of three science park managers or by at least one tenant firm have been included in the table. The table indicates that more services and facilities have been deemed an important contribution to the link between start-ups and mature firms by the interviewed science park managers than by the interviewed science park tenants.

It is noteworthy that only network events has been marked as an important contribution towards the link between start-ups and mature firms by the interviewed tenant firms. This is the only listed service or facility that has been deemed a valuable contribution towards this link unanimously by the science park managers. Furthermore it is remarkable that the use of laboratories has been deemed important by a tenant on the High Tech Campus Eindhoven as this was not deemed as an important factor for linking tenants by the science park manager of the High Tech Campus Eindhoven. A side note to this is that the tenant mentioned that these laboratories where mostly a place where they meet with suppliers so the interaction with other firms is rather limited. Another noteworthy observation is that the presence of an auditorium was assessed as a valuable contribution by a science park tenant whereas only two science park managers expected that auditoria would be useful for creating a link between start-ups and mature firms.

Table 5.7 Synergy between start-ups and mature firms according to science park managers and science park tenants

Service/facility		Link according to managers	Link according to tenants
Research & Development	Laboratories	3	1
Work-related facilities	Meeting rooms	3	
	Conference rooms	3	
	Eating facilities	4	
	Auditorium	2	1
Leisure facilities	Sport centers	4	
Services	Networking events	6	3
	Training	3	
	Venture capital access	3	

5.3 Open innovation

In the third and last part of the interviews the acts of firms of open innovation were discussed. Both from the managerial perspective as well as from the perspective from the tenant firms. Science park managers indicated how they tried to stimulate firms to engage in open innovation. Tenants on the other hand described how they get involved in open innovation within and outside science park borders. Like stated during one of the interviews, different types of firms deal differently with innovating. Start-ups have their main focus on realizing their idea. A corporate has different departments all trying to innovate within their subsector within a certain budget.

Interaction firms

Many science park managers indicated during the interviews that the interaction between firms on science parks has a lot of variety. A lot of useful interaction is also done informally. Firms stated that collaborating with other firms on an informal basis works easier and creates a more relaxed atmosphere. During the network events the contact between firms is also primarily informal according to the tenant firms. More formal ways of interaction mostly appear when firms have to settle agreements. Mostly larger sums of money are involved in such cases. Therefore the more formal ways of communication are used in order to prevent severe miscommunication which might cause major losses for a firm. Some science parks also pointed out that their science parks have certain clusters located on their parks. Within these clusters, firms were located with the same specialization within a sector.

"Beside the hardware side of science parks, the software side is also, if not more, vital for keeping up a community in which collaboration is encouraged."

A lot of interaction happens coincidentally, where two individuals share knowledge with each other when they bump into each other. Some science park managers also mentioned that if they wanted to stimulate interaction between firms they brought them in touch with each other. The firms that they would invite to their table would be firms that are expected to have something valuable for each other so they could invest in a mutually profitable relationship. It was also stressed by multiple science parks managers that making companies visible to each other helps in creating interaction among firms.

Three out of the six science park managers explicitly stated that the bigger mature firms can learn from the operating ways of start-ups. Start-ups operate a lot quicker and are therefore able to develop new innovations faster than mature firms. This was also underlined during one of the interviews with a science park tenant. A mature firm can also decide to buy out such a start-up if they become a direct competitor for a mature firm. This has two benefits for the mature firm. Firstly, they lose a competitor in their field. Secondly, they gain an important innovation that strengthens their position in the market.

"Mature firms can learn from how start-ups innovate"

These science park managers noticed that on these science parks the mature firms observe and try to imitate the innovative behavior of such start-ups. Science parks can also steer on this behavior. At the High Tech Campus for instance the acceleration service HighTechXL also runs a program in which mature firms can participate. Instead of trying to find investors for their innovations, participants have to convince their organizational board that their innovation is promising enough for the firm in order to continue financing such a development.

Interactions between firms can also take place virtually. Especially on the Smart Services Campus, the use of IT facilities to keep up a good social network between firms was stressed as important addition of the science park to the innovativeness of firms. In such a network, a lot of data can also be shared easily among firms. With the sharing of data, firms can steer their innovativeness better. The other firms also gave notice that this could be improved on their parks. They felt that the addition of an open network where individuals from firms can stay in contact with each other more easily in order to keep each other updated with new developments.

Despite steering on open innovation, the majority of the science parks stated that a lot of companies are not very keen on sharing their deepest secrets due to fears of losing terrain to their competitors. This is also affected by the way firms had their (new) innovations settled in terms of IP. If the IP is settled very strictly, a firm can share their working ways more easily without the fear of another firm taking off with their breakthrough. One of the tenant firms indicated during the interviews that cultural differences between start-ups and mature firms also play a role in this. People that work for a mature firm are usually older than founding members of a start-up. This generation gap was hinted to be one of the reasons why start-ups are more unwilling on sharing their innovation in depth. Added to that statement was that start-ups should not share everything about their innovation due to the possibility that unforeseen competitors would gain advantage from this.

Cross-pollination

"The coincidental meeting is as important, if not more, as the planned meeting."

Like discussed in the literature, in order to create innovation that is a huge breakthrough, sometimes a sector has to explore options on the other side of their own sectoral borders. These types of open innovation where two sectors come together was labeled cross-pollination in literature. To investigate how the effect of cross-pollination is embraced on science parks, the question whether the effect of cross-pollination takes place was also asked to both science park managers as well as tenant firms. Most science park managers indicated that the creation of cross-pollinations was primarily serendipitous. Science park can attempt to enhance the odds of cross-pollination by organizing network events. These events mostly have a low threshold which makes it easier for firms to step in and share knowledge with firms that are unknown to them. Sometimes companies that do not know one another are brought together by the science park as they deem the companies capable of developing a successful cross-pollination innovation. The tenant firms stated that they did not collaborate with companies from other sectors and these firms therefore did not contribute to any form of cross-pollination.

On the science parks that were connected to the four Brightlands Campuses in Limburg a number of crossovers have been defined. For each crossover one out of the four campuses has a leading role and firms that are operating within such a crossover will most likely be located on the campus that has the leading role in such a crossover.

"An example of cross-pollination is GrowWise which enables vegetables to grow with the use of LED lighting. Here the terrains of lighting and agriculture meet."

Some science parks also gave notice that the creation of spinoffs from bigger firms happens more than occasionally on their respective campuses. The creation of spinoffs can also be a result of an incubation or acceleration program. Mature firms can let researchers participate in such a program if they have an idea that has the potential to be further developed. Instead of convincing investors in order to finance their innovation they will first try to convince the board of directors within their firm. A firm can either decide to not continue with the development, incorporate the development as a production group within the organization or to create a spinoff. If a development is shaped in the form of a spinoff, it can participate in such an incubation or acceleration program. After such a program has been finished, a firm can reevaluate whether they want to spin the firm back in or that the spinoff has to continue on its own. As discussed in paragraph 3.2, a spinoff that is functioning independently from its parent company on multiple levels, will be labelled a spinout instead of a spinoff.

5.4 Conclusion

The results of the interview have addressed the following research questions that were defined in order to answer the main research question:

- Which services and facilities might strengthen the relationship between start-ups and mature firms?
- How can science park managers stimulate the act of open innovation and cross-pollination among start-ups and mature firms?

All science parks in the interview sample either used a single manager structure or a separate venture in order to manage the campus. The informal team structure has not been applied by any of the science park managers that have been interviewed. The interaction between science parks and tenant firms was regularly but not considered often.

The most important services that contribute to the relationship between start-ups and mature firms were, according to the science park managers, laboratories, meeting rooms, conference rooms, eating facilities and sport centers. According to science park managers, networking events, training and venture capital access were the most useful services they could provide in order to stimulate the relationship between start-ups and mature firms.

Science park managers can take multiple measures to stimulate open innovation and cross-pollination. Firms can be brought in touch with each other directly by science park managers, networking events can be organized and managers try to keep firms updated on recent developments regarding the sector they are operating in. Lastly, mature firms can participate in acceleration program in order to improve their innovativeness in comparison with start-ups.

Chapter 6: Conclusions

In the previous chapters the relationship between science park management and their services towards tenant firms, both start-ups and mature firms, has been discussed by the terms of literature and a set of semi-structured interviews. The results from both the literature study and the interviews will be used to formulate an answer to the main research question this thesis is trying to address:

'How does science park management support start-up firms and mature firms with facility management and is it expected to strengthen a relationship between them?'

To answer this research question, the sub questions that have been formulated in chapter 1 will be discussed into more depth, using both the literature study and the interviews as references. Additionally, this thesis will elaborate on the practical implications based on the scientific conclusions. Lastly, the limitations of this research and possibilities for further research regarding this topic will be discussed afterwards.

The sub questions that this research addressed were:

- What different types of science park management can be distinguished and how do they operate?
- What type of services and facilities do science park management teams offer to firms?
- What are the organizational differences between start-ups and mature firms?
- How can science park managers stimulate the act of open innovation and cross-pollination among start-ups and mature firms?
- Which services and facilities might strengthen the relationship between start-ups and mature firms?

The first three sub questions have been answered by the literature review. The last two sub questions could not be answered by the literature review and have therefore been addressed by interviews. During these interviews some light was shed on the first three sub questions.

In the literature three types of science park management were described (Siegel et al., 2003; Westhead & Batstone, 1998). The types that had been described were the informal team, the full time manager and the separate venture that organizes the science park. All of the interview parks had a separate venture that regulated their respective science parks. The size of this venture differed among the science parks. One of the participating science parks had three people employed for the separate venture of which one worked full time. This leans towards a single manager structure. The other parks had somewhere in-between 10-30 employees. The type of science park management in which the park is managed rather informally by a team consisting of representatives from a selection of the firms residing on the science park (Siegel et al., 2003; Westhead & Batstone, 1998) has not been applied by any of the science parks in the sample. The size of management team seems to be unrelated to the size of the science park as some of the bigger science parks (USP and HTCE) had relatively small management teams in comparison to other parks. The size of the science park management seems to be related with the set of activities that a science park management offers. During the interviews it was mentioned that science parks like USP and NTC Nijmegen outsourced some of the services that were offered to tenants to external parties. An advantage of outsourcing is that these external parties offer better services which might be more beneficial for the science park tenants eventually than when the science park management teams offers these services themselves (Kakabadse & Kakabadse, 2002).

The services that were mostly outsourced according to the science park managers were additional business support functions, catering and hospitality functions and cleaning and maintenance. Other activities carried out by the science park management team that were defined by all interview participants were finance & accounting, operational management, community management, marketing & branding and lobbying.

The importance of community building had been stressed by multiple managers so this can be seen as one of the core tasks of science park management. This is also in line with IASP's definition of science parks in 2017. Backing up this statement is the fact that all participants stressed the importance of network events on a science park. This is what differentiates a science park from a regular business site.

The types of services and facilities that science parks offer to their tenants had been defined in the literature study. During the interviews participants were asked whether this list was complete. The science park managers stated that the list of services and facilities covered what their science parks offered to tenants. The tenant firms that participated in the interviews mentioned some additions that they would like to see on the science park. Such additions entailed a workshop, open community platform and more activity on science parks during out-of-office hours. There was no overlap in these suggestions.

Incubators have mostly been seen by literature as important towards start-ups (Cullen & Chandler, 2014; Peters et al., 2004 & Bergek & Norrman, 2008). During the interviews it was mentioned by science park managers that incubation programs are also useful for mature firms. Firstly, they can participate with a development team within an incubation program in order to speed up their processes of innovation. The differences in innovation pace between start-ups and mature firms has already been pointed out by literature (Freeman & Engel, 2007; Katz & Allen, 1982). Secondly, the incubation program attracts promising start-ups which boosts the prestige of a science park and indirectly the prestige of mature firms residing on the science park. Both the qualifications of an entrepreneur and his idea are deemed important as important selection criteria for incubation programs by all science park managers. This is a combination of the perspectives as described by Bergek & Norman (2008). In the views of Bergek & Norrman (2008), incubators either pick all their tenants based on either the idea as leading selection criteria or all tenants are selected based on the entrepreneur behind the idea. According to the interviews both selection criteria were applied simultaneously by incubators and accelerators.

During the interviews a discrepancy between the science park managers and science park tenant firms occurred with regard to the expected link between start-ups and mature firms for the offered services and facilities. Science park managers expected that especially a lot of the work-related facilities (meeting and conference rooms, eating facilities, etc.) would contribute to creating a synergy between start-ups and mature firms. None of the three interviewed firms confirmed this expectation. Additionally, R&D facilities like laboratories were expected to be an open innovation breeding ground for both start-ups and mature firms. This was only partly indicated by one of the participants. This participant indicated that this link between firms in laboratory spaces was primarily a relationship between supplier and consumer. Of all services offered by the science park, only the network events were highly valued by all three tenant firms. In line with keeping up a network, the use of flexible office spaces were mentioned as well during one of the interviews. The concept of activity based working offices has been discussed in literature already and might be worthwhile to invest more in this concept on science parks (Appel-Meulenbroek, Groenen & Janssen, 2011; Blok, Groenesteijn, Schelvis & Vink, 2012).

Thirdly, only three interviews with science park tenants have been conducted which is not representative for all firms that reside on a science park in the Netherlands.

The results from this thesis point out the importance of network events for a science park community. All participants stated its importance for both start-ups and mature firms and the link it creates between them. This is also underlined by science park literature (Junker, 2018; Ng et al., 2017). Both formal and informal events are deemed important by all the participants of the interviews. These informal events can be held in the different types of leisure facilities. Sport centers were mentioned often by the science park managers as a place where interaction between firms can take place. One science park manager highlighted the value of a canteen of a sport center as an important point where coincidental meetings take place. In Table 6.1, the services and facilities that were stated to contribute to the link between start-ups and mature firms by three or more respondents have been summarized.

Table 6.1 Services & facilities that are expected to contribute to the link between start-ups and mature firms

Category	Service/facility
Research & Development	Laboratories
Work-related facilities	Meeting rooms
	Conference rooms
	Eating facilities
	Auditorium
Leisure facilities	Sport centers
Services	Networking events
	Training
	Venture capital access

The concept off cross-pollination was also addressed during the interviews. A few science park managers stated they actively steered on the cross-pollination by attempting to link firms that do not operate in the same sector. The importance of network events was also stressed in the effect of cross-pollination. The science park managers stated that it is important that firms know of each other's existence and activities. This is in line with what Fleming (2004) concluded in his study on cross-pollination which described the essence of understanding each other's working field in order for a successful breakthrough. During the interviews with the science park tenants none of the firms stated that they actively participated in cross-pollination. This is also in line with the findings of Fleming as he concluded that on average, most attempts to cross-pollination do not lead to an innovative breakthrough. Bearing this conclusion of Fleming in mind, the odds are rather low that one of the interviewed tenant firms would have participated in a cross-pollination that could have led to a breakthrough. If more science park tenants had been included in the science park sample, a more rigid conclusion could have been drawn regarding this topic.

The main purpose of this research was to address the question whether science park management supports both start-ups and mature firms and whether it facilitates a link between them. Based on the interviews and the literature study it can be concluded that science park management can assist in creating a link between start-ups and mature firms.

6.1 Discussion

In the past, a lot has been written about the functioning of science parks from different angles. Be it from an ownership point of view (Link & Scott, 2006; Rowe, 2005; van Dinteren & Keeris, 2014) or managerial point of view (Sieget et al. 2003; Westhead & Batstone, 1998 & Den Heijer, 2011). Tenant selection criteria that business parks or incubators use in general that also could be applied on science parks have also been extensively discussed in literature (van Winden & Carvalho, 2015; Link & Link, 2003; Cullen & Chandler, 2014; Peters et al., 2004; Bergek & Norrman, 2008).

Important services and facilities that are offered on science parks have also been described by several literature studies and were also underlined in the interviews (Ng et al., 2017; Siegel et al., 2003; Westhead & Batstone, 1998 & Junker, 2018).

The list of services and facilities as compiled in Table 2.2 was considered complete by both science park managers and science park tenants. The interviews pointed out which of these services and facilities were deemed important for the success of start-ups and mature firms. These insights were gathered from both science park managers and the tenants. As only three interviews with tenant firms have been conducted it is not enough to form a counterweight to the conclusions based on the interviews with the science park managers. Despite that, these interviews form a valuable addition to the interviews with the science park managers as they add new perspectives.

How both start-ups and mature firms share mutual benefits from each other's presence on science parks has been discussed in paragraph 3.3. Whereas the starts-up hope to gain a better reputation and gain more publicity by cooperating with mature firms (Hora et al., 2017), mature firms benefit from the presence of smaller firms as they innovate more quickly than mature firms (Freeman & Engel, 2007). The act of open innovation among firms is also vital in these benefits. If firms share their ideas more easily with each other, it is most likely profitable for both parties. This was also indicated during the interviews. The interviews also pointed out that science parks can actively assist start-ups and mature firms in getting and staying in touch with each other in order to optimize their innovative performance.

The link between start-ups and mature firms can be supported by science park management. Unfortunately, the frequency and intensity of the support science parks offer can be improved. Labeling a site of companies a science park is not going to add much value to residing firms. The prestige of a science park label attracts firms (Westhead & Batstone, 1998) but a bit of prudence is in place as the prestige of a science park label might devalue if science parks cannot live up to what they claim to be. It should be known to firms what the differences and benefits from residing on and off a science park are. Some firms stated that they did not utilize any of the science park facilities. This raises the question on what other aspects of science parks are deemed to add value by firms besides the offered services and facilities.

The discrepancies between the expectations of the science park managers and the experiences of the science park tenants can have various reasons. Firstly, the science park managers might have higher expectations of the informal meetings that are realized within work-related and leisure facilities. Encounters between individuals are mostly informal and not directly work related. Therefore such encounters might not directly lead towards new innovations which are more valuable to the tenant firms but might contribute to a healthy relationship between two firms. Such a healthy relationship might be beneficial for both parties in the future. Another reason that could explain the discrepancies might be the underestimation of the coincidental meetings by tenant firms. Science park managers' core business is optimizing the community that the firms on a science park create together. Tenant firms might be less self-aware of how these links are created and maintained. This was also underlined by one science park manager that stated that setting up a science park community is only one part of the job, keeping up the network and keeping the firms in touch with each other is the second part of the job.

The mentioned importance sporting centers over sporting grounds can be explained by sporting centers having more added value to a science park than sporting grounds. This is partly due to the large surfaces sporting grounds usually require and therefore cannot be placed on a central location.

Smaller sport centers can be located more centrally on a science park and thus be more useful in stimulating the coincidental meetings between individuals on science parks.

The interviews also shed some light on the difficulties firms face with respect to open innovation and intellectual property (IP). Firms tend to be reluctant on sharing their IP due to possibly losing their position in the market. This is rather logical except this can slow down or even exclude the processes of open innovation and cross-pollination. Science park management teams should find ways in order to encourage collaboration between firms while securing the IP of the firms that are trying to get engaged in open innovation or cross-pollination. An interesting concept might be that firms share their innovations more thoroughly with the science park management, which enables them to act better as a linking mediator between firms. This would require a deeper understanding from science park managers in order to see potential uses for open innovation or cross-pollination (Fleming, 2004) and the risks of losing IP should be terminated by anchoring the risks legally to the science park management.

6.2 Practical implications

This study has focused on how science park management teams operate and therefore has valuable insights for science park managers and science park tenants. The insights are also valuable for parties involved in the development of a science park.

During the interviews, the value of the science park community has been mentioned often by both science park managers and science park tenants. A valuable lesson for science park managers therefore is to put in much effort in creating and also sustaining this community. A science park community entails a set of different things. The most frequently mentioned service that contributes to a science park community is events. These can be organized by both the science park management teams themselves as well as (mature) firms. In the earlier phase of a science park, it is more likely that a science park management team takes initiative in this and then later on plays a more supportive role in organizing events when the mature firms pick up on organizing events in their respective fields.

Despite organizing events is a vital part of science park communities, science park managers can do more in order to create and sustain a science park community. Non-work related facilities like sporting facilities or shops and restaurants are places where the spontaneous meeting between individuals of different firms can be realized. Adding those facilities to a science park and making them attract individuals on a science park will cater the science park community. These coincidental meetings were deemed as vital for open innovation as the planned meeting between firms by science park managers. It is therefore useful to carefully design these non-work related facilities. Such places should preferably be centrally located and easily visible. A good accessibility also adds to frequent use of such facilities.

For tenant firms that are considering to reside on a science park, this study has granted insights in which services and facilities that are offered on science park are possibly increasing their interaction with other firms. Firms can use this knowledge when they are making their location choices as not all science parks might offer such services or facilities.

6.3 Limitations and further research

This study addressed its main research aim of determining the added value of science park management to both start-ups and mature firms by applying a qualitative research approach. Due to this qualitative research approach, the study has an explorative nature.

The explorative nature of this study is in place as there has not been written much yet about this topic within science park literature. As this study uses qualitative data, the conclusions drawn are less solid than the conclusions that could be drawn in a quantitative study or with a larger interview sample.

During approaching participants for the interviews, it turned out that mostly finding tenant firms that were willing to participate in an interview was difficult. In general, most of the science park managers that were approached for an interview were willing to participate. These differences in levels of willingness to participate to this research can be explained by various reasons. Firstly, this research might be more interesting for science park managers as it is closer to their core business and might therefore have added value to their daily activities. The benefits of this research for a science park tenant are more indirect. The results from this research cannot be directly applied by the science park tenants, the science parks they are settled on or are considering settling on can use these results and create a better environment for both mature firms as well as start-ups. A number of science park tenants that had been approached for an interview also stated that their use of the services and facilities that a science park had to offer were minimal to non-existent. Therefore conducting interviews with such firms would not lead to useful insights with regard to which services and facilities are contributing to the relationship between start-ups and mature firms.

For future studies it might be interesting to define the synergy between start-ups and mature firms in a more quantitative matter in order to define the value of the synergetic relation more thoroughly. This study has created a broader basis for the statement that science parks stimulate the synergy between start-ups and mature firms. Van Winden & Carvalho (2015) hinted towards this relation earlier, the interviews conducted for this study confirmed this expectation although a quantitative study would be able to back up this statement more securely.

Future research could also move the scope from investigating the link between start-ups and larger mature firms, to start-ups and SMEs. Van de Vrande et al. (2009) discussed earlier that that SMEs innovate differently than start-ups and larger mature firms. This was stated by a science park manager that explained SMEs had different needs on science parks than corporate firms and start-ups. Therefore it might be interesting for further research to explore how science park management facilitate the possible link between start-ups and SMEs.

Setting up a benchmark among science parks would be useful in order to measure the performance of science parks. This would help science park in keeping up the level of prestige that is associated with science parks and for tenant firms it is useful as it grants them measure the usefulness of a science park concept. This benchmark could include the services and facilities a science park is offering to its tenant and the levels of open innovation that the firms onsite achieve. Finding the right key performance indicators to benchmark a science park community on a campus is a challenge and would nonetheless require a deeper exploration of the subject before it could be quantified in numbers.

Regarding the levels of open innovation it would also be interesting to investigate how the public spaces on a science park can be optimally designed in order to create more coincidental interactions between the members of a science park community. Such a study does not fit within the scope of this study but would nonetheless be useful for especially beginning science parks in order to set-up new science parks in a more effective way. For existing science parks this can also be useful as transforming their parks might boost the overall attractiveness of these parks. This will require a large investment in order to change the existing infrastructure on the science park.

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Appendices

Appendix A: Factsheet science parks in the Netherlands

# Volwassen	Phase	Sector	Region	Employment	Employment companies	Knowledge manifest	Focus on R&D	University / business
1 Kennispark Twente – Enschede	Adult	Technological	Overijssel	9029	6087	Yes	Yes	University
2 Wageningen UR Campus – Wageningen	Adult	Agricutural	Gelderland	7425	2600	Yes	Yes	University
3 Utrecht Science Park – Utrecht	Adult	Medical	Utrecht	26169	2088	Yes	Yes	University
4 Amsterdam Science Park – Amsterdam	Adult	Technological	Noord-Holland	4080	1340	Yes	Yes	University
5 Leiden Bio Science Park - Leiden	Adult	Medical	Zuid-Holland	18010	7500	Yes	Yes	University
6 Science Park Technopolis – Delft	Adult	Technological	Zuid-Holland	11260	2610	Yes	Yes	University
7 High Tech Campus Eindhoven – Eindhoven	Adult	Technological	Noord-Brabant	11500	11500	Yes	Yes	Business
8 Brightlands Chemelot – Sittard–Geleen	Adult	Chemical	Limburg	1888	1787	Yes	Yes	Business
9 TU/e Science Park – Eindhoven	Adult	Technological	Noord-Brabant	5219	1980	Yes	Yes	University
10 Campus Groningen - Groningen	Adult	Life sciences	Groningen	21227	3234	Yes	Yes	University
11 Wetsus/ Watercampus – Leeuwarden	Growth	Water technology	Friesland	486	260	Yes	Yes	University
12 Mercator Science Park - Nijmegen	Growth	Medical	Gelderland	13274	10000	Yes	Yes	University
13 Novio Tech Campus – Nijmegen	Growth	Technological	Gelderland	1511	1511	Yes	Yes	Business
14 Space Business Park – Noordwijk	Growth	Space technology	Zuid-Holland	3600	900	Yes	Yes	Business
15 Pivot Park – Oss	Growth	Medical	Noord-Brabant	550	550	Yes	Yes	Business
16 High Tech Automotive Campus – Helmond	Growth	Car technology	Noord-Brabant	803	637	Yes	Yes	University
17 Maastricht Health Campus – Maastricht	Growth	Medical	Limburg	9174	1568	Yes	Yes	University
18 Dairy Campus – Leeuwarden	Starting	Food	Friesland	75	30	Yes	Yes	University
19 High Tech Systems Park - Hengelo	Starting	Technological	Overijssel	75	1700			Business
20 Polymer Science Park – Zwolle	Starting	Chemical	Overijssel	225	210	Yes	Yes	Business
21 Technology Base Twente - Enschede	Starting	Technological	Overijssel	81	81			Business
22 VU Campus - Amsterdam	Starting		Noord-Holland	13038	225			University
23 Biotech Campus – Delft	Starting	Technological	Zuid-Holland	700	700	Yes	Yes	Business
24 Greenport Horti Campus - Bleiswijk	Starting	Agricutural	Zuid-Holland	115	35	Yes		Business
25 Brainport Industries Campus - Eindhoven	Starting	Technological	Noord-Brabant	-	-			Business
26 Gate2 Aeroparc - Gilze-Rijen	Starting	Technological	Noord-Brabant	42	42			Business
27 Green Chemistry Campus – Bergen op Zoom	Starting	Chemical	Noord-Brabant	60	60	Partly	Yes	Business
28 Food & Health Campus - Den Bosch	Starting	Food	Noord-Brabant	1420	250	Yes	Yes	University
29 Brightland Smart Services Campus - Heerlen	Starting	Technological	Limburg	335	300			Business

Appendix B1 Topic list interviews Science parks managements

This is the interview guide that will be used for the interviews with the science park managers. The opening and ending of the interview are also stated.

Questions

Introduction

- Introduce interviewer
- Introduce research
    - Background
    - Goal
    - Implications
- Ask if recording is allowed

Management styles

- How is the management of the science park structured?
    - Team basis
    - Single manager
    - Separate venture
- How is the workload divided among a management?
    - Branding/marketing
    - Acquisition[
    - Events
    - Maintenance
- Is the science park operated on a stand-alone basis or is it tied with government, university and a company? (triple helix)
- How is the science park ownership settled?
    - One party
    - Divided among companies
    - Separate venture

Services & facilities

- Which of the facilities and services listed below are offered to either start-ups, mature firms or both on your science park?
- Are there any services and facilities that are not listed?
- What facilities and services do you think contribute to collaborations between start-ups and mature firms?
- Do you offer an incubator program?
    - If so, what additional services and facilities are offered in such a program
        - Lower rent first year
        - Assistance on business level
        - Shared offices
        - Other points, need explanation
    - Which selection criteria are used to accept or deny firms in the program?
        - Survival of the fittest approach
        - Entrepreneur focused/idea focused
        - Picking the winners approach

        - Etc.
    - What time span do firms stay in the incubation program?
        - Fixed time span of exiting incubator program
        - Evaluated annually
    - What goals are set for the participating start-ups in order to exit the incubation program?
        - What are the consequences of not meeting these goals?
        - What is expected from participating start-ups in terms of growth?
    - What are the benefits for the science park itself of offering an incubator program?

Service/facility		Start-ups	Mature firms	Link
Research & Development	Clean rooms			
	Laboratories			
	Pilot rooms			
	Other			
	Equipment			
Work-related facilities	Meeting rooms			
	Conference rooms			
	Eating facilities			
	Library			
	Auditorium			
	Exhibition rooms			
Leisure facilities	Sport centers			
	Sporting grounds			
	Hotel			
	Cinema			
Secondary facilities	Shops (Food)			
	Child Care			
	Medical			
	Banking			
	Residential housing			
	Shops (non-food)			
	Travel agency			
Services	Networking events			
	Training			
	Consultancy			
	Venture capital access			
	Information access			
	Management support			
	Administrative			

	Marketing	
	Accounting	
	Graphical design	
	Cleaning and maintenance	
	Safety and security	

Open innovation

- How do start-ups & mature firms support each other on science parks and how can a science park contribute to this relationship?
    - Shared facilities
    - Events
    - Physical proximity
- What kind of interaction happens?
    - Knowledge sharing
    - Equipment & trade related ties
    - Informal interaction/social events
    - Other forms of interaction

Final question

Which matters that you deem important with regard to optimizing both start-up as mature firm performance that have not been mentioned during the interview?

Closing

- Send report
- Expected due date
- Thank you

Appendix B2 Topic list interviews Science parks tenants

This is the interview guide that will be used for the interviews with the tenants resided on science parks. The opening and ending of the interview are also stated.

Questions

Introduction

- Introduce interviewer
- Introduce research
    - Background
    - Goal
    - Implications
- Ask if recording is allowed

Services & facilities

- Which of the facilities and services listed below does your firm use on the science park site?
- Which of the offered services and facilities are deemed the most useful and why?
- Are there any services and facilities that are not on the list that are valued by your company?
- Are there any services and/or facilities that you would like to have on the science park but are not being offered right now or are being offered insufficiently?
- Has the incubator program been useful for your company? (Start-ups only)
    - Did it increase the chances of survival for your business?
    - Did it speed up the success the company had in terms of financial gains and company growth in terms of employees?
- Has your company profited from the presence of an incubator program? (Mature firms)
    - Getting in touch with start-ups
    - Improvement overall image science park location

Services/facilities		Use (yes/no)	Link to other parties
Research & Development	Clean rooms		
	Laboratories		
	Pilot rooms		
	Other		
	Equipment		
Work-related facilities	Meeting rooms		
	Conference rooms		
	Eating facilities		
	Library		
	Auditorium		
	Exhibition rooms		

Leisure facilities	Sport centers	
	Sporting grounds	
	Hotel	
	Cinema	
Secondary facilities	Shops (Food)	
	Child Care	
	Medical	
	Banking	
	Residential housing	
	Shops (non-food)	
	Travel agency	
Services	Networking events	
	Training	
	Consultancy	
	Venture capital access	
	Information access	
	Management support	
	Administrative	
	Marketing	
	Accounting	
	Graphical design	
	Cleaning and maintenance	
	Safety and security	

Open innovation

- Which companies does your company keep up ties with? (examples)
  - Start-ups
  - Mature firms
  - Name?
- How often do you meet these other firms?
  - Multiple times a week?
  - Once a month
  - Few times a year
- What ties do you have with other firms?
  - Only formal
  - Contractual
  - Knowledge sharing
  - Informal
- Where are these ties maintained?
  - At the office
  - Shared facilities
  - Different locations
- How does your firm engage in innovation?
  - On campus or off campus?

    - Selling or buying ideas?
    - Revealing or receiving?
    - Dependent on innovation partner?
        - Startup
        - Mature firm
    - Back and forth relationship with the same partners?
- Does your firm maintain ties with firms on the science park that operate in the same sector or in different sectors?
    - Same sector only
    - Mixture
    - If both are maintained, are they valued equally important?
    - Do both type of ties result in useful breakthroughs for the company?
    - Differences for collaborating with startup or mature firms?
- On what level of the organization does collaboration take place?
    - Management/CEO level
    - Research/laboratory level
    - Informal meetings at shared facilities
- (if startup) Did the initiation of this start-up start at a bigger firm?
- If so, what type of bonds are maintained with the bigger firm?
    - Financial
    - Formal
    - Informal
    - None

Management styles

- What is your relationship with the science park management?
    - How often do you meet?
    - What is being discussed with the management?
    - Is this meeting formal or informal?

Final question

Which matters that you deem important with regard to optimizing both start-up as mature firm performance that have not been mentioned during the interview?

Closing

- Send report
- Expected due date
- Thank you

Appendix C: Interview summaries science park managers

Respondent	1. Management structure	2. Operational structure	Operational structure (continued)
HTC	One venture that is responsible for: - General manager - Finance & accounting - Operations (services for tenants) - ICT - Marketing & communication - Business development	Services like catering, cleaning, maintenance, security etc. are outsourced. HTC b.v. primarily focusses on business support services.	Connections with the university is mainly informal through individuals. The TU/e is the main supplier of employees on the HTC. Formal ties are even prohibited by municipal laws in order to prevent decentralization of TU/e.
USP	One venture (10 employees) that is responsible for: - Marketing & branding - Business development (stressed as most important) - Account manager - Community manager - Hospitality manager - Lobby function	USP management is founded by 5 parties: HEI Utrecht, University of Utrecht, UMC Hospital, municipality of Utrecht & province of Utrecht. USP is non-profit and has a director that reports to a board consisting of representatives of the HEI, UU and UMC.	
NTC	Staff: - One director that works full-time - Office manager (part-time) - Communication manager (part-time) Functions: - Management and maintenance of the campus - Acquisition & marketing - Business support & development	A lot of support functions are outsourced but also resided on campus. ScienceMeetsBusiness offers business support for PHD students that are trying to set up a business, HealthValley organizes a lot of events in health care and life science. Campus management is coordinating campus activities with these external firms.	
MHC	Organization of 32 employees - CEO + COO - Management team - Employees per team	- Marketing - Community development - Finance	Brightlands is a brand, created by the province of Limburg. It is an attempt to keep higher-educated people in the region and provide jobs for them. Limburg has 4 Brightlands campuses with each its own specialism. Each campus is its own entity with a separate venture but the cooperation between the management teams and firms from the different sites is good.
BSSC	- COO - Finance - Marketing - Facility management - Program development - Start-up assistance - Sales - Community management	Tenants can be involved in 4 ways on-site: - Normal resident: office space + use of services - Flat resident: only rents office space, useful for firms to try if the BSSC fits for them. - Full resident: office space + use of services + participating in co-creation projects - User: use of services but not renting office space - Contract per working space: events + services included	Services provided by BSSC: - Data services that grants access to (a part of the) data of larger companies - Collaboration services that keeps people in touch after a network event (e.g. DJIVE platform) - Collective coding service - Innovation booster, gathering of metadata that can be used by firms in order to determine the course of their future innovation plans.
DCL	Operationally we organize all facilities that DCL offers and community-wise trying to attract corporate and educational activities. 20 employees from DCL management and 30 people from WUR, researchers and lecturers are on DCL daily.	Initiative from Wageningen UR, other EI's present on site. Close ties to the national Dutch Dairy Centre which unites dairy farmers all over the NLs. Regional farmhouse which resides research opportunities for EI's and companies	The municipality of Leeuwarden & province of Friesland are also funded the foundation of the DCL, in return a lot of activity is generated in the region.

Respondent	3. Ownership	4. Incubation programs	5. Selection criteria incubator
HTC	Full ownership in own venture. Therefore the vision of the HTC can be guarded with more precision.	HTC cooperates with HighTechXL to accelerate promising start-ups. HTC delivers the accommodation and provides a fund to accelerate start-ups. This is not a direct fund for start-ups. These have to gather their own funds, preferably within the HighTechXL network.	- Fit in with the HTC concept (high-tech/hardware related) - Be close to market penetration
USP	- 90% by UU - 9% by UMC - 1% by municipality of Utrecht (infrastructure) The division of ownership leads to some challenges when the USP tries to guard its concept as many parties are involved, therefore we are formulating a vision for the upcoming 10 years	The USP has 2 places where start-ups can settle themselves in. UtrechtInc is fully fledged incubator service. All start-ups are accepted, those close to market penetration as well as wandering researchers that need to develop a business. The other one only provides spaces where start-up can locate themselves.	UtrechtInc used to be quite wide sectorially speaking but focusses more on life sciences which fits better in the scope of the USP as well.
NTC	The ownership of the campus grounds is 100% of NTC BV. Parties like Kadans and EPR lease the spaces on the campus. This way NTC BV has control on which companies settle on the site and whether they fit in the concept. All shares of NTC BV are in hands of the foundation NTC which is founded by the Ontwikkelings Maatschappij Oost NL (Development Company Eastern NL).	Briskr Academy is built up from concepts that also are present in incubating services. Furthermore, Rockstart has settled on the NTC, which runs accelerator programs in the digital health sector.	Operating in the digital health sector is vital of course. Rockstart tries to attract potential start-ups all over the world. After a selection procedure, 10 start-ups that will participate remain. Most of these start-ups are relatively close to market penetration as developing a good idea into an invest-worthy concept takes usually longer than 6 months. Participating firms must therefore already have a cash flow.
MHC	The entire area is owned by the academic hospital, university, municipality of Maastricht and the province of Limburg. The university and province of Limburg are 2 of the 3 shareholders (this applies to all Brightlands campuses) and the 3rd shareholder of the MHC is the academic hospital. There is a combined vision from all these parties that is guarded by the campus BV.	Incubating services for different types of companies are offered on MHC. Scale-ups that are already on the market are located here as well as smaller and bigger start-ups. Where start-ups reside on the campus depends on their budget and due to that also their proximity to market penetration.	Both the entrepreneur as well as the idea are taken into consideration. The idea has to fit in the cardiovascular theme that MHC has in its veins. Most entrepreneurs that participate are more rooted as a researcher than in the business aspect of a start-up. This is where we can assist them.
BSSC	The province of Limburg, the university of Maastricht and APG (Algemene Pensioen Groep) all have shares in a foundation that owns the campus. These three parties + the southern HEI also contribute financially to the foundation. The foundation is non-profit and therefore has to operate with a closed budget.	BIF runs both incubation and acceleration programs. The program did not fit the needs of the firms on BSSC. Program adjusted to BSSC offers, workspace, 7.500 starting capital, 8 weeks of business development courses, monthly feedback session, additional lectures and consults and lastly assistance in finding investors.	As start-ups are mostly in the beginning of their life-phase, participants of the program are checked on whether their idea is unique and has a solid ground to build a firm on. We also check the team revolved around such a firm, there needs to be a certain level of commitment in order to make it work.
DCL	Juridically, the WUR has full ownership. On site, the Dairy Campus is the intermediator. The ownership of the WUR is therefore not too visible on-site.	DCL does not offer an incubation service. For the future it might be interesting to gather start-ups on the DCL but this is not set as a main priority by the WUR, a project developer or the municipality could pick the lead in this.	Operating in dairy sector, transparent and open for co-creation.

Respondent	6. Exit criteria incubator	7. Benefits program	8. Interaction firms on-site
HTC	The duration is 7 months. The striving is that start-ups have found investors within this timeframe. For those that have not found an investor it will be evaluated if it is useful to continue with the program. Start-ups that have found an investor might leave the HTC depending on the demands of the VC.		The collaboration differs between mature firms and start-ups. Mature firms try to be successful by working successfully together within company boundaries. For start-ups the key to success can be found anywhere outside their own company boundaries
USP	Most programs offered by UtrechtInc are 4-6 months. The criteria differ on which kind of program is chosen as UtrechtInc facilitates programs for entrepreneurs as well as researchers who both have a different starting point.	For the HEIs it is useful as more of their research can be valorized. For bigger firms the benefit of such an incubation program lies in the different ways of innovating that are used at start-ups whereas bigger firms tend to be slower in this. Bigger firms organize events in order to get in touch with the start-ups better.	USP has a number of clusters which all have their own specialism. Companies within the same cluster are collaborating more intensively than companies located at other ends of the USP. We are striving to generate more activity outside office hours. This is mainly done by the hospitality sector.
NTC	The program Rockstart runs on our campus has a length of 6 months. After this period, a company will have to be able to stand on its own feet. We can help them when they have questions or face difficulties but the responsibilities remain in the hands of the entrepreneur.		Many relations between companies on the campus are between suppliers and client. It is debatable whether that is a normal work-relation or a way of open innovation. We also organize all kind of social events where engineers can share what they are working on without giving away all details.
MHC	The end of the incubation program is when the start-up can survive on its own with the use of acquired investments. Some companies find investments easier than others. These will get a bit more time. This is why we do a check on start-ups and their ideas by specialist who are rooted in the field of the start-ups. This also provides a quick link for the start-ups if they reside on the MHC.	Larger companies can also attend the workshops and trainings that are given to start-ups. This way they will be up-to-date with regard to all developments within their fields and laws. It also helps in community building.	Knowledge sharing, collaborating, using each other's facilities are the most common ways of direct interaction on site. This can be done both formally as well as informally.
BSSC	The length of the program is 2 years, after this time span, it is expected that the participant has a working product, a potential client, ready for scaling up production.	Individuals within a mature firm can also participate in the program if they have a good idea for spinning out. Furthermore there are mostly soft benefits for mature firms. It shows them that innovation is also created outside company borders and the enthusiasm of start-ups has an effect on mature firms as well. Start-ups can learn much from the expertise that mature firms possess. Although they can only offer a stake in the firm to these mature firms, they mostly enjoy helping them.	BSSC offers a different set of floors within its office building. It offers 2 community floors with flexible working spaces. Here the frequency of contact among individuals of different firms is high.
DCL		-	Firms mostly use the data that is gathered in farmhouses, be it on their own demand or from other initiatives. As they pay the DCL for carrying this out, this forms the largest part of their revenues alongside with the milk that is produced on the DCL.

Respondent	9. Cross-pollination	10. Stimulation collaboration firms onsite	11. Other important factors regarding optimizing services science parks
HTC	The realization of crossovers is luck based. Sometimes firms are facing challenges in which they have to collaborate with other types of firms. An example of this is GrowWise which enables vegetables to grow with the use of LED lighting. Here the terrains of lighting and agriculture meet.	Social events, both formal and informal, are the main source of interaction for firms. This is where we can steer on interaction between firms on site and off site.	Mature firms can learn from how start-ups innovate. Therefore HighTechXL runs innovation projects within these mature firms (Philips, KPN, etc.). These projects will be pitched in front of a board of directors. They will decide to let go off a project, to spin it out for a while or to carry on with an innovation project.
USP	This is something we as USP and mainly our Business development can steer on. A nice example is the creation of a 3D-printed skull which was used to save a woman's life who suffered from a skull that got thicker. Our Business development team connected two parties which together realized such a solution. They do not know the exact matter but know enough to connect them to each other.	We organize events both formal and informal. Currently we see that more and more firms also take over organizing events. Furthermore we try to stimulate spontaneous meetings on the USP by attracting them to go to the center of the USP where a lot of shared facilities are located. We also offer campus bikes in order to further stimulate this.	It is also important to look at how other parks operate. That is why we are connected to the IASP and we also are trying to set up collaboration bonds with Toronto and Hong Kong in order to share knowledge so both parties can experience more growth. Hong Kong for instance tries to penetrate the European market, this is something we can assist them in.
NTC	At these events new links can also be created if a firm sees something they hear or see something they find interesting. Purely coincidental links do not happen often as large sums of money are mostly involved. Therefore collaborations between firms have to be thought thoroughly. Especially when companies have to share costs and IP.	It is noticeable that if companies are more in sight on the campus, they are more involved in activities with other companies on the campus than when they are located on the edge or just outside the campus borders. Also if this is drawn a bit broader to the city of Nijmegen, the exact location of your business really matters if you want to hop on a certain network.	Mature firms are very focused in how they operate. Especially chip production firms are very cost driven which is noticeable in the entire organization. Keeping in touch with them within the network and keeping up relationships is mostly done in informal settings.
MHC	We can steer on that by informing everyone what is happening. Both on this campus as well as on the other Brightlands campuses. If firms know of each other's existence, interaction is more likely.	Network events, workshops, programs in which firms can participate and simply inviting two firms at the table that we think could create a mutually beneficial relationship.	It is important to create a culture on a campus in which everyone feels equal. Otherwise start-ups might feel overwhelmed by the larger companies and be less likely to try to get in touch with the bigger firms. In the end, also the bigger firms can learn from the smaller ones.
BSSC	Within the 4 Brightlands campuses a number of crossovers has been defined. In each crossover 1 of the 4 parks has a leading role. The other campuses are settled in a following role. BSSC for instance has the leading role in Digitalization. A good example is the digital dermatologist. That was predominantly IT (80% it and 20% medical) therefore that firm resided on the BSSC instead of the MHC.	- Invite firms that could serve each other well to a table - Create a community and sustain that community by facilitating in letting firms keep in touch with each other.	The importance of co-creation on campus is very important for a science park to label themselves as science park. Firms are rarely initiating co-creation, as a science park we should try to trigger that among firms.
DCL	Partly coincidental, partly based on policy. Management tries to link parties that might benefit from each other.	It is important that firms are up to date with regard to each other's activities. As a management we can highlight this so firms know of each other's existence and ideas.	Besides the hardware side of science parks, the software side is also, if not more, vital for keeping up a community in which collaboration is encouraged.

Appendix D: Interview summaries science park tenants

Respondent	Start-up /mature	Job description	1. Reason to reside on science park	2. Missing S&F	3. Incubator program
ABB - HTC	Mature firm	Responsible for global standardization	Prestige, inspiring working environment, many people that feel the same about innovating. Additionally the facilities for individuals are also neat.	During the out of office hours, the HTC is a bit deserted. The HTC could setup facilities that individuals could use for their non-work related activities after work so more activity is generated during out of-office-hours. On the TU/e Campus for instance with another start-up I participated in it was much more likely to stay longer on the site, this is also due to the workflow of the students there.	No direct profit from such a program. The developments that take place in such programs are interesting to follow. It is important to create a certain atmosphere among the participants in such a program.
Usono - HTC	Start-up	CEO	The HTXL program helped us a lot with setting up a network. We also sustain good ties with the NTC but here we have a close connection with the Catherina Hospital, Maxima Medisch and Philips.	I am missing spaces where start-ups could reside relatively cheap but where they are encouraged to interact more with each other. And the availability of a workshop is also missing here.	The HTXL program did not offer any facilities, only spaces that could serve as meeting rooms and a work place. The HTXL program offered a training which took 4 months and has different themes each week (HR, Business model canvas, financial modeling etc.)
Nexperia - NTC	Mature firm	Head of communication and branding	Nexperia is a spinout from NXP. As NXP resided at the High Tech Campus at that time, Nexperia was looking for another location that was focusing on high-tech and therefore decided to settle on the NTC.	An open platform where interaction between firms can take place more easily and freely in order to share knowledge and ideas.	Nexperia does not profit directly from such programs but it increases the overall attraction of the NTC and the region of Nijmegen which also boosts the levels of activity on the spot.

Respondent	4. Open innovation	5. Cross-pollination	6. Interaction with other firms
ABB - HTC	ABB thinks of innovation on the long term. We want to remain leading in the global market. Therefore we need to watch the market and our competitors. Next to that we are also really dependent on the innovations within cars themselves. The advantage of a larger firm is the fact that we can tackle a problem over multiple disciplines. On the other hand are start-ups quicker on finding solutions on more specific problems. ABB could buy out such start-ups, then it loses one competitor and gains an important development. For such investments we have a venture capital department.		Direct customers (suppliers charge services) and with car producers (except Tesla they have their own product). Most interaction is informal as that works easier, but sometimes it is very formal especially when contracts or certificates have to be set up.
Usono - HTC	Engaging in the act of open innovation entails co-creation with the end-user mostly. We try to keep up with other trends as well but this is not within our focus. We do not notice the direct influence of start-ups on mature firms here but HTXL offers an acceleration program for bigger firms as well. This enables them to speed up their innovation processes.		We developed our innovation through the feedback of doctors at six different hospitals. This was an iterative process, after each feedback session we redesigned our product and returned to the hospitals 5 weeks later to receive new feedback. This process happened for a while until we were satisfied with our product.
Nexperia - NTC	It does not happen on the campus right now but it is something we try to realize with others on the campus in the future. There is a lot of knowledge present on-site and if knowledge is shared more here it can have a lot of potential. Involving students and teachers from the university could also be part of this.	We only operate with firms that are active in our sector, we do not experiment with firm that are not within our sectorial boundaries.	With NXP for instance we have a business relation which is rather formal at management level at times. This does not involve the NTC. Most contact with other firms (including start-ups) is mostly informal on the networking events that are organized here. Those events are mostly much specified towards one topic and therefore not interesting for everyone on the NTC.

Respondent	7. Relationship with management	8. Other aspects
ABB - HTC	Contact on regular basis, mainly to stay updated on new developments on the campus and its residents.	The HTC should consider facilities regarding prototyping. This can be useful for start-ups to scale up their production processes from creating one product to mass production. The focus here lays primarily on R&D. The HTC could collaborate more with the Strijp-T area which focuses on scaling up the production process.
Usono - HTC	Contact with management is minimal. They are also present at informal drinks. Sometimes they are shooting some videos in order to show outsiders the presence of start-ups on the HTC.	
Nexperia - NTC	Regular contact with the science park management. General things are being discussed like signposts, green management etc. Those meetings are semi-formal.	There is a generation gap between start-ups and mature firms. People that are employed for a major firm over 30 years are expressing other corporate culture than young people that just created a start-up. As a start-up you cannot share all of your ideas as you do not know all your competitors.

Appendix E: Summary services & facilities on science parks

Each of the science park managers indicated whether each service or facility was present on their science park. Legenda shown underneath the table.

Service/facility		Start-ups	Mature firms	Link
Research & Development	Clean rooms	H,U,N,M	U,M	M
	Laboratories	H,U,N,M,S,L	U,M,S,L	U,M,S
	Pilot rooms	H,L		
	Other	H,U,N,M	U,M	U
	Equipment	H,U,M,L	U,M,L	U
Work-related facilities	Meeting rooms	H,U,N,M,S,L	H,U,N,M,S,L	N,M,S
	Conference rooms	H,U,N,M,S,L	H,U,N,M,S,L	N,M,S
	Eating facilities	H,U,N,M,S,L	H,U,N,M,S,L	U,N,M,S
	Library	H,U,M,S,L	H,U,M,SL	U,S
	Auditorium	H,N,M,S,L	H,N,M,S,L	N,S
	Exhibition rooms	H,M,L	H,M,L	
Leisure facilities	Sport centers	H,U,N,M,S	H,U,N,M,S	U,N,M,S
	Sporting grounds	H,U,M	H,U,M	U
	Hotel	M	M	
	Cinema	H,M	H,M	
Secondary facilities	Shops (Food)	H,U,N,M	H,U,N,M	U
	Child Care	H,U,M	H,U,M	U
	Medical	H,U,M	H,U,M	
	Banking	H	H	
	Residential housing	M	M	
	Shops (non-food)	H,U,M	H,U,M	U
	Travel agency	H	H	
Services	Networking events	H,U,N,M,S,L	H,U,N,M,S,L	H,U,N,M,S,L
	Training	H,U,N,M,S,L	H,U,N,M,S	H,U,N
	Consultancy	H,U,N,M,S,L	H,U,M	U,N
	Venture capital access	H,U,N,M,S	H,U,N,M	H,U,N
	Information access	H,U,M,S	U,M,S	U
	Management support	H,N,M		
	Administrative	H,N,M		
	Marketing	H,N,M,L	M	
	Accounting	H,U,M,L	U	U
	Graphical design	H,M,L	M	
	Cleaning and maintenance	H,U,N,M,S,L	H,U,M,S	N
	Safety and security	H,U,M,S	H,U,M,S	H

1) HighTechCampus Eindhoven = H
2) Utrecht Science Park = U
3) NovioTechCampus Nijmegen = N
4) Brightlands Health Campus Maastricht = M
5) Brightlands Smart Services Campus = S
6) Dairy Campus Leeuwarden = L

Appendix F: Summary of service and facility usage tenant firms

Each of the science park tenant indicated whether they used each service or facility that was present on the science park they were residing on and whether they experienced that the facility or service contributed to the link of the firm to other parties. Legenda shown underneath the table.

Services/facilities		Use (yes/no)	Link to other parties
Research & Development	Clean rooms		
	Laboratories	HA	HA (suppliers only)
	Pilot rooms		
	Other		
	Equipment	HA	
Work-related facilities	Meeting rooms	HU	
	Conference rooms	HU	
	Eating facilities	HA	
	Library		
	Auditorium	HU	HU
	Exhibition rooms		
Leisure facilities	Sport centers		
	Sporting grounds	NN	
	Hotel		
	Cinema		
Secondary facilities	Shops (Food)	HA, HU	
	Child Care	HA, HU	
	Medical	HA, HU	
	Banking	HA, HU	
	Residential housing		
	Shops (non-food)	HA, HU	
	Travel agency		
Services	Networking events	HA, HU, NN	HA, HU, NN
	Training		
	Consultancy		
	Venture capital access		
	Information access	HA	
	Management support		
	Administrative		
	Marketing		
	Accounting		
	Graphical design		
	Cleaning and maintenance	HA, HU	
	Safety and security	HA	

HA = ABB on High Tech Campus Eindhoven
HU = Usono on High Tech Campus Eindhoven
NN = Nexperia on Novio Tech Campus Nijmegen