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Building for success

The cases of Dutch excelling innovation campuses and constructing the 'High Tech Systems Park' for success

Master Thesis

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Submitted to
University of Twente
Dr. N.J. Pulles
Dr. ir. S.J.A. Löwik

Technische Universität Berlin
Dr. A. Lorenz

Wout Oude Alink (s1011111)
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Supervisors: University of Twente
Dr. N.J. Pulles
Dr. ir. S.J.A. Löwik

Technische Universität Berlin
Dr. A. Lorenz

Date: 17-05-2016
Student name: Wout Oude Alink
Student number: s1011111

Management summary

Scholars increasingly acknowledge that innovative development has to be understood in a context outside the boundaries of a single company, namely that of an innovation network and the different forms it comes in (Ritter and Gemünden, 2002; Vanhaverbeke, 2006). Companies continuously seek for opportunities, exploring new potential, while keep exploiting existing capabilities. Thales Nederland, the Dutch branch of the international Thales group, is not an exception. Thales recognized that in order to remain market leader and technology innovator, they have to look beyond the boundary of the organisation and into their surrounding networks. This train of thought resulted into a complex and ambitious plan, in which the former grounds of Thales Hengelo are to be transformed into an industrial innovation campus. All parties involved in the development of the 'High Tech Systems Park', would like to aspire to a certain goal; 'a successful innovation campus'. However, creating an industrial innovation campus from scratch means treading into relatively unexplored terrain. There is no all-encompassing formula to ensure success in building an industrial cluster, or in this case, an innovation campus within the regional cluster of Twente. This search for a custom made innovation campus recipe led to this investigation's research question: *"What are the factors that are likely to make the High Tech Systems Park a success and what does the High Tech Systems Park organisation have to do in order to achieve that success"?*

The trajectory of finding answers to this research question, started with an extensive literature study, which dived into the underlining concepts of the innovation campus: its linkage to co-creation and co-development, working down through networks, (innovation) clusters, innovation campuses, and ultimately into relevant factors potentially influencing innovation campus success. In order to obtain more in-depth information on innovation campus success, the factor-framework with the fourteen factors derived from literature formed the basis for a multiple case study, in which representing experts from five mature innovation campuses in the Netherlands participated in a semi-structured interview, resulting in a comprehensive take on success- and pitfall factors and the trajectory of innovation campus development.

During the case analyses it became evident that the five innovation campuses showed quite a bit of common ground on the relevant factors, which stressed by the representing campus experts, are of great importance in achieving individual campus success. As categorized in Table 7, a total of seven different factors were identified by the experts as their top five most important contributors to campus success, while in contrast eight factors were identified as experienced bottlenecks or pitfalls (Table 8). Additionally, the case analyses indicated that in varying levels of significance, all fourteen factors from the factor-framework are relevant for building campus success. These findings indicate that all factors (especially the most valued) are relevant throughout campus development, although the actual value and functioning of the factor can change, depending on the environmental situation per development phase. In fact, Table 9 emphasises eleven factors throughout three stages (one to ten years) of campus development. In addition to the most valued or most important factors, the other factors are considered to be of importance as well. In fact, the findings suggest that there is some sort of interaction effect between the different factors, which implies a certain relationship between (some of) the factors (see Table 9). These two factor 'types' can probably be described best as necessary- (most important) and sufficient (identified and valued to a certain extent) factors. It is likely that the sufficient factors are required to be well functioning in order to support, or at least not to negatively affect the highly valued necessary factors. These findings seem to support the notion of the campus experts, arguing that all factors are somehow important for campus success.

Analysing the cases also resulted in an additional finding, which became evident due to the strong emphasis the experts attached to the 'Triple Helix Approach'. All experts highlighted the Triple Helix one way or another, but the main function of these partnerships appears to be on enhancing the campus support base and to assist in facilitating the campuses' basic needs (e.g. government: infrastructure, permits, promotion; university: students, facilities). However, one expert expressed that regional government actually invested in their campus, extending their support base even further. Based on the findings, this study argues that the Triple Helix should become a stand-alone factor. The same principle applies on the concept of Open Innovation, which were highly regarded by the business-driven campuses and carefully, and increasingly valued by the other campuses. As Huizingh (2011) stated that OI cannot be seen as a single construct, but more as varying degrees of openness, there should probably be a factor developed that enables that train of thought. All experts considered (a certain version of) OI to become increasingly important in the future.

Literature initially made a distinction between the 'founding origins' of innovation campuses, such as the Science & Research Park and Open Innovation Campus (BCI, 2009). In turn, differences between business- and academically driven campuses were supported by the findings of this study. Participating organisations at a business-driven innovation campuses such as HTCE and BCC appear to be mainly interested in enhancing business growth and profit through collaborative innovation efforts, and thereby through campus success.

It seems likely that there may be no underestimation of the (potential) differences between the ideal academic world and the complex reality. This is why several of the factors potentially leading to success or potential pitfalls, were translated to the HTSP situation. In relation to the HTSP, especially the business-driven factors, both success and pitfall, should be taken into account due to the fact that the campuses share similar goals. Since these factors are an important prerequisite of innovation campus success, neglecting them is likely to result in the undoing of the planning to build on HTSP success. Chapter six provides a set of short- and long term recommendations to the HTSP organisation. Additionally, several factors are explained in the context of the HTSP, enabling practitioners to potentially make usage of those recommendations. To conclude, the findings of this paper especially stress the importance of an encompassing campus organisation, which has the availability of all the necessary capabilities in relation to their task as support organisation, a strong dynamic company base and a clearly set campus profile.

Abstract

Innovative development is increasingly seen and understood in a context beyond the boundaries of a single firm, namely that of an innovation network and the different forms it comes in. The newly founded High Tech Systems Park (HTSP) shares this idea. This article aims to explore our understanding of successful innovation campuses by working down from the networking concept, to the cluster concept, via the innovation campus, to relevant influencing factors. In doing so, this study addresses the questions of what (which factors), how (factor content), and when (campus development trajectory). The different networking concepts are rich, but the innovation campus is still unexplored in literature. A multiple case study into five top innovation campuses in the Netherlands ought to shed light on that topic. The results show that out of fourteen identified factors, seven success- and eight pitfall factors are possibly highly relevant during innovation campus development. In addition, it appears that several factor-effects differ between academic- and business driven campuses. This paper does not underestimate the (potential) differences between the ideal academic world and the complex reality, which is why in addition to developing a comprehensive factor model the most valued factors were translated to the HTSP situation.

Keywords: Innovation Campus, Collaboration, Success/Pitfalls Factors, HTSP, Support Organisation

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Chapter 1 Introduction to the innovation campus

In this day and age, can co-creation and co-development with partner firms, institutions and universities be considered to be essential for being innovatively successful or even successful in general? Although the exact content of that question sometimes varies, the general meaning has been topic of investigation for many academics and practitioners who have committed themselves relentlessly in finding answers in all aspects of inter-organisational co-operation (Cooke, 2001; Payne, Storbacka, & Frow, 2008; Delgado, Porter, & Stern, 2010; Jaakkola & Hakanen, 2013; Prahalad & Ramaswamy, 2013). Scholars acknowledge that innovative development has to be seen and understood in a context beyond that of a single company, namely that of an innovation network and the different forms it comes in (Gemünden & Heydebreck, 1994; Gemünden, Ritter, & Heydebreck, 1996; Ritter & Gemünden, 2004; Vanhaverbeke, 2006). By recognizing the value of being innovative, companies continuously seek for opportunities to explore new potential, while exploiting existing capabilities. Thales Nederland, the Dutch branch of the international Thales group, is in no way an exception.

1.1 The 'who, what and why' of the High Tech Systems Park

The story begins at the headquarters of Thales Nederland, which is located in Hengelo (Netherlands). This company is specialized in designing and producing professional electronics for security and defence applications, such as communication and radar systems. The company is also renowned in the field of public transportation systems. The organisation has about 1,800 employees working at branches at five locations; Huizen, Enschede, Delft, Eindhoven and Hengelo (Headquarters). Thales Nederland recognized that in order to be innovatively successful, they have to look beyond the boundary of the organisation and into its network surroundings. This train of thought resulted into a highly complex, costly and risky plan, in which the former grounds of Thales Hengelo are to be transformed into an industrial innovation campus.

This immense project has been initiated by Thales Hengelo building new high-end facilities for their own activities, as well as a Shared Facility Centre (SFC) for the future campus. In 2015, The High Tech Systems Park, or HTSP, has been actually founded as an innovation campus for high tech companies. Thales Hengelo (and local government) stated their mission; "to create an innovative business climate for the future campus residents in order to enable them to innovate faster, accelerate business growth and to create a work environment that appeals to the best in order to attract future employees".

The terminology of the campus; 'High Tech Systems Park' clearly reflects the nature of its (future) residents. The reasoning behind this categorization lies in the geographic location of Hengelo, which is located in the region of Twente. The region of Twente is specialized in high tech Systems and Materials (Kennispark, 2016). This specialization consequently represents the nature of the main industrial cluster within the region and the application areas with growth potential (Kennispark, 2016). Although High Tech Systems Park might sound a bit generic, the aim of the profile was to express the distinctive character of the innovation campus and in addition its positioning within the high tech Systems and Materials Cluster.

The terrain of Thales Hengelo ought to be transformed from a regular business park where originally physical production sites dominated, into a 'high tech' innovative environment. Thales founded the HTSP as an institution that can and should act independent from the founding organisation (Thales

Nederland). During the first stages of development, the main focus went to the physical factors of importance for the HTSP. The Shared Facility Centre for example, has been built in order to function as a central meeting point for the future residents. Currently, the first participating firms are already located on the premises, or have started to build their own facilities. Additionally, testing facilities such as; a Near Field Test Centre, a Group Competence Centre, Environmental Test Labs and a Materials lab, are already- realized and will be offered for usage to the campus participants.

Being aware of their geographical location and consequently mapping possible threats and opportunities, the High Tech Systems Park will aim to use their geographic position to their advantage. The close presence to sources of knowledge as for example Kennispark Twente, the University of Twente, and Saxion University of Applied Sciences as well as other types of (physical) resources are expected to be of value to the HTSP. Future HTSP organisational endeavours will be aimed at attracting other new businesses; exploring- new and exploiting existing ties with knowledge institutes, and improving governmental ties. The aim of these activities is to create a successful innovative high tech business environment, or in other words: “a highly successful innovation campus”.

1.2 Stating the problem

Thales Nederland took quite a bit of risk by ambitiously founding a new industrial innovation campus. Although the founding party clearly stated their reasoning for developing and contributing to the High Tech Systems Park, all parties would like to aspire to a certain goal; ‘a successful innovation campus’. However, creating an industrial innovation campus from scratch means treading into relatively unexplored terrain. There is no all-encompassing formula to ensure success in building an industrial cluster, or in this case, an innovation campus within a regional cluster. For the purpose of exploring the innovation campus phenomenon we attempt to operate from a specific perspective. In fact, the parties participating at the HTSP expressed their preference for setting up a specific campus organisation. This organisation will be tasked to represent the interest of the campus residents, but most of all will facilitate co-creation and co-development among the campus residents in order to foster innovation. This specific perspective, namely; the HTSP organisation and its functioning, is highly relevant for the development of the innovation campus and its functioning. Despite the value for practitioners, the role of a campus organisation as a driving force in stimulating innovation is currently under-explored in literature. Literature is missing a comprehensive take on the innovation campus concept, a strong body of potential factors leading to innovation campus success and the potential pitfalls during campus development. That is why this paper aims to contribute to the extending our understanding of the development (process) of innovation campuses.

Identifying the absence of a state-of-the-art and immediately applicable ‘success formula’, raises the need for a custom-made organisation-recipe, that is likely to result into HTSP success. This brings us to the goal of this explorative research, which will be stated in the following paragraph.

1.2.1 Research Questions

The previous paragraph stated the intention to find a custom-made recipe for success in developing the High Tech Systems Park. Although that specific result in practice might prove to be a utopia, the aim of this paper and its trajectory is to provide an insightful and comprehensive understanding into the dynamics of an (industrial) innovation campus and especially into the factor-steps to achieve future success. These results are intended for both practitioners (Thales Nederland, HTSP) and academics in the field of innovation research. We started by defining the paper-guidelines through developing a set of research questions:

- RQ: *“What are the factors that are likely to make the High Tech Systems Park a success and what does the High Tech Systems Park organisation have to do in order to achieve that HTSP success”?*

Sub-research questions (SRQ):

1. *“What factors does literature constitute as necessary factors in obtaining campus success”?*

After we identified and mapped the findings from sub question one, we went to investigate innovation campuses that are comparable to the HTSP, to find out what they have done to become successful.

2. *“What did innovation campuses comparable to the HTSP do in order to become successful”?*

What did they do? Or in other words:

- I. *“What steps did the top innovation campuses take throughout their development”?*

What did they not do? Or in other words:

- II. *“Which pitfalls did the top innovation campuses identify during their developments and how could they have been avoided”?*

This last question (SRQ2 II) is aimed to determine the possible ‘lessons learned’ or ‘bottlenecks’ that the different campuses identified, while building on campus success. The next step was to translate the knowledge obtained from the literature study and the empiric investigation to the High Tech Systems Park organisation, which brought us to the question:

3. *“In what developmental stage is the HTSP currently situated and what steps should the organisation take and avoid to come to the desired outcomes”?*

What should be done? Or in other words:

- I. Given the gathered literature and the explorative data gained from the first two research questions; *“how should the High Tech Systems Park organisation be shaped in practice”?*

It is evident that in these types of explorative investigations there may be no underestimation of the (potential) differences between the ideal academic world and the complex reality. This raises the issue of transforming, or ‘translating’ literature factors into the present practice, in which the HTSP and other innovation campuses operate. By doing so, this paper aims to not only contribute to academic literature, but to increase its value for practitioners as well. Analysing multiple cases will aid in bridging the identified factors, success or pitfall, from the academic perspective to the practical HTSP. These cases represent five innovation campuses in the Netherlands; 1) Leiden Bio Science Park, 2) Wageningen Campus, 3) Kennispark Twente, 4) High Tech Campus Eindhoven and 5) Brightlands Chemelot Campus. When talking about a successful innovation campus, we make a clear distinction between what the five cases (innovation campuses) constitute as success and what the HTSP considers to be success. In fact, the number of spin-offs and/or spinouts, increasing employment, economic or company growth and knowledge valorisation (BCI, 2014) can all be considered to be successful outcomes of campus initiatives. The definitions of success per campus were addressed during interviews with the five representing experts.

Answering the questions on the success of innovation campuses will be structured as follows: The first sub question has a theoretical nature and asks for a thorough literature study. The literature section dives into the underlining concept of the innovation campus: its roots and origin and linkage to co-creation and co-development, through networks, (innovation) clusters, and ultimately into relevant factors potentially influencing innovation campus success. The empirical section, which is relevant for sub question two, focuses on investigating these potential factors through semi-

structured interviews with representing experts from five established innovation campuses in the Netherlands. In addition to testing these factors through this multiple case study, the interviews might lead to altering and/or expanding of the factors relevant to making the High Tech Systems Park a success. The second sub question embodies the major part of the research. The third sub question will aim to bridge between the research findings and the goals set by the HTSP by making a comparison between an ideal situation according to literature and the empiric data gained from the cases in relation to the present circumstances of the HTSP. This last sub question results in an advice on: how to close the gap between the ideal theoretical and optimal case situation and the current HTSP conditions. The result will be a set of recommendations with which the HTSP organisation can proceed developing the innovation campus in search for success.

1.3 Report structure

The continuation of this report consists of the following:

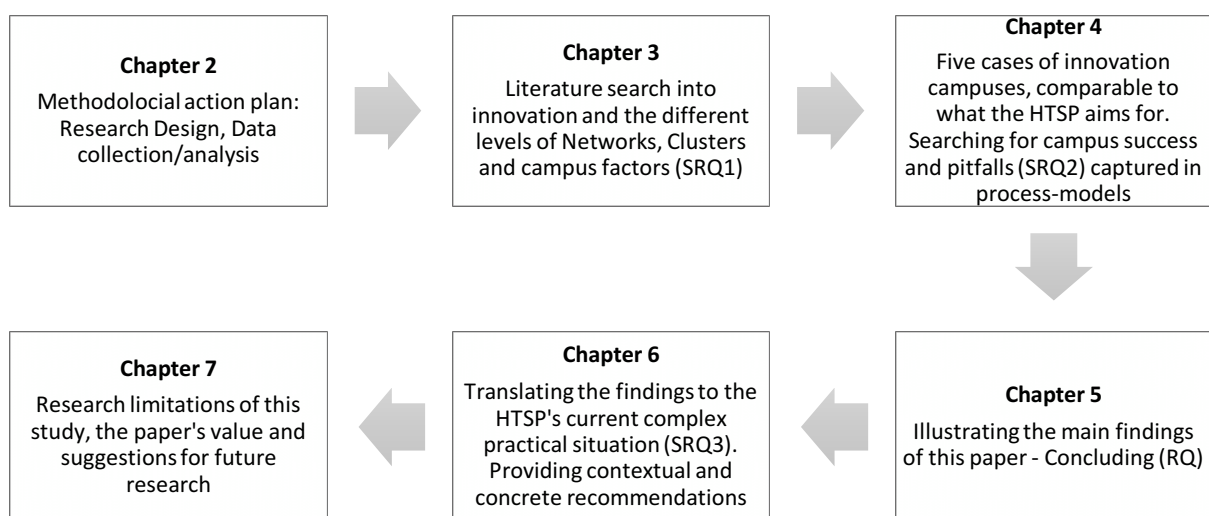


Figure 1 - Report structure

The following chapter contains an action plan, in which the methodology process of this paper will be explained. Firstly, the research design will be described, after which the process of collecting and analysing the data will be elaborated on. Chapter three embodies the process of obtaining a solid theoretical base for this paper, by investigating the background of the innovation campus, which will be dissected by starting at the network theme, working down through the cluster concept ending at the innovation campus level. The literature part of this chapter ends with an overview of potential factors relevant for innovation campus success (SRQ1). The fourth chapter is dedicated to the five cases and their; 1) success, 2) pitfalls and 3) trajectory (SRQ2). Chapter five and six form the natural ending of this paper by drawing conclusions (RQ) and developing the translation of findings to the HTSP, while recognising the differences between the ideal academic world and the complex reality (SRQ3). The last chapter aims to express the value for both scholars and practitioners and to identify the papers limitations and future research potential.

The following paragraph elaborates on the methodology used during this investigation into innovation campuses.

Chapter 2 Structuring the Methodology

This paper’s second chapter elaborates on the choices that were made regarding the research design, collection of data and the method of analysis that were used, in order to be able to draw conclusions and develop recommendations on innovation campus success and to translate the results to the HTSP.

2.1 Research Design

Although the ‘networking’ and ‘cluster’ phenomena have been researched extensively (Cooke, 2001; Riter and Gemünden, 2002; Visser & Atzema, 2008; Porter 2010), the (industrial) innovation campus and the driving force behind campus development represent a research field that is still quite undeveloped (Zhao, Zhou, Hüsigg, & Vanhaverbeke, 2010). That is why, for this qualitative research, an exploratory (multiple) case study has been set up in order to investigate the success of (industrial) innovation campuses. Yin (2003a, p.2): “the distinctive need for case studies arises out of the desire to understand complex social phenomena”, which is because “the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events,” for example, events such as organisational and managerial processes (Kohlbacher, 2006).

<p>Sub Research Question 1</p>	<ul style="list-style-type: none"> •What are we dealing with? Investigating the concept of networking, clusters, and innovation campuses in relation to innovative co-creation and co-development. The aim is to obtain more in-depth information of the innovation campus concept. •Extensive literature search to identify potential key factors relevant to innovation cluster or campus success. Based on literature, we develop a comprehensive factor list.
<p>Sub Research Question 2</p>	<ul style="list-style-type: none"> •Solid multiple case study through careful case selection, resulting in five top innovation campuses in The Netherlands. Relevant factors for case selection were; HTSP comparability, similar socio-economic and political settings, campus founding origin, campus success, technological background, and campus life cycle stage. •Strongly developed semi-structured interviews (Appendix II) with (carefully selected) representing experts from the different campuses. The participating experts job-description all work for campus representing organisations and are all directly related to campus development and stimulation.
<p>Sub Research Question 3</p>	<ul style="list-style-type: none"> •Effectively answering sub research question three, means that the data gained from the first two sub questions need to be analysed and processed thoroughly. •The findings from literature and the semi-structured interviews will be translated to the HTSP, while recognizing the differences between an ideal world and the complex reality.
<p>Main Research Question</p>	<ul style="list-style-type: none"> •By answering the first three sub research questions, the main research question can be answered through a strong derivative from the findings that will be identified. Both literary (from the scholarly search) and empiric data (from the semi-structured interviews) are necessary to answer this main research question.

Figure 2 - How to answer the research questions?

In order to conduct an extensive and especially thorough empiric investigation, a strong theoretical foundation is key. The background of innovation in relation to networking, clusters and innovation campuses will be sketched extensively, followed by a scholarly listing of potential key factors leading to campus success or potential pitfall. Finding answers for sub research question one will be leading during the literature search, since these findings are an important prerequisite for answering sub research question two and three.

2.1.1 Case studies

Yin (1994, 2003a) emphasizes that a case study is an empirical inquiry that investigates contemporary phenomena within the context of real life, especially when the boundaries between the context and phenomenon are not evidently clear. This statement by Yin (1994, 2003) stresses that an important strength of case studies is the ability to investigate into a phenomenon in its respective context (Kohlbacher, 2006); there is no necessity to replicate the phenomenon in a laboratory or experimental setting in order to obtain a better understanding of the phenomena (Rowley, 2002). That is why, for intents and purposes of this paper, the investigation is conducted through a qualitative approach since this paper aims to recognize social phenomena and subjective meanings regarding 'innovation campus success' by investigating five cases in depth. This in-depth investigation allows us to take a closer look into the second sub research question and is also necessary to map the success factors, the pitfalls and the campus life-cycle trajectory of the five top innovation campuses. Multiple case designs are preferred over single case designs; since the basis of replication logic illustrates that multiple cases can be regarded as the equivalence of multiple experiments (Rowling, 2002). The more cases the more robust the research outcomes. In turn, an embedded case design can identify a number of sub units, each of which can be explored individually (Rowling, 2002). In fact, the multiple- cases and sources of information enhance the value and strength of not only the answers to SRQ two and three, but of the paper as a whole. That is why for this paper an exploratory (multiple) case study has been considered to be most suitable.

2.1.2 Selecting top shelf cases

Selecting suitable cases or unit of analysis is crucial according to Rowley (2002). The same principle applies to this paper. Selecting cases must be determined by the research purpose, research questions and theoretical context, however, there are likely to be other constraints that impact the case selection as well (Rowley, 2002). For that reason, the composition of a suitable case-set has been done in a purposive manner by searching for innovation campuses who are among the top selection in the Netherlands. Saunders, Lewis, & Thornhill, (2009) recommends purposive sampling when the researcher aims to select cases that are particularly informative. The reasons why the Netherlands is chosen as geographic boundary condition of this paper are; comparability of 'similar' circumstances of the cases relative to the HTSP, the high level of innovation campus development and also due to pragmatic reasons. Over the past years (2009, 2010, 2012), Buck Consultants International (BCI) conducted research in order to provide an overview of campuses and science parks (and initiatives) in the Netherlands. During that research, BCI identified the 'successful innovation campuses' and the different life stages they operate in. The agency conducted those investigations by order of the Ministry of Economic Affairs. Out of 39 so called campuses, only eight were identified as mature innovation campuses that met all conditions (for innovation campus conditions see paragraph 3.2.1) From these eight cases, five were selected for this research. These cases were selected based on their; founding origin, high tech or high level nature, financial structures and their reputation of "being the best" in their field. A detailed description of the selected cases and their respective undertakings can be found in chapter four. The BCI report can be considered to be an enabler for identifying the five innovation campuses relevant for this paper.

The following paragraphs sketch the used procedure in collecting data from literature as well as case studies.

2.2 Collecting data from literature

Similar to most explorative research, this study's foundation lies in a thorough literature review to explore the underlying concepts and themes, and theoretically highlight the subject area of innovation campuses. For an exploratory inductive research approach, a narrative review of literature is better suited, relative to a highly systematic review (Bryman and Bell, 2015). Bryman and Bell (2015, p.110) stated about this approach: "researchers may discover issues that they did not previously anticipate as likely to be important to their area of study". In fact, this paper started with a general question; "In this day and age, can co-creation and co-development with partner firms, institutions and universities be considered to be essential for being innovatively successful or even successful in general?" This question does not only express co-creation and co-development within a specific campus context, but approaches the concept of networks or collaboration in general. Since it is quite naïve to think that innovation campus success can only stem from relevant factors within the campus geographic borders, the literature review commences at the (regional) cluster level. By doing so, there is no underestimation or exclusion of potentially relevant influences from the cluster, in which the innovation campus is located. In line with the previous paragraph that described the research design, this research follows a narrative literature review approach in order to not overlook any concepts and issues that turn out to be relevant. Therefore, we were aware not to use overly restricted- literature search procedures in terms of very specific key words, specific author and journal selection, and time frame. This explorative literature review concerning the research topic, largely contributed to the framework on which the empirical part of the study has been built upon. The literature investigation of this paper led to building a factor-framework including fourteen different factors or elements that ought to be relevant for innovation campus success.

2.2.1 Collecting data from case studies

As stated earlier, for the empirical part of this paper, the (multiple) case study method has been chosen. According to Yin (2009) there are six recommended sources of information that are important to consider while conducting a case study research, namely; 1) Interviews, 2) Documents, 3) Archival records, 4) Participant observation, 5) Direct observation and 6) Physical artefacts. For the purpose of this paper, particular attention went to semi-structured interviews with representing experts of the five innovation campuses and to studying published data and documents with both an academic and practitioners' perspective. By combining these primary and secondary sources of data, the cases ought to be explored in more detail and depth. The secondary data is foremost relevant for providing contextual information in relation to the interview findings and for triangulating the obtained data. In fact, Ghauri (2004) argues that documents with a rich nature often have a lot to offer to the researcher in situations concerning the pre-interview and post-interview. For instance, even without using the data directly, documents with concrete figures describing the individual 'campus context', aided in both preparing and conducting the interviews and enables the researcher to set possible data from the interviews in perspective.

2.2.2 Expert selection process and conducting the semi-structured interviews

The semi-structured interviews were conducted with five expert representatives from five different top innovation campuses in the Netherlands. Their expert functions were directly related to the development of the innovation campus. In fact, the job descriptions varied from Campus Developer, Business Developer, and Cluster Developer to Campus Director. Due to their high- and expert position within the campus organisations, it is likely that they could provide a comprehensive overview of relevant factors or influences concerning the success of their respective innovation

campus. Since these interviews embody the most important source of data, every precaution was taken. Up front, all interviewees agreed with recording the interviews, which holds several benefits. For example, recording the interview ensured that the transcribed data could be revisited and ensured an accurate rendition of the content of the interview. It was also helpful in facilitating the conversation flow, since the interviewer was not being distracted by the need of taking notes meticulously.

The five interviews had a semi-structured nature since this enables a more open-ended discussion, which leaves room for slightly guiding the conversation and for potential unsuspected findings. An interview guideline was prepared prior to the interviews in order to have a certain completing structure. This guideline has been developed and tested beforehand with a non-participating expert, in order to obtain a certain level of quality and finesse of the guiding questions. The interview guide (see Appendix 2) has been constructed based on literature and consists of four basic questions supported by potential follow-up questions. During the personal interviews, the interviewer made sure that every factor or element identified by SRQ1 were taken into account, without steering the participants' answers into specific directions. In fact, sources with secondary data such as campus brochures and presentations, newspaper articles and innovation campus websites, provided means to slightly titillate the experts in covering the different factors and more. As a side effect, throughout the interviews potentially new elements were identified as well, enhancing the value of these interviews.

The interviews were not only aimed at identifying the campus-relevant elements, but also on mapping the value and relevance that the experts attach to individual factors, relative to the impact on campus success. Prior to the interview, the experts were asked to formulate their answers with respect to the relevant time frame. By doing so, the findings do not merely identify the different factors, but also 'why' they are relevant, 'what' lessons were learned and 'when' these lessons were learned. After the completion of the questions, there was plenty of room for the interviewees to come up with any additional information, thoughts, or insights in relation to the topic. The average length of the interviews was approximately 75 - 80 minutes, ranging from 69- to 85 minutes. Shortly after the interviews were conducted, the recordings were transcribed into text to allow unbiased and direct usage of the content for analysis, resulting in more than twenty-four pages of transcribed text per case. As validation check, the interview findings per case were presented to the campus experts, which did not result in any major perceived differences of data.

The following paragraph will illustrate the process of data analysis for the purpose of this paper.

2.3 Analysing the Data

There is no general procedure casted in iron for analysing case study results. For the analysis of exploratory case studies, Rowley (2002) suggests an analytic strategy, in which to develop a descriptive framework as a guiding structure for organizing and even evaluating the case studies. Such a descriptive framework contains important themes, which were derived during the literature review of several relevant theoretical themes on collaboration and co-development. In this paper's framework of factors that are potentially relevant for innovation campus- success or pitfalls, the factors represent different elements or themes, such as the role of Support Organisations, or Geographical Proximity (see Table 1 for factor-framework) and their effect on campus success.

Since five mature innovation campuses are being investigated, the analysing- and discussion sections of this paper are structured by the factors potentially leading to campus success, or pitfall obstacles and their relevant development trajectories. The different factors derived from literature, were ranked per individual case in relation to their relevance and respective value or impact (see Chapter four). Ranking the potential success factors per case, based on the value the experts attached to

them, resulted in a relatively large emphasis on four to six factors per case. The same principle applied to the potential pitfalls, since the experts mainly stressed the value of two to three factors per campus. This does not mean that the experts consider other factors to be irrelevant, but there appeared to be quite a bit of valuation difference between the factors perceived as most important relative to the other factors. Hence, in Chapter four, the five campuses are analysed individually with a main emphasis on a top five of most valued factors potentially leading to success and a top three of most valued potential pitfalls or bottlenecks. Choosing to mainly focus on the most important factors perceived by the experts enables more in-depth insights into innovation campus success instead of providing a relatively generic list of factors that are in 'some way' relevant. The selection of the 'most important' factors, were stressed by the experts or were derived from the transcribed data. To avoid potential biases due to possible judgements or any other subjective actions by the researcher, the interview findings per case were presented to the campus experts, which did not result in any major perceived differences of the valued factors. Per case, a top five of factors potentially leading to campus success and a top three of potential pitfalls or lessons learned, were developed. The remaining factors however, are likely still to be of value, which is why these factors are not disregarded. In addition, the data from the interviews will be analysed with reference to the general time-line perspectives of a cluster life cycle, resulting in a process or trajectory model per case, describing the different factors. Paragraph 3.3 elaborates on the literature grounding of these campus development trajectories by setting the different factors in a time-line perspective through the use of cluster life cycles. By identifying the most valued factors along with the underlying time perspective, quite an extensive description of the case study can be achieved, which can be corroborated from multiple sources of evidence (Rowley, 2002).

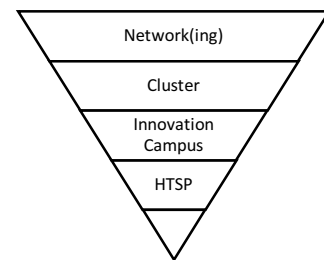
In the following chapter, an extensive literature investigation will be illustrated and the obtained data presented.

Chapter 3 Literature investigation

This chapter embodies the scholarly information search of this paper by providing an overview of relevant topics and themes in relation to the area of investigation (e.g. innovation campus success). In this chapter, the aim is to reduce the ‘fuzziness’ on innovative collaboration theories such as the innovation network-, clustering- and innovation campus concepts, but most of all build a factor-framework potentially relevant for innovation campus success.

3.1 Literature - Dissecting innovation campus ‘success’

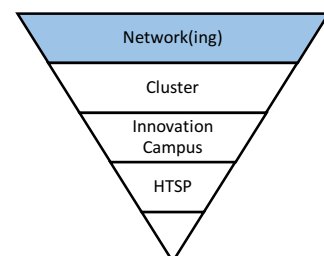
Since in the field of innovation research a comprehensive take on innovation campuses and campus success is lacking, this study sets the literature starting point at a higher level than just the campus concept. In order to do so, we first have to recognize some of the underlying themes and concepts of the innovation campus, which is why this paragraph starts at the (innovation) networks theory, working through the cluster concept, towards the innovation campus and its core characteristics. Although there exists a vast amount of other collaboration-related literature, the National Systems of Innovation approach (Lundvall, 1988; Lundvall, 2007) for instance, is more focussed on public policy and on understanding a wider setting, which makes the theory less suitable for researching the geographical closely-knit innovation campus. In turn, sections 3.1.1 till 3.1.4 aim to provide a certain context and theoretical grounding on innovative collaboration in relation to innovation campuses.



First of all, what is ‘innovation’? Scholars developed a wide variety of definitions. In fact, Baregheh, Rowley and Sambrook (2009, p.1334) described innovation as; *“the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace”*. Although the exact understanding of the term innovation might differ per interviewed campus expert, it is likely that a similar general principle applies that all innovations ultimately have a certain possibility of application.

3.1.1 The role of Networks for innovation

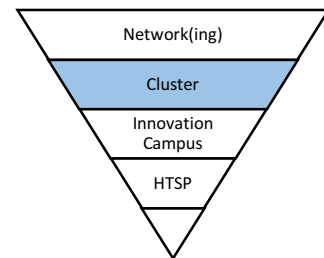
Academics in the field of innovation studies have over the last decades increasingly highlighted the function of networks in innovation processes (Freeman, 1991; Tidd, Pavitt, & Bessant, 2001; Ritter and Gemünden, 2004; Boschma & Frenken, 2010) This accelerated increase in number of studies in the field of innovation has led to a vast variety of network related- theories, concepts and methodologies (Ozman, 2009). The innovation process can involve collaboration with a variety of different types of partners, each offering significant and likely unique resources (Ritter and Gemünden, 2004). In fact, several scholars indicate that early (LaBahn and Krapfel, 2000) and especially intensive collaboration (Langerak, Peelen, & Nijssen, 1999) is likely to lead to shorter innovation processes, reduced costs of innovation and higher innovative output (Ritter and Gemünden, 2004). In other words, innovation development should be understood as/or in a context of technological interweavement of a company, simply said: an innovation network (Gemünden and Heydebreck, 1994; Ritter and Gemünden, 2004). Boschma & Frenken (2010) in turn aimed to propose an evolutionary perspective on the geographic formation of Networks in a dynamic



proximity framework. Academic- and practitioner interest in the idea and value of ‘geographic proximity’, explains why the cluster concept is currently still a topic of academic interest.

3.1.2 From Networks to Clusters

In fact, one of the most celebrated and at the same time criticized theory concerning the importance of networks has been stated by Michael Porter in his book: ‘The Competitive Advantage of Nations (1990)’. In his micro-economically based theory, Porter highlighted the prominent role of Clusters in relation to being competitive while acting in a global economy. The cluster phenomenon in one form or another has been acknowledged and explored extensively in literature (Porter, 1998; Cooke, 2001; Porter, 2000; Boschma & Fornahl, 2011). The nature of an increasingly complex, knowledge-based, and dynamic economy, supports Porter’s (2010) view that clusters represent a new way of thinking about economies at a local, state, and national level. Clusters have been defined and categorized by a vast amount of different authors (Porter, 1998; Cooke, 2001; Morosini, 2004; Sölvell, 2008), within an equally vast amount of different contexts. Contexts such as: Industry types, Cluster goals (R&D vs. production), Cluster actors and Cluster origins, are just a few examples of ways clusters have been accounted for.



The different categorizations aside, “What is a cluster”? While scholars have significantly produced literature on clusters since the late nineties, the definition of the concept is still contested (Arthurs, et al., 2009). Although knowledge of clusters is highly fragmented, very descriptive and often inconclusive on many points, we denote one definition to be most suitable for this research. Morosini (2004, p. 307) denotes clusters in both a socio-economic context: *“An industrial cluster is a socioeconomic entity characterized by a social community of people and a population of economic agents localized in close proximity in a specific geographic region. Within an industrial cluster, a significant part of both the social community and the economic agents work together in economically linked activities, sharing and nurturing a common stock of product, technology and organisational knowledge in order to generate superior products and services in the marketplace”*. This definition is considered to be most suitable for this research, since the emphasis on social communities is likely to be of importance in relation to creating an innovative environment.

Relative to single industries, clusters can include a variety of linked industries and other entities (Porter, 2000), such as companies, governmental- and other institutions (e.g. universities, think tanks). Many of the advantages of clustering in general and especially for innovation, are the result of spillovers across firms, industries and institutions (Porter, 2000). These broad cluster-influences are till a certain extent affected by personal relationships and networks of institutions and individuals that interact with each other. Such effective relationships are far from automatic and formal as well as informal cultures and organizing mechanisms often play an important role in the development and functioning of Clusters (Porter, 2000).

3.1.3 Clusters and innovation

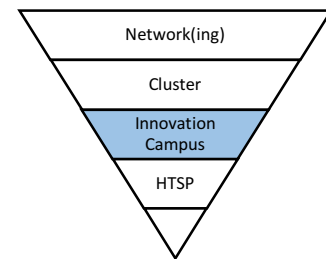
In addition to the more general benefits of clustering, cluster participation offers many potential advantages in innovation compared to an isolated location (Porter, 2000). The concept of the innovation Cluster slightly differs from the industrial cluster, since the purpose is mainly set on (technological) innovation (Il & Yim, 2013). Science- and Techno Parks are examples of innovation Clusters, where the innovation process from idea to technological commercialization occurs within the innovation cluster (Il & Yim, 2013). According to Besterfield (2004), innovation cluster comprises of; 1) innovation nodes (firm, university, research institutes) and its relationships within Networks, 2) Innovation Input (support, information, personnel), 3) Innovation Process (input, process, output), 4)

innovation Culture (both Individually and Collectively), 5) Interaction of the innovation nodes, and 6) Hardware Infrastructure (Andersen, 2010 discussed by Il & Yim, 2013).

The notion of the innovation cluster seems to be corresponding to the open innovation concept in relation to the general idea of co-development and co-creation among the different innovation nodes. Since Chesbrough coined the term open innovation in the early 2000ths, the OI concept has become one of the hottest topics in the field of innovation management. The basic idea behind the notion of open innovation (OI) is ‘opening up’ the innovation process (Huizingh, 2011). Chesbrough et al., (2006, p1) defined OI as: *“the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively”* and Vanhaverbeke (2006, p1), states that; *“Open innovation is almost by definition related to the establishment of ties of innovating firms with other organisations”*. According to Huizingh (2011), the term ‘open innovation’, contrasted by ‘closed innovation’, serves as an umbrella for all fashions of collaboration. Huizingh (2011, p3) does not consider open innovation to be a dichotomy, but rather *“a continuum with varying degrees of openness”*. The following paragraph is aimed to sketch a clear overview of the innovation campus concept.

3.1.4 The innovation campus as centre of excellence

Previous research into clusters mainly focused on high tech development zones and high tech clusters, which are relatively large in either industrial wideness and/or geographical space (Zhao et al., 2010). Zhao et al. (2010) categorized a wide range of cluster types based on; 1) Innovativeness, 2) Industry Broadness and 3) Geography Wideness and identified the innovation campuses; High Tech Campus Eindhoven and Chemelot as Centre of excellence. The developments of these relatively small clusters reflect the ‘campus awakening’ of companies. In fact, practitioners acknowledged the strategic importance for today’s businesses to co-operate and co-develop with other firms and organisations. Royal Haskoning (2016) that with benefits such as; lower costs, faster time to market and higher returns on investment, in mind, the trend of a growing number of science and technology parks seems quite logical. However, a less well-known development involves medium-sized and large innovative firms establishing their own ‘science park’, or in other words: industrial innovation campus (Royal Haskoning, 2016).



In the Netherlands, the growing number of science parks and (industrial) innovation campuses did not go unnoticed as well. In fact, in line with several practitioners and scholars, BCI (2009) categorizes campuses as: Science & Research parks (company site, where R&D takes place by Universities, hospitals, research institutes and companies), and Open Innovation Campuses (former company campus on which an ‘anchor tenant’ conducts R&D, where other companies can settle and mutual interaction and co-operation in a certain research domain is being actively stimulated). In turn, literature identifies two different natures of an innovation- campus or park as well, which is related to the campus business- or academic origins. There appears to be no clear understanding on the potential differences in functioning and output between the two campus types. However, since the science & research parks nowadays (which will be illustrated by the selected cases) have quite a commercial focus, for the purpose of this research both types of campuses are acknowledged as ‘innovation campus’, while still recognizing the potential differences of campus nature.

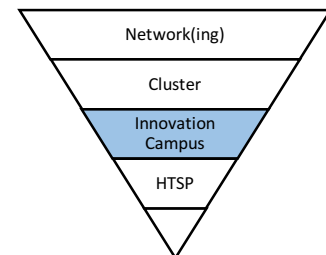
3.2 Core elements and factors of an innovation campus

This paragraph will provide a framework of the relevant core elements and factors in relation to potential innovation campus success. That factor-framework forms the basis for the empirical section of this chapter. During our literature search, we did not come across much research on (industrial)

innovation campuses. The vast amount of literature on innovation and co-operation and co-development mainly consisted out of investigations into networks or clusters. To our knowledge, these constructs have not been identified by literature at a campus level yet. Therefore, for the purpose of this research we take the general cluster perspective as starting point. As highlighted in the analysis by BCI (2014), the innovation campus should be seen as a critical mass and physical location within a cluster, which is why we aim to transfer (potential success) factors at a cluster level identified by literature, to the context of the innovation campus.

3.2.1 Cluster development indicators and constructs

In the paper; "Indicators to support innovation cluster policy", Arthurs et al., (2009) developed a set of constructs and indicators, which ought to be relevant for cluster development, since cluster theory suggests that competitive advantages derives not solely from firm-based resources and capabilities, but also from resources and capabilities located in the firm's geographically proximate business environment, or so called ecosystem. The authors (Arthurs et al., 2009) recall empiric evidence showing that clustering can have a significant positive effect on rates of firm productivity, firm formation, profitability, growth, and especially interesting; 'innovation' (Boschma, 2005; Rosenfeld, 2007). Instead of profiting from just one positive effect, it is likely that firms aim to explore the range of positive effects as far as possible. Which is why, from the campus perspective, the value of other effects in addition to stimulating innovation is recognized in this paper. Arthurs et al. (2009) investigated several cluster initiatives in Canada resulting in six main- and fifteen sub-constructs concerning cluster development;



- | | |
|------------------------------|---|
| 1) Factors: | Human Resources, Transportation, Business Climate |
| 2) Supporting Organisations: | Innovation and firm support, Community Support, Suppliers |
| 3) Competitive Environment: | Local Activity, Firm Capabilities |
| 4) Significance: | Critical Mass, Responsibility, Reach |
| 5) Interaction: | Identity, Linkages |
| 6) Dynamism: | Innovation, Growth |

In turn, these fifteen sub-constructs represent 34 indicators in relation to cluster development. In fact, the innovation sub-construct is mapped by; R&D Spending, Relative Innovativeness and New Product Revenue, as (relatively) measurable factors relevant for cluster development. Arthurs et al., (2009) emphasize the importance of performing on as many indicators as possible, since it directly influences the main- and sub-constructs and thereby the potential of developing a cluster success.

3.2.2 Critical success factors and cluster evolution

Tavassoli & Tsagdis (2014) in turn identified fifteen different Critical Success Factors in relation to cluster success:

- | | | |
|--------------------------|-----------------------------|----------------------------|
| 1. Vision. | 2. Strong actor(s). | 3. Entrepreneurship. |
| 4. Trust. | 5. Physical infrastructure. | 6. Company base. |
| 7. Geographic proximity. | 8. Networking. | 9. Staff attraction. |
| 10. Knowledge tradition. | 11. Finance. | 12. External links. |
| 13. Brand Name. | 14. Innovation. | 15. Support Organisations. |

These factors represent an extensive framework of Critical Success Factors during the four Cluster Lifecycle stages (see paragraph 3.3). For instance, the factor Trust (4) is meant between cluster firms and between firms and other support organisations, which slightly differs during the four development stages (Tavassoli & Tsagdis, 2014). For the specific cluster, which has been investigated

by Tavassoli and Tsagdis (2014), the factor Support Organisations appears to be declining in importance starting at the maturity stage, highlighting the changing nature of the different factors. According to Tavassoli and Tsagdis (2014), several of the identified factors are somewhat related to each other, which is why the author argues that performing weak on one factor, might result in a negative influence on other factors. This simple principle applies to most factors that contribute to the successful performance of a cluster. This extensive list of critical success factors represents a solid and encompassing view on cluster development and cluster success.

3.2.3 Success factors and cluster evolution

The paper of Su and Hung (2009) is a great example how scattered and fuzzy the research landscape on cluster success factors currently is. Whereas the previous sections illustrated a long list of different constructs or factors, Su and Hung (2009) make a distinction between (innovation) clusters, which might be 'spontaneous' or 'policy-driven', throughout their life cycles. During the evolutionary process of the Biotech Clusters the authors investigated, five success factors were identified (Su & Hung, 2009):

1. A strong science and industry base
2. Finance supporting mechanisms
3. Entrepreneurship
4. Social Capital
5. Networking

The first factor is a strong science and industry base, including strong Networks between industry and science (Chiesa & Chiaroni, 2005) are an import prerequisite for cluster success. A strong scientific and industry base can facilitate growth of both academic and industrial spin-offs. The second factor finance supporting mechanisms are important for cluster formation since product development (especially in Biotech) is often a long, risky and costly process. Pre-seed capital, seed capital, government funds or venture capital could therefore prove to be of great importance (Chiesa & Chiaroni, 2005). Entrepreneurs in turn are active agents who organize resources, are a critical element during the formation and viability process of innovative industries and Clusters. Maskell and Malmberg (1999) back this idea by proposing that the key of cluster success is promoted mostly by the third factor: local Entrepreneurship. Social Capital is the fourth factor, defined as the ability to secure resources by the virtue of membership in social networks and/or larger social structures (Portes & Mooney, 2002). High-tech economic development should therefore be based on trusting alliances and partnerships (Phillips, 2005), making social capital essential for a region in order to build trust among civic organisations. The fifth and last factor is Networking, which means creating links between industrial participants at the core of a successful cluster. In addition to the essential role of geographic proximity, collaboration among organisations is a key component of success growth (Su & Hung, 2009). The last three factors are somewhat intertwined, illustrated by an entrepreneur who could not succeed without an atmosphere of trust.

3.2.4 Campus building blocks

Earlier on we noted the BCI definition of innovation campuses. This section aims to sketch four core elements of a campus according to the same BCI investigation. The business community involved in a campus might range from start-ups and SMEs till large (multinational) firms and new foreign companies, depending on the type of campus. According to BCI (2009), a campus consists out of four core elements or constructs:

1. *'A High-end physical business locations and research facilities'*; highlight the availability of a physical space offering high-end opportunities for knowledge-intensive activities and for (shared use of) laboratory-, cleanroom- and testing facilities.

2. *'A distinct focus on R&D/innovative activities'*; indicates that in order to achieve innovation, joint product development and the exchange of knowledge, the campus focus has to be directed to R&D and/or knowledge-intensive activities.
3. *'An Evident Knowledge Carrier'*; is embodied by the presence of a large evident knowledge carrier who is physical and substantially involved and acts as the 'anchor tenant' at the campus. There are several types of potential knowledge carriers, such as: a Multinational, a (Technical) University, an Academic Medical Centre or a large research institute. The term 'evident' illustrates that the company or institute is of substantial size and has a strong reputation in relation to a specific theme or technological field.
4. *'Active Open innovation (OI)'*; can be embodied by the presence of an organisation dedicated to open innovation. An organisation that is engaged in; collaborative partnerships inside- and outside of the campus, knowledge transfer, knowledge valorisation, networking, business development and the acquisition of (new) companies.

The four core elements identified in the BCI model (2009) and the element-related factors represent a solid foundation in researching successful innovation campuses. Can these elements actually explain differences in success between the different campuses? Up till a certain level it probably can, since the elements identify the general building blocks of a campus.

3.3 Deriving factors from literature

We highlighted four clearly different models and perspectives on clusters and cluster success. Let alone the different amount of relevant success factors, all models seem to be somewhat intertwined. However, do these theories or models fully explain cluster of campus success? For example, when talking about such a dynamic cluster environment, the BCI model seems to be too generic, perhaps even insufficient. For example, even BCI themselves (2014, p10) state: *"A technology cluster can be successful without a campus, a campus cannot be successful without a dynamic and vivid cluster"*. This suggests a great influence and importance of the campuses: external environment, but in the BCI model, externality barely scratches the surface. Moreover, the BCI model suggest a 'dedicated' open-innovation organisation, but does not state who should pick up such a task, how such an organisation should be shaped, and what the actual activities and responsibilities of such an organisation entail. The model is also unclear about the nature of a specific campus and its origins. In turn, both Arthurs et al. (2009) and Su and Hung (2009), used all-encompassing success factors as well, leaving the other models to be more detailed in describing a variety of factors.

Firstly, the innovation campus as a cluster within a cluster will be mapped. In fact, according to the analysis by BCI (2014), there is a distinct relationship between campuses, clusters and the regional economy. Campuses offer a critical mass and form a physical base of clusters (BCI, 2014). With a specific focus, campuses can highlight that in which a (regional) cluster performs excellent in. Therefore, it is likely that an innovation campus can contribute to the development of the cluster it operates in. Fact is however, academic- and practitioner literature both cannot fully explain cluster- or innovation campus success. Without making the bold assumption that we can do so, we will aim to develop a success factor-framework that dissolves the fuzziness around cluster and innovation campus success. However, it is likely that a variety of different factors will always be somewhat intertwined and/or directly linked to each other. With that in mind, we developed a framework based on the existing literature. In fact, out of a selection of papers we identified fourteen factors or constructs (e.g. Arthurs, et al., 2009; Su & Hung, 2009; Tavassoli & Tsagdis, 2014; BCI, 2009) that ought to contribute to both cluster and campus success. This factor-framework is derived from literature by comparing the different models and constructs. The overlapping factors were removed or combined and vague terms were adapted, which resulted in a list of (redefined) factors that should cover factors potentially leading to campus success or could turn out to be developmental pitfalls or bottlenecks. This factor-framework however, leaves room for slight changes and even new

factors based on the outcomes of the case analysis. For an overview of developed factors see Table 1 and for additional information see Table A1.

Table 1 - Factors potentially resulting in campus success or pitfall.

Factor (potential success or pitfall)	General Factor description (Potential Activities)
Geographical proximity	Internal and external closeness/focus (e.g. proximity among campus participants or between other actors, such as; University, policy makers and financial institutions)
Physical infrastructure	Basic: Energy, Communication, Transport, etc. Specialized: Laboratories, Research Institutes, Conventions Centre, etc.
Willingness and Capacity for (Open) innovation/R&D within- and among firms (Entrepreneurial perspective)	Investing as campus participant in enhancing R&D capacity (Knowledge, Skills, Facilities) and could move towards a more Open innovation approach (initial task Promotor Role Actor).
Clear Profile/Right Vision	Developing a broadly supported campus Profile and Strategy among participating- Firms/Institutes, campus Support Organisations, and Policy Makers.
Capacity for Achieving Campus Consensus	Clear communication in relation to campus- strategy and future plans creating value and to align campus interests.
Evident Knowledge Carrier/Strong anchor actor	A strongly acting anchor tenant; (Technical) University, Multinational firm, University Medical Centre.
Pre-existing (unique) Knowledge	Local or Regional Knowledge culture. No direct influence, but important prerequisite. Campus relevant Technologies/Industries in the region preceded the campus.
Dynamic and/or Growing Company base	Diverse portfolio of firms and organisations of all sizes in order to increase dynamic culture. Mix of thriving start-ups, SME's, Multinationals and Research Institutes.
Trust/Social Cohesion	Among campus- firms, institutes, and Support Organisations. Stimulating trust through strong communication, clear vision, events and successful (small) collaborations.
Networking	To increase knowledge integration, added value and link to international market. Stimulating local- and extra local collaboration among campus firms and between firms and other actors (e.g. Support Organisations, policy makers).
Support Organisation(s)	Intermediary campus- or other types of Organisations (Incubator, Knowledge Exchange Centre, etc.), perhaps through paid campus services; campus promotion, Social cohesion, providing (Financial, IPR, HR) guidance (Competence support), Coordinating R&D projects, Inter-firm and firm-university cooperation, and stimulating spin-offs.
Access to Finance/Venture Capitalists	Essential (especially for start-ups) for stimulating innovation. Originated from the Government, Financial Institutions, Venture Capitalists and Industry, to the firms and institutes.
Brand name	Utilizing the Brand name. E.g. Strengthens the attraction of investment and venture capital, new firms, skilled workers, complementing the marketing of campus firms.
Talent/Staff attraction	Obtaining talent from outside the campus, due to regional atmosphere, government efforts, campus Brand name. Selling the campus.

The fourteen identified factors are considered to be potentially leading to success, but in turn can prove to be pitfalls during campus development. The different factors in Table 1 form a descriptive framework on which the empiric part of this investigation is built. All of these factors were addressed during the semi-structured interviews with the representing campus experts, while keeping in mind the different stages of campus development. To be able to map these stages, or a certain campus

development trajectory, this paper considers the Cluster Life Cycle models by Menzel and Fornhal (2009) and Martin and Sunley (2011) to be suitable to transform to the innovation campus level. There is no direct reason to assume that the life cycle of an innovation campus will greatly differ from that of clusters, which is why the four relatively similar main phases of the two models; 1) Emergence, 2) Growth, 3) Sustainment/Adaptation and 4) Decline/Renewal, form a guiding structure in describing the campus development process or trajectory.

The following chapter makes the jump to the five cases under investigation by identifying individual campus success, pitfalls and development trajectory.

Chapter 4 Results of analysis: Dissecting five Dutch innovation campuses

In this chapter, the five different cases are being thoroughly investigated with the main goal of identifying the most important factors that contribute(d) to their respective development to campus success. As stated in Chapter two, not only the potential success factors per campus were identified, but this investigation also aims to map the (top three) pitfalls, which the campus organisations identified during their development, or in retrospect identified as lessons learned. As mentioned earlier, experts from the five cases: 1) Leiden Bio Science Park, 2) Wageningen Campus, 3) Kennispark Twente, 4) High Tech Campus Eindhoven and 5) Brightlands Chemelot Campus, were interviewed. Despite the open nature of semi-structured interviews, the interviewer made sure that all factors derived from literature were addressed in one-way or another, while keeping room for personal contributions from the experts. We recognise that the experts are more inclined to talk about campus success, which is why during the interviews their potential pitfalls were subtly dealt with.

Per case, a short general description of the campus and the representing expert will be provided, followed by a set of factors potentially leading to campus success or the potential pitfalls the campus organisations might have faced. During the semi-structured interviews, these factors were identified, described, valued and put in time perspective by the experts. As mentioned in paragraph 2.3, the main focus of the analysis is set on the top five potential success factors (one being most valued) and the top three potential pitfalls (one being most valued), due to relatively large differences in perceived factor value. These factor values (one to three/five) were explicitly stressed by the experts or were derived from the transcribed data, after which an evaluation check has been done. All factors can be considered both a success and/or pitfall, which if that is the case will be explained during the individual case analysis. Every case paragraph contains a campus specific factor explanation section for both potential- success and pitfall. Each case concludes with a campus development trajectory model, in which the different life cycle stages have been taken into account in relation to the relevant factors. For the purpose of this research, campus development is considered to be campus growth, which can include a variety of facets (physical infrastructure, growing employee and/or company base, improved campus cohesion, etc.). If not specified in the text, development of the campus includes all of these aspects. The full list of relevant factors used for analysis can be found in Table 1.

4.1 Leiden Bio Science Park: Academically Driven

Founded in 1984, nowadays the Leiden Bio Science Park (LBSP) counts 173 (2014) organisations from which over 90 medical life science- companies and institutions. The LBSP houses the largest number of bioscience start-ups in the Netherlands, several multinationals and internationally renowned research institutes. LBSP is considered to be a mature science cluster (BCI, 2014), which includes drug-developing companies in all stadia of the value chain in addition to the top academic R&D institutes of Leiden University (LU) and Leiden University Academic Medical Centre (LUMC).

LSBP 2014 expressed in numbers:

<p>Leiden Bio Science Park in 2015 - Founding 1984</p> <ul style="list-style-type: none"> • Organizations: 173 • 130 Companies :93 Medical, 37 Other • 19 Research Institutes • 10 Healthcare organizations • 14 Others • Employees: 16907 • M²: 110 Ha • Academic origin: 	<p>Wageningen Campus in 2014 - Founding 1998</p> <ul style="list-style-type: none"> • Organizations: • 90 Companies • 9 Research Institutes • Employees: 1800 + ± 5000 Wageningen UR personnel located in Wageningen (50:50 University and research insitutes) • M²: 50 Ha • Academic origin 	<p>Kennispark Twente in 2014 - Founding 2006</p> <ul style="list-style-type: none"> • Organizations: • 400 Companies • 360 Start-ups • Employees 5741 + 3000 University • M²: 12Ha campus, 20 Ha total • Both Academic and Business origin 	<p>High Tech Campus Eindhoven in 2014 - Founding 2003 (renewal in 2012)</p> <ul style="list-style-type: none"> • Organizations: 145 • 132 Companies • 13 Institutes • 36 Multinationals • 55 Start-ups • Employees: 10000 • M² 103 ha • Business origin 	<p>Brightlands Chemelot Campus in 2014 - Founding 2012 (renewal in 2008)</p> <ul style="list-style-type: none"> • Organizations: 85 • 74 Companies • 11 Research Institutes • Employees 1540 • M²: 20 ha • Business Origin
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The representing expert who was interviewed for this researched, works for the Leiden Bio Science Park Foundation (founded in 2006, including five FTE), one of the four organisations facilitating the innovation campus. The foundation mainly focuses on stimulating the development of the LSBP within their organisational responsibilities. After having analysed the interview, the following main factors were identified:

Table 2 - Success factors and Pitfalls Leiden Bio Science Park

Success factors	Pitfalls
1. The presence of Evident Knowledge Carriers/Strong Anchor Actors - Represented by LU and LUMC as main sources of (new) knowledge, technology and students/talent and are the main stimulators of cooperative projects and partnerships. Enhancing and creating new knowledge is leading for these organisations (academic perspective).	1. Deficient Access to Finance/Venture Capitalists - Proved to be difficult due to absence of regional development fund (nowadays resolved). Since R&D in Bio Science is quite costly, obtaining access to new sources of finance was key.
2. The existence of a Dynamic or Growing Company Base - As a stimulating factor for innovation- dynamics and output, especially since the increasing number of start-ups. These dynamics are perceived to improve collaborative activities among campus participants (mostly university-business).	2. Lacking of coherent Support Organisations - Affects the effectiveness of this 'success factor'. The scattered landscape of (somewhat overlapping) support organisations raises obstacles due to possible financial, communication and responsibility issues. There are plans towards one powerful support organisation, declining bottleneck effects.
3. The availability of Support Organisations - Represented by four campus Organisations (e.g. focussed on Financial- and Legal advice, Intellectual Property Management and start-up guidance). Although important, not highly effective partly due to the absence of one strong campus organisation. The Triple Helix partnership (for basic needs: infrastructural activities, permits from local government) is considered by LSBP as some sort of Support Organisation as well.	3. Lack of Capacity for (open) Innovation and R&D - Among the different firms sometimes proves to be difficult. There is a deficiency of collaboration on (open) innovative activities, which results in golden fruit picking at the LSBP. While campus firms are highly capable to innovate (internal), sharing IPR proves difficult. In fact, the firm Jansen Biologics only opens up when it suits them (e.g. to attract finances and talent, etc.). A mind-set of close innovation makes OI quite difficult, which negatively affects start-ups.
4. A Clear campus profile/vision - Set as Bio Science by LU as landowner and LUMC (nowadays defined and protected through Triple Helix Partners ¹ , through contracts), ensuring that new campus entrants fit the campus profile.	

¹ Triple Helix Approach - In addition to the neo-institutional model of networked relations among 1) Industries, 2) Universities and 3) Governments, the Triple Helix model can be illustrated in a more neo-evolutionary context as three selection environments operating in relation to each other; markets, organisations and technological opportunities (Leydesdorff and Zawdie, 2010). These environments fulfil three social functions; creating wealth, organisation control and organised production of knowledge (Leydesdorff and Zawdie, 2010). During the interviews it became apparent that the Triple Helix Approach played an important role during the campuses development, in one way or another. Most experts viewed the Triple Helix as a combination of Support Organisations with their own respective tasks.

5. Availability of Talent - Since attracting and retaining talent is both a success and a cause of success, the LSBP organisation greatly values attracting new Talent.	
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4.1.1 Success: Building upon the Bio Science foundation

The success from the LSBP can be traced back to the founding organisation and the single two Evident Knowledge Carriers; Leiden University (LU) and Leiden Academic Medical Centre (LUMC). According to the expert, the first two decades of the LBSP can be described as “*growing organically*”. During this period of time, the university as landowner of the park actually took a somewhat unnatural role of stimulating R&D and business on its campus. It became apparent that the LU was not fully equipped for this task, which is why other organisations such as the Leiden Bio Science Park Foundation were established. In fact, the LU, the LUMC, and the local government decided to join forces by collaboratively working on acquisition, promotion and the self-proclaimed internal cohesion at the campus, which resulted in the LSBP foundation. Over time, additional to the LBSP Foundation, three organisations have been established for the function of; park management & maintenance and joint facilities (OV BSP), (start-up) Incubation (BioPartner Centre) and Knowledge Exchange (Luris). According to the expert, Luris, BioPartner Centre and the LSBP Foundation are the main drivers of the campus and its development.

Companies located at the LBSP fiercely compete for international (top) **Talent (5)** personnel with the external environment and even among the campus participants. The expert illustrates that the relative success in attracting external talent is not only the result of the campus ‘brand-name’, but also due to the regional atmosphere and government efforts. In fact, the initiative by the city of Leiden and its surrounding region called: ‘Economino 71’ is a project aimed to improve the quality-of-life in the nearby surroundings by stimulating for example luxury residential settings. By doing so, attracting talent can be considered to be a valuable input as well as output. Initiated by the university, the **Clear Profile (4)** and strict participant selection procedures have quickly been acknowledged by local and regional government. In fact, the parties involved did put their agreeing minds in writing, stating the ‘Life Science’ profile and identifying the different stakeholders. This appears, and is acknowledged by the expert, to be a great example of a well-functioning **Triple Helix Approach**, in which the different parties play their own supporting role. The expert stated: “*we aim to work as closely as possible with our Triple Helix Partners, mainly to ensure close cooperation and to enable our basic needs*”.

Additional to support from policy makers, the expert highlights the importance of **Supporting Organisations (3)** at the campus. In fact, the BioPartner Centre (Incubator) provides housing and testing facilities for start-ups and also makes (mostly financial) guidance available, organises networking events and readings. Transcending merely the start-up level, Luris (Knowledge Exchange Office) aims to connect scientists from Leiden University and LUMC with the market and society. Luris is eager to search for- and establish partnerships, attempt to fund as much research as possible and to enhance the societal impact of Leiden research (not just business-university impact, but society as well). With a multidisciplinary approach, Luris actively searches for opportunities for campus residents and assists in knowledge partnering, entrepreneurship, legal, grant development and public relations. In turn, the LBSP Foundation is set as the first link between the campus and the external environment, actively searching for-, welcoming and embedding new participants; “*We have the important responsibility to ensure that a newly located organisation becomes embedded in the campus community*”. The organisation also initiates marketing activities (websites, brochures, presentations, etc.) and above all attempts to function as campus intermediary.

In fact, to stimulate internal cohesion the foundation organises a variety of events and meetings, such as drinks, tech-talks, subject- or project specific meetings, all of which the expert considers the

monthly 'Life science café' as perhaps most important. The expert states: *We mostly organize networking activities such as drinks, introductions of new companies to the community, but also aim to connect science to practice through 'Tech Talks' such as Ginomics, or via Pharma symposia.* Face-to-face contact is the most important aspect of these events. The frequency of specific activities varies greatly depending on the need or perceived need from the community. For these activities to be effective, the expert highlights the value of a **Dynamic and Growing Company Base** (2). Differences between the campus residents varying from age, nature and size, seems to be greatly important in order to create a dynamic atmosphere at the park. With aid from the supporting organisations, the different companies ought to be (relatively) complementary to each other, being in a collaborative/co-operative or competitive sense, thereby stimulating each other in accelerating internal- and collaborative innovation. However, the joint collaborative activities are quite moderated due to fear for damaging IPR (see paragraph 4.1.2). Nevertheless, the university acknowledged the importance of a dynamic company base, sketched by the expert as: *"In cooperation with other parties, the university is in the process of founding the Leiden Centre for Innovation and Entrepreneurship to foster new and joint collaborative activities"*. It appears that most of these innovative stimuli can be traced back to the **Evident Knowledge Carriers** (1) of the campus. Whereas the Leiden University and LUMC use to, and still are the strong actors of the campus, several multinational firms have complemented that selection. In fact, Janssen Biologics for example, greatly contributes to the value of the park concerning employment and appearance. However, the increase of sizable companies also has a downside, which will be elaborated on in the next paragraph. Since the LSBP has to combine the scientific focus of the main actors, the university and LUMC, and the business focus of the participating companies, the expert recognizes the difficulty of finding a suitable balance. A balance that presently is mainly directed to enhancing knowledge production. Nevertheless, the presence of such strong actors seems to be the main driving force of the campus.

4.1.2 Pitfalls: Social- as well as organisational cohesion

As mentioned earlier, the development of the campus and the increase of participants, especially the strong actors, presented not only benefits but also several problems. For the expert, the exchange of knowledge (stimulated by Luris) is negatively affected because of the nature of the Bio Science Industry, in which protecting Intellectual Property Rights (IPR) is considered to be of key importance for a company. IPR related protective measures from the campus firms' hampers Open Innovation and innovative collaboration in general, which is portrayed by: *"Several firms on campus make use of shared facilities and shared ID, but with moderation, which is exemplary for the merely basic forms of collaboration"*. In fact, the presence of large multinational firms or Evident Knowledge Carriers at the campus, makes it quite difficult for start-ups and other 'smaller' firms to get to the 'golden fruits', which are way too expensive to develop by themselves. The campus **Capacity for Open Innovation and R&D** (3) seems to be affected by the fruit picking by multinationals. In fact, Janssen Biologics appears to be an example of a company that focuses extensively on obtaining relevant knowledge, talent and skills through acquisition. *"The three different subsidiaries from Janssen form a small world on its own"* according to the expert. This one-way-street acting negatively affects the actual exchange of knowledge and talent since firms, both small and large react by protecting their assets, which decreases trust and internal cohesion. Building trust and internal cohesion among the participants seems to be negatively affected by the absence of one strong and all-encompassing intermediary organisation. The expert confirms this, since at the LSBP four different **Support Organisations** (2) are tasked within their own respective fields resulting in relatively uncoordinated, unnecessary and unwanted activities. The lack of cohesion among the support organisations and the dispersed resources reflect in a relatively weak output. This being said, at this point in time, the LSBP is planning to merge the activities, resources, and responsibilities of the organisations in order to create a more streamlined organisation. *"We expect that merging the different campus organisations results in more effectiveness"*. The expert mentioned that one of the main obstacles or pitfalls during

the development of the LSBP was the absence of a regional development agency, which contrasted with other regions in the Netherlands. Obtaining **Access to Finance and Venture Capitalists** (1) proved to be very difficult and since conducting R&D in this specific field is highly cost intensive, the absence of such resources hampered the development of the campus. The expert stated: *“despite that we are well-equipped, academic, strong employee base, etc., the absence of a regional development fund proved to be a disadvantage relative to other regions”*. A stronger networking lobby would have been useful in obtaining such access, which nowadays they do have in addition to a regional development fund.

4.1.3 Process: Stimulating Bio Science

This paragraph provides a comprehensive process model illustrating the campus development trajectory of Leiden Bio Science Park.

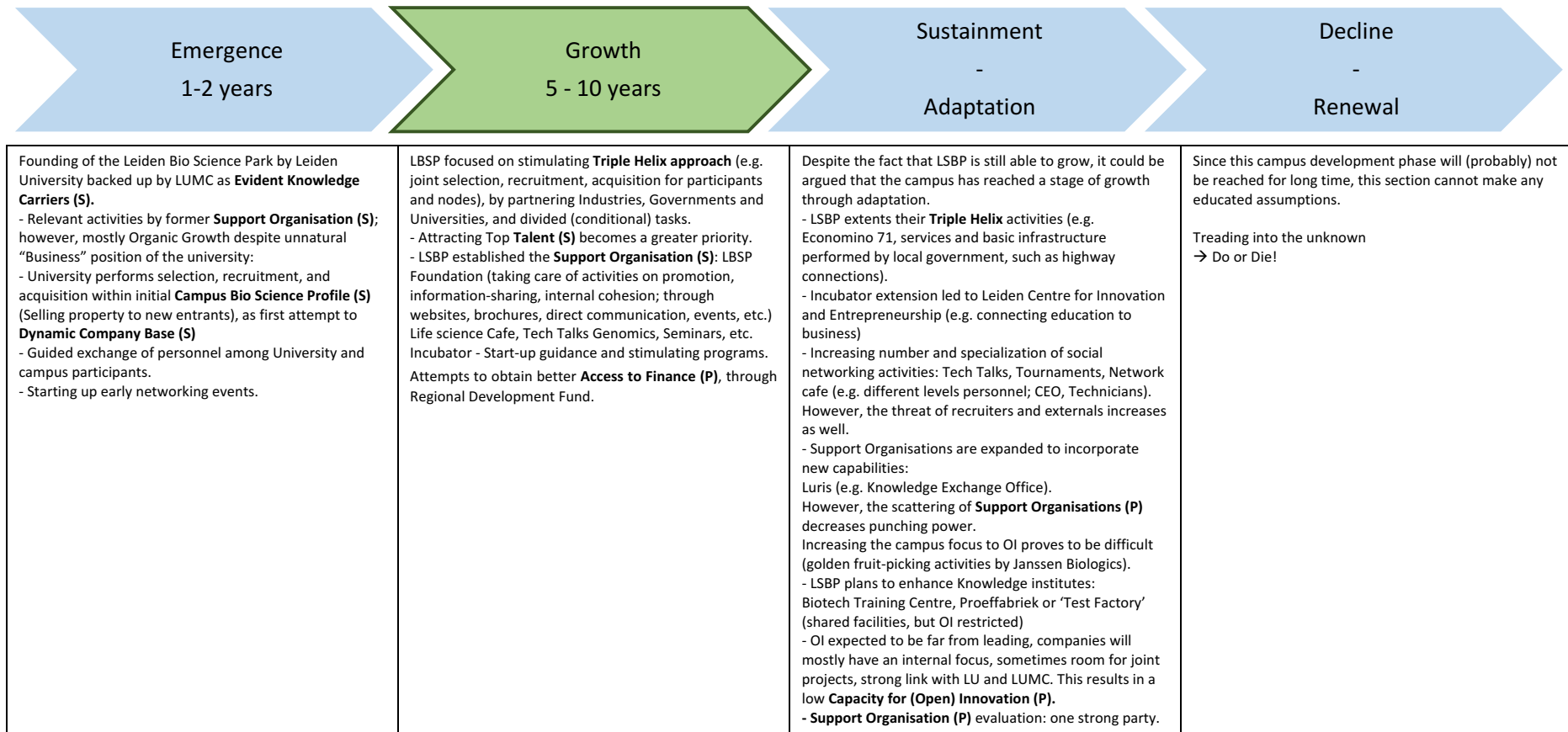


Figure 3 -Leiden Bio Science Park development trajectory.

Legend: S: Factor potentially leading to success, P: Factor potential pitfall.

Figure 3 illustrates the different phases of LSBP development by sketching the different factors identified by the LSBP expert in a campus life cycle context.

4.2 Wageningen Campus: Academically Driven

In 1998, the Wageningen University and the contract research organisation ‘Dienst Landbouwkundig Onderzoek’ (Service Agricultural Research) merged, resulting in the Wageningen University and Research Centre, or Wageningen UR. Shortly after that, it was decided that the locations of the organisations, which were spread out over Wageningen, would be located on what is now known as the Wageningen Campus. The roots of the University go back almost hundred years, when the first step into agricultural research was set. Continuous development in relation to this subject has nowadays led to the Wageningen UR organisation, which operates in the domain with three core areas: 1) Food and food production, 2) Living environment and 3) Health, lifestyle and livelihood, with its main location in Wageningen on Wageningen Campus. Nowadays, the actual campus consists of two (geographically) closely set locations; namely the terrain around the buildings of Wageningen UR and the Business & Science Park.

Wageningen Campus 2014 expressed in numbers:

<p>Leiden Bio Science Park in 2015 - Founding 1984</p> <ul style="list-style-type: none"> Organizations: 173 130 Companies :93 Medical, 37 Other 19 Research Institutes 10 Healthcare organizations 14 Others Employees: 16907 M²: 110 Ha Academic origin: 	<p>Wageningen Campus in 2014 - Founding 1998</p> <ul style="list-style-type: none"> Organizations: <ul style="list-style-type: none"> 90 Companies 9 Research Institutes Employees: 1800 ± 5000 Wageningen UR personnel located in Wageningen (50:50 University and research insitutes) M²: 50 Ha Academic origin 	<p>Kennispark Twente in 2014 - Founding 2006</p> <ul style="list-style-type: none"> Organizations: <ul style="list-style-type: none"> 400 Companies 360 Start-ups Employees 5741 + 3000 University M²: 12Ha campus, 20 Ha total Both Academic and Business origin 	<p>High Tech Campus Eindhoven in 2014 - Founding 2003 (renewal in 2012)</p> <ul style="list-style-type: none"> Organizations: 145 <ul style="list-style-type: none"> 132 Companies 13 Institutes 36 Multinationals 55 Start-ups Employees: 10000 M² 103 ha Business origin 	<p>Brightlands Chemelot Campus in 2014 - Founding 2012 (renewal in 2008)</p> <ul style="list-style-type: none"> Organizations: 85 <ul style="list-style-type: none"> 74 Companies 11 Research Institutes Employees 1540 M²: 20 ha Business Origin
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The representing expert, who was interviewed for this researched, works for Wageningen UR as Campus Development Manager (founded in 2006, including one FTE). Other activities and roles concerning the facilitation of the campus and its participants are relatively scattered throughout the Wageningen UR organisation. After analysing the interview, the following main factors were identified:

Table 3 - Success factors and Pitfalls Wageningen campus

Success factors	Pitfalls
1. A Clear Profile/Right Vision - Means that the Wageningen campus profile is clearly set around the AgroFood, Health, lifestyle and livelihood theme, which comes natural due to the regions’ background. This profile provides a clear setting for new campus entrants, ensuring a strong fit among the campus members.	1. The Capacity for achieving Campus Consensus - Sometimes proves to be difficult. It is likely that the dominance of Wageningen UR is seen as an obstacle for the companies located at the business part of the campus. These companies might feel left out. However, a cautious shift towards joint collaboration (e.g. via start-ups) seems to become relevant.
2. The Wageningen Brand name - Since the Wageningen region is (historically) worldwide renowned for its specialisms. The campus greatly utilizes the Wageningen brand factor for a variety of outcomes (e.g. attracting talent, attracting Venture Capitalists and developing new partnerships).	2. The idea of Support Organisations - Appear to be not that relevant at the campus, since really strong support organisations are absent or quite scattered. Due to organic growth, the necessity is perhaps missing but it seems likely that a strong support organisation could proves beneficial, when joint collaboration becomes more relevant.
3. A campus Evident Knowledge Carrier - Is represented by Wageningen UR as main source of (new) knowledge and technology. The entry of companies such as Friesland Campina seems to alter the current balance, but still	3. The Wageningen Clear Profile/Right Vision - Might deter other types of companies and organisations that might be relevant for the located organisations. Such a profile could sometimes be a factor of strength and

enhancing knowledge creation via the university and the campus institutes is leading instead of a more commercial focus. The campus appears to be functioning from an academic perspective.	sometimes a weakness since it could deter other relevant (e.g. lifestyle, health) organisations. This factor functions as both success and potential pitfall. However, large negative effects of the factor restrictions seem to be avoided quite well.
4. The Dynamic and (still) Growing Company Base - Since the campus houses a variety of different (levels of) firms, supplemented by companies in the region. This vibrant mix results in organically developed partnerships (mostly business-academic). However, the slight shift to joint collaboration seems to have begun, perhaps even enhancing the campus dynamics.	
5. Effective Talent/Staff Attraction - Since new talent ensures higher quality, while higher quality ensures more new talent. International student and employees' populations represent over 100 nationalities, which seems partly due to the Wageningen Brand.	

4.2.1 Success: 'The Wageningen way'

As stated earlier, Wageningen has a long tradition of conducting research in relation to agriculture, food and health. Due to their successful track record and ground-breaking research in this field, for many people in the Netherlands and in the rest of the world, mentioning Wageningen or Wageningen University immediately rings a bell. The representing expert from the Wageningen campus started the interview by mentioning the benefits of having such a reputation in for example attracting new **Talent** (5). This first statement represented a reoccurring theme, which actually combines the first three main success factors, with the two follow up success factors as a positive output and a necessary input. In fact, the participants of the Wageningen campus strongly benefit from the 'Wageningen' Brand when attracting new talent. With the university as **Evident Knowledge Carrier** (3) and strong anchor actor, the strong **Brand Name** (2) it is associated with, and the projection of a **Clear Profile and Vision** (1), it appears that these factors are strongly connected.

The clear profile of the Wageningen campus is according to the expert, the result of decades of strong research from the Wageningen University (and other closely located institutes). Over time, the reputation of Wageningen and its direct region strongly improved, making it quite easy to use knowledge in that field of research in building a strong and recognizable profile. According to the expert: *"Due to its importance, the campus profile is constantly being reviewed since the domain the campus residents operate in is becoming increasingly dynamic"*. In turn, the university largely determines the direction of the campus profile, of which enhancing knowledge production is one of the focal points (academically driven campus). Promotion of the Wageningen campus seems to be mainly based on the presence of the university and research institutes and re-acknowledging the Wageningen reputation. This occurs through websites, brochures and especially through ambassadorship of the students and companies. A specific focus on promotion has been set on students, since attracting top international students is of key importance for the university. Clearly, despite the already established Wageningen brand, the organisation actively searches for talent. The expert stated: *"The Wageningen- or Wageningen University Brand is possibly quite a bit stronger than the brand of the Wageningen campus. However, the outside world often does not perceive any difference, which makes a strong Wageningen Brand equal to a strong campus Brand"*. Nowadays, that profile is firmly set and looked after by the university, regional development agency (acquisition partner via Food valley), and local government. In fact, the university is still owner of most of the campus terrain and has therefore the largest say when it comes to attracting new companies or other organisations. However, not only do new organisations have to fit within the current campus profile, they have to assure their own investments, since the university does not directly use financial resources for developing new businesses or institutes. For instance, a new incubator building will be

realised without any financial support of the university, while in turn, the university does invest in the campus as facilitator (e.g. terrain, local infrastructure, acquisition, programming, etc.)

The role of the university has been poured solid as strong campus actor and Evident Knowledge Carrier. Wageningen UR does not only conduct a vast part of the total campus R&D activities, the organisation attempts to involve other institutions and companies during the research processes. In fact, a lot of the research conducted by the university and its research institutes is being co-financed by interested firms. Quite often, those organisations are not just interested in the research outcomes, but also in the people conducting the research. As the university and the university brand attract a lot of international talent, many companies aim to get more involved during the research processes and by doing so; hope to in turn attract new talent as well. This repetitive cycle of attracting talent is concerned by the expert as important in keeping up the extremely high level of research and related activities. The expert highlights that: *“The great diversity in nationality of both talented employees and students illustrates a difficult discussion if attracting Talent is a tool or an outcome, since we profit from both”*. The Wageningen concept did not just attract new talent. Over the past years a vast amount of companies and research institutes have started their business in Wageningen or have located on and around the campus (e.g. FrieslandCampina, NIOO-KNAW, MARIN, KeyGene, Noldus, Kikkiman, NVWA, etc.). Now, there is a mix of organisations complementing- and/or competing with each other.

An increasing number of start-ups, several (inter)national companies, a variety of research institutes and the vibrant setting of the University forms a **Dynamic and still Growing Company Base (4)**. According to the expert: *“this mix is crucial in relation to campus development and the overall success of the campus, which is why we increasingly focus on stimulating entrepreneurial activities”*. At a certain level there is a synergy among the campus participants that increases the likelihood of in collaborative innovative activities. However, the expert illustrated that a number of companies did not locate in at Wageningen Campus in order to conduct more collaborative activities and to innovatively co-develop. In fact, the focus of the companies seems to be often set on the Wageningen Brand and the potential of attracting new- top-talent and knowledge from the university. Wageningen campus success might therefore differ somewhat from other campuses. Enhancing and creating new knowledge is considered to be the guiding principle at the Wageningen Campus. The expert however, recently identified a slight change in the campus mind-set; *“for some companies, especially those that have located on the Wageningen campus more recently, collaboration is becoming an increasingly important factor”*. Although there is no general campus consensus on co-development and co-creation among the relevant campus parties, future collaborative activities among campus participants are to be expected. However, these innovative efforts seem to be at quite an early stage. Since at this point in time, the interests of the campus residents seem to differ and even sometimes contradict, the dominant role of the university, and the absence of a strong intermediary organisation seemingly highlight the relevance of ‘organic growth’ of the campus. Nevertheless, resident’s largely focussing on their own interests does not seem to affect the dynamics and output of the campus in a negative way and future efforts supporting collaboration could even enhance these campus dynamics and organisational performance.

4.2.2 Pitfalls: Wageningen-region, Wageningen UR or Wageningen campus?

In fact, despite recently prudent interests in collaboration and aside from the fact that the majority of campus participants act and operate in the same domain, the different organisations appear not to share a common understanding or believe in relation to co-creation and co-development yet. In general, innovative activities appear to be more internally orientated, especially after the pre-competitive phase, in which joint research is conducted with the universities. Exemplary, the expert illustrated that *“the closely located Business & Science Park sometimes feels underrepresented by the Wageningen campus as a whole”*. Partly due to the strong **Profile and Vision (3)** of the campus, the

Wageningen UR is quite dominant, resulting in other organisations having less exposure. In turn, for start-ups, the university poses a positive motivation to locate on the Wageningen campus in order to be 'close' to such a source of relevant knowledge.

The absence of strong **Supporting Organisations** (2) other than Wageningen UR itself illustrates the dominance of the university and might also explain the difficulty in **Achieving Campus Consensus** (1), *"Since it is quite difficult to represent all the different parties"*. The interests of the participating organisations do not seem to be aligned equally. Wageningen UR as support organisation could imply a certain prejudice towards the University, which might result in the participants feeling underrepresented. The expert provided another example: *"Universities have to publish their findings, while firms aim to protect those. Research institutes could be a middle station, at which innovative collaboration could be conducted more easily"*. The (long term) established campus firms find it difficult to collaborate with one another, while the interest with the largest campus players do not seem to fit. The large multinationals and the Wageningen UR might cast a shadow over the other participants, which could result in a decrease of both trust and perhaps even collaborative efforts. Overall, although not fully recognized by the expert, the absolute dominance of the university seems to form an obstacle or perhaps pitfall for past and future innovative co-operation and co-development. Regardless that the Wageningen campus still seems to thrive 'organically', the focus seems to be increasingly shifting towards collaboration, which could lead to a more general campus consensus on joint innovation.

4.2.3 Process: Building upon the Wageningen Brand

This paragraph provides a comprehensive process model illustrating the campus development trajectory of Wageningen Campus.

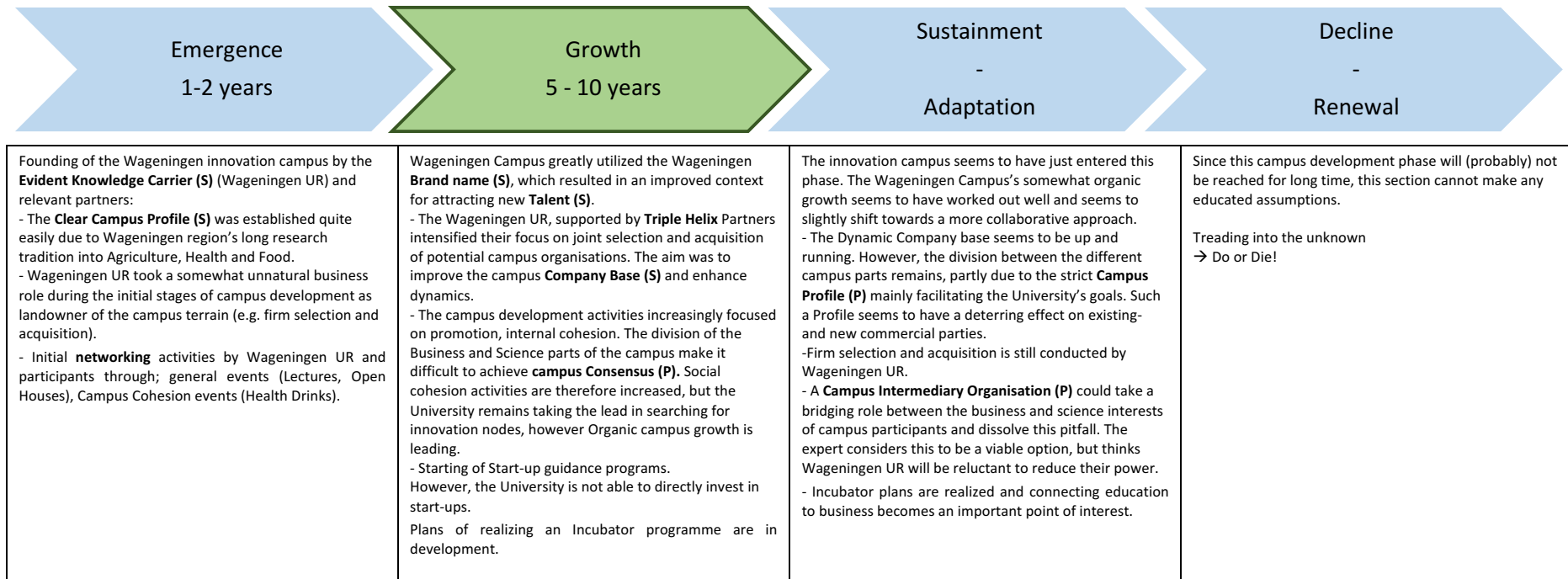


Figure 4- Wageningen Campus development trajectory

Legend: S: Factor potentially leading to success, P: Factor potential pitfall.

Figure 4 illustrates the different phases of Wageningen Campus development by sketching the different factors identified by the Wageningen UR expert in a campus life cycle context.

4.3 Kennispark Twente: Both Academic and Business Driven

The Kennispark Twente Foundation is a joint initiative by the University of Twente, the City of Enschede, the Region of Twente, the Province of Overijssel and Saxion University of Applied Sciences. Through Kennispark Twente, these founding organisations share the economic development goal of creating 10.000 new jobs for the region of Twente. Kennispark Twente Foundation considers itself to be an all-encompassing organisation for the campus of the University of Twente and the directly linked Business Park. However, the organisation does not own any buildings nor additional facilities and infrastructure. Kennispark Twente’s mission is set to further develop an innovative entrepreneurial climate in the region through; 1) Support and support systems for innovative start-ups, 2) Industrial innovation and 3) Attractive Business Climate.

Kennispark Twente - 2014 expressed in numbers:

Leiden Bio Science Park in 2015 - Founding 1984	Wageningen Campus in 2014 - Founding 1998	Kennispark Twente in 2014 - Founding 2006	High Tech Campus Eindhoven in 2014 - Founding 2003 (renewal in 2012)	Brightlands Chemelot Campus in 2014 - Founding 2012 (renewal in 2008)
<ul style="list-style-type: none"> Organizations: 173 130 Companies :93 Medical, 37 Other 19 Research Institutes 10 Healthcare organizations 14 Others Employees: 16907 M²: 110 Ha Academic origin: 	<ul style="list-style-type: none"> Organizations: <ul style="list-style-type: none"> 90 Companies 9 Research Institutes Employees: 1800 + ± 5000 Wageningen UR personnel located in Wageningen (50:50 University and research insitutes) M²: 50 Ha Academic origin 	<ul style="list-style-type: none"> Organizations: <ul style="list-style-type: none"> 400 Companies 360 Start-ups Employees 5741 + 3000 University M²: 12Ha campus, 20 Ha total Both Academic and Business origin 	<ul style="list-style-type: none"> Organizations: 145 132 Companies 13 Institutes 36 Multinationals 55 Start-ups Employees: 10000 M² 103 ha Business origin 	<ul style="list-style-type: none"> Organizations: 85 <ul style="list-style-type: none"> 74 Companies 11 Research Institutes Employees 1540 M²: 20 ha Business Origin

The representing expert who was interviewed for this researched, works for the Kennispark Twente Foundation as Board Member with the portfolio: Industrial innovation and jointly innovation projects. His functioning at the foundation is sponsored by the Regional Development Agency; Oost NV. After analysing the interview, the following main factors were identified:

Table 4 - Success factors and Pitfalls Kennispark Twente

Success factors	Pitfalls
1. Dynamic or Growing Company Base - Is both great potential success and potential pitfall at the same time. The diversity exists but mainly start-ups thrive at the campus. These current start-ups dynamics are of key importance for the campuses development.	1. The Dynamic or Growing Company Base/Geographical Proximity - Is both a success and potential pitfall. Despite the existing diversity, it is difficult to link companies and organisations from different levels (Business to Business and University to Business). Seemingly geographic division between business and science parts. A lot of effort is being put in bridging the gap.
2. The (Clear) Profile/(Right) Vision - Which is widely supported due to broad range of founders (e.g. University of Twente, Saxion University of Applied Sciences, City of Enschede, etc.). In theory, the profile ensures a strict selection of new potential entrants, through the use of a stopping sign model. However, since Kennispark does not own any buildings, the stopping sign model does not apply to the whole campus resulting in conflicted interests (profile vs. renting m ²). Regardless, the profile seems very suitable for start-ups, fitting the dynamic company base.	2. Gaining Access to Finance/Venture Capitalists - Proved to be very difficult. Since introduction of the Cottonwood fund, this situation has improved, but getting access to sufficient funding opportunities sometimes remains a struggle. This shortage of Venture Capitalists obstacle hampers new collaboration initiatives. Difficulties in obtaining Access to Finance also have its effects on the Kennispark Twente Foundation, its capacity, its strength, and leverage on the campus.
3. The Support Organisation - Kennispark Twente Foundation (Triple Helix origin) as main intermediary actor supplemented with other supporting organisations, aimed	3. The Support Organisation - Embodied by the Kennispark foundation, as main intermediary actor is relatively small and financially feeble. Kennispark’s employees and its

to provide guidance for firms (e.g. mentorships, financial advice), stimulates social cohesion through events, and aims to connect potential partners and investors.	finances are 'donated' by the founding organisations, resulting in an agile Support Organisation but with relatively little punching power. In addition, other supplementing organisations are quite scattered.
4. Evident Knowledge Carrier - Is mainly embodied by the University of Twente (e.g. not only knowledge exchange but also spin-off resulting in vibrant start-up scene). As strong campus actor, the university plays an important connecting role in- and external of the campus.	
5. Pre-existing (unique) Knowledge - Is strongly embedded within the region, especially in High Tech Systems and Materials (e.g. Twente region and at University of Twente). Campus residents can relatively easy 'tap' into knowledge.	

4.3.1 Success: A thriving start-up scene

Since in 1964 the University of Twente became the first Dutch university that was built in accordance to the 'campus idea', the concept of an innovation campus where science and business ought to meet felt quite natural. According to the expert however, during the developing stages, there emerged an increasingly 'perceived distance' between the university campus and the directly adjacent business park. The balance between science and business became shaky and shared goals were not met, which is why the Kennispark Twente Foundation was created.

The organisation's main goal is to improve the entrepreneurial climate in the region of Twente and as largest innovation campus of the Netherlands (BCI, 2014; Kennispark, 2015); one might say that they have succeeded. Especially the sub-goal of supporting- and stimulating support systems for innovative start-ups can be considered to be a great success, at the least in effective numbers. With The Gallery building as Centre of Innovation and simultaneously the biggest housing facility of the 360 (total) start-ups located at the campus, the building functions as a set point where science and business meet. The expert stated that: *"The Gallery is geographically set between the University campus and the former business park, aiming to link the two worlds and to stimulate both business growth and the increase of knowledge production"*. However, during the interview it became obvious that there is a clear distinction between the desired- and actual outcomes of the Kennispark innovation campus. In fact, regardless of the size of the innovation campus, the expert acknowledges the difficulties in bridging the (small) gaps between the participating organisations at the campus and its direct surroundings. Whereas Kennispark seems to be greatly successful in relation to fostering and guiding start-ups, the involvement of SME's and larger companies, despite great efforts, remains at quite a low level, thereby directly illustrating campus- success vs. pitfalls (see paragraph 4.3.2).

First things first, it appears that the top five success factors identified during the interview are mainly related to the vibrant start-up scene in Enschede. Before Kennispark, the University of Twente as **Evident Knowledge Carrier** (4) already produced a vast amount of (successful) innovative spin-offs that originated partly due to the regional **Pre-existing Unique knowledge** (5) in high tech (industry, materials, systems) and additional support from the university. The university's role as **Support Organisation** (3) in guiding start-ups is nowadays a collaborative effort between Kennispark and the university with a leading role of Kennispark. The expert highlights this successful approach since in the previous stage: *"start-ups were mainly supported from a scientific point of view, instead of using a more practical approach"*. Depending on their specific working stages, start-ups nowadays (can) receive proper guidance by Kennispark in relation to aspects such as Finances, Intellectual Property, Legal affairs, etc. The expert highlights the importance of such support and support systems (e.g. organisations) since; a vast amount of start-ups becomes overwhelmed and insecure during their development.

Perhaps sketching the bridging-process of the different participating organisations at the campus as being quite difficult might be a little too negative. In fact, successful connections between the different campus players are indeed being made, although perhaps on a more incidental base. The Kennispark Twente Foundation aims to reduce the level of chance when it comes to connecting the different parties in joint projects, guiding programs, or perhaps solid partnerships. Despite this challenging goal, the foundation uses an array of different methods in stimulating potential collaboration and co-development. The expert indicates their starting-point as, aside from the necessary high tech facilities (laboratories, cleanrooms, etc.), is to create suitable preconditions for companies and other organisations to act in. The foundation as supporting organisation attempts to create a certain excitement among the campus and its inhabitants through organising promotional or marketing activities and networking events such as; Tech Talks, Project Dedicated- as well as Pitch and Match sessions (linking firms and science). In fact, the Virtual Reality Lab from T-Xchange, which is a collaborative effort between a multinational company (Thales Hengelo) and the university and is located at the campus, which is according to the expert: *"sometimes used as a 'pressure cooker' to actively connect people and parties"*. The actual effectiveness of T-Xchange is still under evaluation, but such a high tech networking method illustrates the intentions of parties involved. The Kennispark Foundation is considered to be a facilitator and intermediary according to the expert. The success factors; **Dynamic and/or Growing Company Base (1)** and **Clear Profile/Vision (2)** might be according to the expert: *"considered to be under construction"*. Current and future efforts by the Kennispark foundation are aimed to bring more balance in the dynamics and cohesion of the company base and thereby building on the development of the campus Profile. However, the output of the innovation campus in terms of start-ups is a great success by the campus and by most of its participants. That is why these two factors are identified as most important and already, till a certain point, are highly successful. Overall, the expert demonstrated 'reason' throughout the interview. Despite great success in specific fields of the campus, the expert acknowledges that there is still a lot of work to be done and that their role as intermediary could probably be improved.

4.3.2 Pitfalls: Bridging the distance between Kennispark participants

Throughout the interview the expert remained strikingly percipient about the real-life difficulties that Kennispark faces in working towards their organisational goal as support organisation. Clearly, similar to other campuses, Kennispark also has its difficulties. In fact, despite its thriving start-up scene there is still a lot to be gained in involving and stimulating the rest of the campus community and to improve the innovative output. Perhaps the most important pitfall during the development of the campus and even still, is that the **campus Company Base Dynamics (1)** does not function to its full potential, minus the existing dynamic start-up scene. According to the expert: *"a vast amount of the entrepreneurs and their companies located at Kennispark have quite an apathetic attitude when it comes to collaboration, co-development and other joint-efforts"*. Although it is difficult to assess the actual cause of this mismatch, the perceived distance between the (former) business park and the university campus seems to prevent that the organisations involved consider Kennispark to be 'one' innovation campus. These difficulties despite the **Geographical Proximity** did not go unnoticed. According to the expert; *"In accordance to our philosophy of a strong innovation campus, we increasingly focus on integrating the two parts of the campus by diminishing the effect of the dividing physical road through adapting the infrastructure and by using The Gallery as connecting element."* The **Support Organisation (3)** Kennispark as intermediary ought to play an important role during this integration process, aiming to further improve both Academic-to-Business- as Business-to-Business collaboration. However, the Kennispark Foundation only has the availability of limited (financial) means, which as a result reduces their acting capacity. Financial resources as well as Kennisparks' employees are being sponsored by the 'founding' organisations, resulting in a lean and flexible, but also financial feeble organisation. Other small supporting organisations are quite scarred throughout the region, making it difficult to pack a punch in stimulating the campus. Problems with **accessing**

Financial Resources (2) seem to be hindering the development of the Kennispark Foundation and consequently the campus growth. In fact, the expert states: *“We aim to assist in area development, programme finance and organise as many relevant events as possible, but financial capacity is leading and since we are dependent from our founders, we face quite a few restrictions”*. However, the foundation is not the only affected party, since it is quite difficult to attract financial resources for start-ups, for collaborative projects between firms, and for large all-encompassing programs for campus stimulation. The introduction of Cottonwood Technology Fund in addition to the existing programs (Angel Investments, etc.) did improve this situation, but there is still a lot to be gained through other potential channels.

4.3.3 Process: Finding the right focus

This paragraph provides a comprehensive process model illustrating the campus development trajectory of Kennispark Twente.

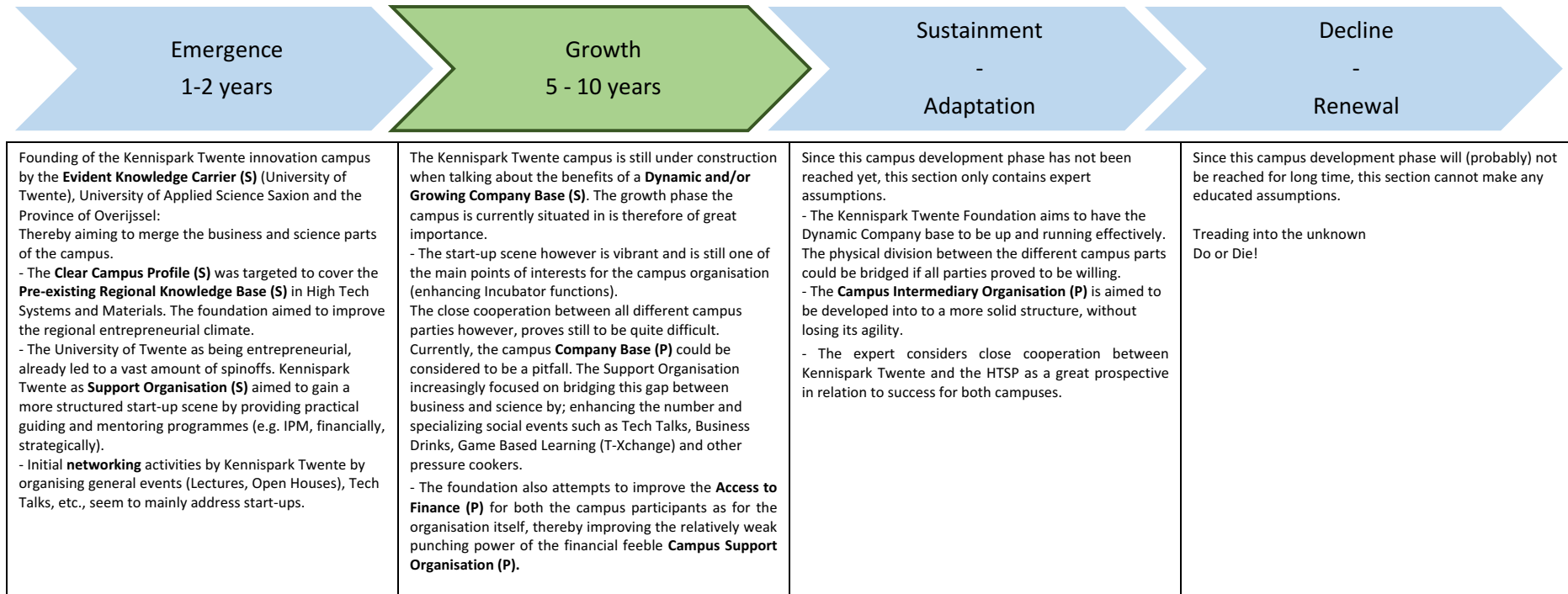


Figure 5 - Kennispark Twente campus development trajectory

Legend: S: Factor potentially leading to success, P: Factor potential pitfall.

Figure 5 illustrates the different phases of Kennispark Twente development by sketching the different factors identified by the Kennispark expert in a campus life cycle context.

4.4 High Tech Campus Eindhoven - Business Driven

In 1990, the R&D activities of Philips were spread across Eindhoven. To remedy this ‘strategic error’ and to compensate moving the headquarters to Amsterdam, Philips established the Philips High Tech Campus in 1998. After turbulent and not genuinely successful years, Philips decided to accelerate the process of boosting their innovative capacity by opening up the campus to other technological companies in 2003. Affected by influences from Chesbrough’s Open Innovation² concept, the campus was set as an open innovation campus, in which inter-collaboration is actively stimulated. The acceleration was illustrated by the massive campus growth with a great amount of both large and small innovative companies. In March of 2012, after being sold by Philips to Ramphastos, High Tech Campus Eindhoven entered a new phase, in which it could act as an independent organisation. Nowadays, the Eindhoven region is considered to be one of the ‘smartest regions’ of in the world and campus companies are responsible for about 40% of all Dutch patent applications.

High Tech Campus Eindhoven 2014 expressed in numbers:

<p>Leiden Bio Science Park in 2015 - Founding 1984</p> <ul style="list-style-type: none"> • Organizations: 173 • 130 Companies :93 Medical, 37 Other • 19 Research Institutes • 10 Healthcare organizations • 14 Others • Employees: 16907 • M²: 110 Ha • Academic origin: 	<p>Wageningen Campus in 2014 - Founding 1998</p> <ul style="list-style-type: none"> • Organizations: • 90 Companies • 9 Research Institutes • Employees: 1800 + ± 5000 Wageningen UR personnel located in Wageningen (50:50 University and research insitutes) • M²: 50 Ha • Academic origin 	<p>Kennispark Twente in 2014 - Founding 2006</p> <ul style="list-style-type: none"> • Organizations: • 400 Companies • 360 Start-ups • Employees 5741 + 3000 University • M²: 12Ha campus, 20 Ha total • Both Academic and Business origin 	<p>High Tech Campus Eindhoven in 2014 - Founding 2003 (renewal in 2012)</p> <ul style="list-style-type: none"> • Organizations: 145 • 132 Companies • 13 Institutes • 36 Multinationals • 55 Start-ups • Employees: 10000 • M² 103 ha • Business origin 	<p>Brightlands Chemelot Campus in 2014 - Founding 2012 (renewal in 2008)</p> <ul style="list-style-type: none"> • Organizations: 85 • 74 Companies • 11 Research Institutes • Employees 1540 • M²: 20 ha • Business Origin
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The representing expert who was interviewed for this researched, works for HTC Eindhoven Site Management as Director Business Development (employs over nineteen people, plus facility personnel). Ramphastos, represented by HTC Eindhoven Site Management is owner of all buildings and additional infrastructure and the organisation responsible for the exploitation of the Open Innovation campus as a whole. After analysing the interview, the following main factors were identified:

Table 5 - Success factors and Pitfalls High Tech Campus Eindhoven

Success factors	Pitfalls
1. The presence of Pre-existing (unique) Knowledge (In addition to skills and attitude) - Embodied by Philips and Eindhoven Region, provided a kick-start for the (open) innovation campus. For new campus entrants it was relatively easy to ‘tap’ into the region’s unique business propositions. Nowadays, that knowledge base has only been expanded due to the vast amount of high-tech organisations at the campus.	1. The Evident Knowledge Carrier - In the form of Philips has been mentioned as a success factor as well. However, the initial plans of a Philips campus and its absolute dominance at the campus during the first years had mainly negative effects (e.g. deterring effect by Philips) resulting in loss of new firm leads. Selling the campus to Ramphastos made Philips a campus participant and is now an important knowledge carrier without the negative dominant effects.
2. The Support Organisation or campus Development	2. The Support Organisation - Nowadays, HTCE Site

² Open Innovation - The general idea behind the Open Innovation (OI) concept is that firms should look and operate beyond their immediate boundaries in relation to in- and external knowledge flows during the innovation process (Huizingh, 2011). During the interviews it became apparent that the HTCE and BCC (paragraph 4.4 and 4.5) have been designed according to the ‘Open Innovation’ concept since the foundation (or shortly after) of the campuses. This innovative mind-set seems to be fostering co-development and co-creation among campus organisations. The open attitude can also be perceived as a clear distinction between the business- and academic driven campuses, which appear to be more closed.

<p>team - Was a result of a collective foundation during the first phase: Triple Helix Approach. Nowadays an independent (relatively large) organisation with a lot of punching power in relation to finance, knowledge, and employee strength. The Startupbootcamp accelerator is an example of a stimulating program by the support organisations. The organisation also organises many events to promote campus cohesion and to proactively connect relevant partners. In fact, campus organisations are actively linked through supporting collaborative activities. Connections with the Triple Helix partners are quite strong, contributing in mostly basic needs.</p>	<p>Management had its difficulties due to its dependent link to Philips. This initially resulted in lack of strength despite the campus vast amount of financial resources. The organisation sometimes was mistrusted due to its Philips connections. Selling the campus to Ramphastos solved these issues.</p>
<p>3. The Evident Knowledge Carrier - was initially embodied by Philips (strong anchor actor) but is now for filled by the multiple multinationals at the campus, supplemented with the University of Eindhoven (not directly located at the campus) and other campus knowledge institutes (and around the world). These large campus actors could be seen as inspiring to connect with for other parties. (In the initial development stages, Philips was not only a source of knowledge, but also invested 500 million in the campus).</p>	<p>3. Obstacle in obtaining Access to Finance/Venture Capitalists - Proved to be no obstacle at all in the first stages of campus development due to the large investments by Philips. However, at a certain point in time Philips stopped investing and thereby the campus development came to a hold. Selling the campus to Ramphastos radically changed the campus financial position and opened up room for investments.</p>
<p>4. The Clear Profile/Right Vision - Resulted in a strict stopping sign model developed by the support- and governance organisation HTCE Site Management. <i>“Saying no to new entrants who are not suitable for the campus is a strength, not a weakness”</i> The profile ensures benefits on the long run by staying close to their specialisms.</p>	
<p>5. A Dynamic and/or Growing Company Base - Through a strong diversity is an important success factor, since all levels of company’s partner-up and compete with each other, resulting in stimulating innovative processes and output. Stimulation of start-up scene through Startupbootcamp aims to improve the company base.</p>	

4.4.1 Success: Gaining independence

As one of the first innovation campuses, the start-up phase of the Philips high tech campus in 1998 was marked by one major advantage; the **Pre-existing Knowledge base** (1) represented by not only Philips, but the Eindhoven region as a whole. With the previous R&D centre of Phillips (e.g. Natlab) in mind the expert stated: *“You did not need to explain the term innovation to the people working here”*. Philips did not merely take the role of **Evident Knowledge Carrier** (3), but Philips management committed themselves in contributing to the innovation campus a success by investing (in time) over 500 million euros. Such an investment meant a kick-start for the campus, provided (financial) room for future developments and thereby its long-term existence. Initially however, the campus was meant to function as a Philips campus and only after the interference of Henry Chesbrough the focus of Philips management started to shift. Chesbrough has coined the concept of ‘Open Innovation’ and according to the representing expert, the concepts; influence greatly affected the transition of a closed campus to an open innovation campus. Whereas the campus was already subject to drastic changes in infrastructure, after developing a **Clear Campus Profile and Vision** (4) the physical development accelerated tremendously. In fact, the high tech profile resulted in several target groups representing organisations that were considered to be interesting for future participation. As result, global firms, research institutes, service companies, SME’s and start-ups were attracted in order to comply with key criteria of the open innovation idea. Building such a **Dynamic and Growing Company Base** (5) took quite a bit of time, but at this point in time; over 130 companies form a thriving community. By abandoning the idea of a Philips campus and embracing the innovation campus concept a part of the governance by Philips was transformed into a regional development

group/foundation with an independent chairman representing not only Philips (CTO) but also the government (three representatives) and several companies (three representatives). For four years this foundation functioned as accelerator in promoting the campus domestically and abroad contributing to the growth of the innovation campus and its participants. Under Philips 'reign', the campus participants increasingly were involved in co-creation projects and co-development partnerships mainly with innovative intent. Due to the commercial nature of the different actors, the main idea behind these partnerships is likely to be able to accelerate company growth relative to companies outside of the campus. Despite the fact that Philips still owned the actual campus and its related facilities, a new campus **Support Organisation** (2) was founded. This organisation (now known as HTCE Site Management) was responsible for maintaining and expanding the basic and specialized facilities, ensure campus promotion, improve 'campus cohesion', stimulate 'new' business development and to attract new organisations to the campus. The direct link to Philips however, remained until 2012 when Philips sold the campus to Ramphastos and thereby HTCE Site Management gained complete independence organisations located at the campus. The expert pointed out this important milestone, since the take-over mend new campus investments and also big changes for the supporting organisation due to the elimination of the direct link with Philips. Because of its independence as an organisation, HTCE Site Management obtained more opportunities for campus promotion, stimulating site residents and overall campus cohesion, and actual acting as an intermediary organisation between all parties involved in the high tech campus, both in the internal and external environment. Nowadays, the campus Profile is set around three high tech focus areas; 1) Health, 2) Energy and 3) Smart Environments and most potential participating organisations have to comply to this profile. In fact, a 'stopping sign' method is applied during the selection, recruitment and eventually acquisition of organisations. According to the expert a strict profile is key; *"Sometimes you have to say no to a new company. That is not a weakness, since it works beneficially in the long run"*. Having the luxury of saying no seems to express the financial situation of the campus organisation despite the fact that the HTCE business model is based on renting the campus buildings and facilities. The backing of Ramphastos is likely to have strengthened this position.

The developments since 2012, seem to have resulted in a trendy innovation campus with high value for its residents who in general are prepared to 'open up' in one way or another and to participate in collaboration with partners and even competitors. According to the expert it was no sinecure to obtain this level of campus co-development. Before 2012 there certainly were activities conducted by the support organisation to stimulate start-ups, campus cohesion, inter-organisational collaboration, and to promote the campus within the region and beyond. Today, the 'Open Innovation' campus has the availability over high-level facilities such as the Strip where campus personnel from all the different companies 'incidentally' meet on a daily basis during lunch, sporting activities, scholarly- and tech talks, and a variety of other events. These somewhat structured collapses of bright minds are being stimulated by the HTCE Site Management by organising hundreds of events a year varying from small direct partnerships between firms till large high tech conventions. In addition, the support organisation aims to facilitate the campus participants in all their needs. For example, besides their own efforts, the involvement of local government (through Brainport), Startupbootcamp acts as specific support organisation for the (potential) start-up residents. Build on a solid pre-existing knowledge foundation, powerful initial campus actor and strong financial base, the expert considers the interaction between the campus residents and the role of the HTCE Site Management organisation as intermediary as one of the key success factors for the present High Tech Campus Eindhoven: *"We are the campus' thriving facilitators"*.

4.4.2 Pitfalls: Abandoning the Philips ship?

The growth trajectory of the HTCE cannot be described as a success story that did not face any challenges. In fact, the expert identified three major difficulties or even pitfalls. The intensive

involvement of Philips in building the innovation campus proved to have a lot of advantages as Evident Knowledge Carrier, heavy investor and initial driver of the campus. However, as a famous Dutch athlete (Johan Crujff) stated: "Every *advantage has its disadvantage*", which in time came true for the HTCE as well. Despite the fact that Philips had 'opened up' the campus for other parties, the extremely dominant position of the organisation had quite a few negative effects. The expert highlighted that Philips as **Evident Knowledge Carrier** (1) had somewhat of a deterring effect on potential new organisations that were willing to join the campus community. The expert argued: "*The initial idea of Philips was to run the campus by- and for themselves, through the attraction of firms that ought to take over parts of Philips product developments*". The risk of being shaded by Philips often proved quite threatening for other firms. Additionally, the former version of the campus **Support Organisation** (2) was strongly linked to Philips resulting in biased stimuli from Philips to other participants, which negatively affected the effectiveness of the organisation. In 2012, in search for **access to Finance** (3) the campus organisation knocked on the door of Philips management for investing in future development of the campus. However, that door remained close, which posed quite a threat for the campus potential and overall long-term future. However, Philips selling the campus to Ramphastos evidently solved all of three major problems. The campus became independent from Philips with a less biased support organisation as a result, the deterring effect of Philips as main actor diminished and the access to financial resources improved drastically. The expert stated: "*Firstly, the new owner wanted to invest in expansion. Secondly, we gained complete independence enabling us to grow as campus and as High Tech Campus Eindhoven and as HTCE Site Management*".

4.4.3 Process: From private campus to thriving centre of knowledge

This paragraph provides a comprehensive process model illustrating the campus development trajectory of High Tech Campus Eindhoven.

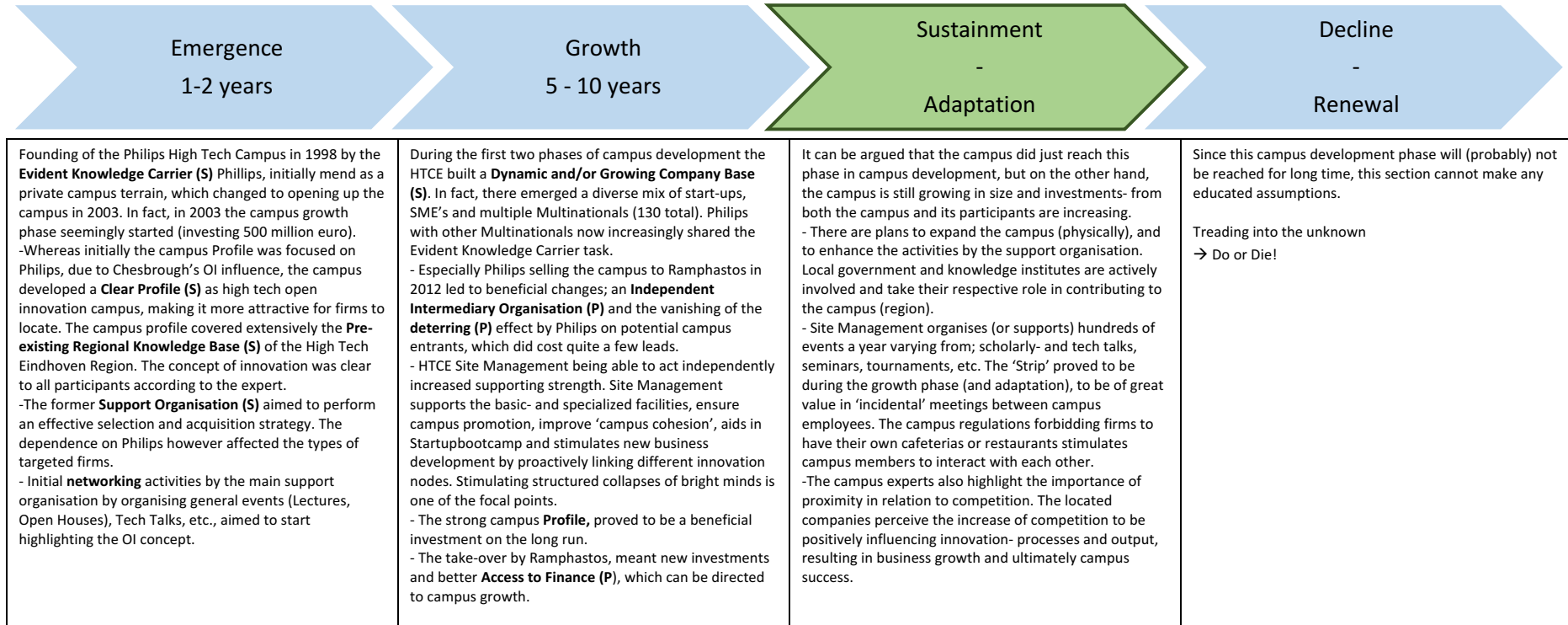


Figure 6 - High Tech Campus Eindhoven development trajectory

Legend: S: Factor potentially leading to success, P: Factor potential pitfall.

Figure 6 illustrates the different phases of HTCE development by sketching the different factors identified by the HTCE Site Mangement expert in a campus life cycle context.

The following paragraph is dedicated to the Brightlands Chemelot Campus.

4.5 Brightlands Chemelot Campus: Business Driven

The current Brightlands Chemelot Campus (BCC) functioned between 1930 and 2000 as the company grounds of DSM. In 2000, DSM presented new plans for a radical shift of course. The petrochemical activities from DSM, about half of DSM’s activities in Geleen were transferred to SABIC, other business units were sold as well, and the new business park was named Chemelot. This created a new situation where two large players operated on the same industrial park. In 2012 the Chemelot Campus had three major stakeholders: 1) DSM, 2) the Province of Limburg and 3) the University of Maastricht/MUMC+ illustrating their Triple Helix Approach. Additional to investments from DSM, the Province of Limburg invested more than a hundred million euros in the development of the campus. The campus is set up as an open innovation campus, in which inter-collaboration is actively being stimulated.

Brightlands Chemelot Campus 2014 expressed in numbers:

Leiden Bio Science Park in 2015 - Founding 1984	Wageningen Campus in 2014 - Founding 1998	Kennispark Twente in 2014 - Founding 2006	High Tech Campus Eindhoven in 2014 - Founding 2003 (renewal in 2012)	Brightlands Chemelot Campus in 2014 - Founding 2012 (renewal in 2008)
<ul style="list-style-type: none"> • Organizations: 173 • 130 Companies :93 Medical, 37 Other • 19 Research Institutes • 10 Healthcare organizations • 14 Others • Employees: 16907 • M²: 110 Ha • Academic origin: 	<ul style="list-style-type: none"> • Organizations: • 90 Companies • 9 Research Institutes • Employees: 1800 + ± 5000 Wageningen UR personnel located in Wageningen (50:50 University and research insitutes) • M²: 50 Ha • Academic origin 	<ul style="list-style-type: none"> • Organizations: • 400 Companies • 360 Start-ups • Employees 5741 + 3000 University • M²: 12Ha campus, 20 Ha total • Both Academic and Business origin 	<ul style="list-style-type: none"> • Organizations: 145 • 132 Companies • 13 Institutes • 36 Multinationals • 55 Start-ups • Employees: 10000 • M² 103 ha • Business origin 	<ul style="list-style-type: none"> • Organizations: 85 • 74 Companies • 11 Research Institutes • Employees 1540 • M²: 20 ha • Business Origin

The representing expert, who was interviewed for this research, works for Brightlands at the Brightlands Chemelot campus as Director Business Development & Acquisition (employs over 50 people from which nine business developers). This organisation is owner of all buildings and additional infrastructure and is responsible for the exploitation of the open innovation campus as a whole. After analysing the interview, the following main factors were identified:

Table 6 - Success factors and Pitfalls Brightlands Chemelot Campus

Success factors	Pitfalls
<p>1. The presence of Pre-existing (unique) Knowledge (In addition to skills and attitude) - Represented by DSM and SABIC knowledge capacities, especially during the early stages. A solid (unique) foundation to build for future success. The initially unique business positions at the BCC provided a kick-start. This resulted in a number of world leading business positions. Because former co-workers were closely located and the concept of OI was not new, made collaborative activities (building upon S1) quite easy.</p>	<p>1. The poorly conditioned Physical Infrastructure - Initially resulted in quite a few obstacles. The absence of Shared Facilities- High End laboratories made it quite difficult to attract new companies and other organisations. Especially foreign firms were difficult to attract. However, companies that did locate at the campus were there for the “right” reasons, from which the campus is able to benefit from today.</p>
<p>2. The Support Organisation (campus Development Team) - Embodied by the Brightlands organisation responsible for stimulating (e.g. facilitating all needs) the campus, provides five different (partly optional) services to its participants. For instance, the organisation pro-actively searches for the different nodes in- and outside of the campus. Startupbootcamp is an attempt by the support organisations to stimulate the campus dynamics. The organisation even invests in- and builds new business</p>	<p>2. The strong actor Evident Knowledge Carrier - Is not only a Chemelot success factor, since DSM initially had a quite a deterring effect while attracting new firms and other organisations (e.g. being too dominant as strong actor). According to the expert, that attitude did cost valuable leads. After the attitude and influence of DSM changed, the deterring effect of DSM changed as well, resulting in a more positive impact.</p>

opportunities. The organisation acts as an important intermediary between the different campus nodes.	
3. A Clear Profile/Right Vision - Has been developed by the strong governance and supporting organisation Brightlands and is being supported by Triple Helix actors (DSM, University of Maastricht and Region of Limburg). Such a clear profile made it difficult to say no to potential partners, but resulted in a dynamic and well-functioning environment.	3. The Support Organisation - Although the difficulties were relatively manageable, the campus' main support organisation being dependent from DSM made it quite difficult for other parties to make a clear distinction between DSM and the support organisation. This was often perceived as threatening, reducing the effectiveness of the organisation. Nowadays resolved through independence.
4. The strong actors and Evident Knowledge Carriers - Nowadays not only represented by DSM and SABIC but also by other parties (both firms and knowledge institutes), embodying extensive sources of knowledge and skills. These sources of knowledge provide access for start-ups and other partners, enabling them to innovate faster and with more impact, resulting in a win-win situation.	
5. A Dynamic and/or Growing Company Base - In the form of a diverse company portfolio set within the specific campus profile. Startupbootcamp is an example of attempts to stimulate the company portfolio. The campus organisation is strongly focused on this factor due to the value the start-up scene creates (e.g. resulting in acquisition or joint projects).	

4.5.1 Success: Building upon a unique business position

As of the year 2000, it was clear that the campus underwent a radical shift of nature, transforming from a regular industrial business park to a new open innovation campus. The representing expert immediately highlighted a key success factor, which was important during the start-up phase of the campus, and is relevant still. According to the expert, the presence of **Unique Pre-existing Knowledge** (1) that immediately could be utilized was essential during the (initial phases of) development of the campus. The expert stated: *'Without that knowledge, you start with absolutely nothing'*. So the first question that they asked themselves is: *"What unique strengths do we possess"*? Consequently, their key strengths were mapped, illustrating several world leading business positions. The main body of that knowledge was owned by the two main **Evident Knowledge Carriers** (4); DSM and SABIC. According the expert: *"the next step was identifying if the parties with the world leading business positions were prepared to work together, with each other and with other new organisations"*. The just founded campus organisation aimed to set a **Clear Profile and Vision** (3) right from the start; Co-creation and co-development through the concept of open innovation. The aim was that the firms located at the campus were able to grow faster relative to other (external) companies, following the campus vision. The expert emphasised the importance of a clear and ambitious campus profile by stating: *"DSM always wanted to be world leader, nowadays we as campus want to be word leader. If we cannot maintain such a position, we change our strategy"*.

Since most of the initial participating parties originated from former DSM, there remained a good connection between the different parties. According to the expert, it was just luck that there was some sort of community of people who used to be colleagues and already have a certain Network and level of Trust; *"The collaboration between the companies could be shaped almost in a natural sense"*. The expert emphasizes again the importance of the presence of unique knowledge and business position, and makes a clear distinction between 1) Business Knowledge, 2) Tacit Knowledge and 3) Academic Knowledge and that they focus on the first two. *"Since academic knowledge is set in, or even precedes the pre-competitive phase, it is not directly useful in gaining a competitive advantage"*, which according to the expert is therefore a knowledge type that is less interesting.

Additionally, the campus profile represented collaboration between organisations. The campus organisation enforced regulations in relation to attracting new companies. When a new company would have liked to join, the firm should already collaborate with at least one of the residents, by doing so added value is enhanced. To be able to do so, the campus organisation needed business developers with business knowledge. In the process, a strong campus- or **Support Organisation** (2) has been developed, which focuses not only on their general tasks (facilitating infrastructure), but also on creating added value through a pro-active attitude and developing 'new businesses'. The expert stated that: *"the main necessary cash flows in operating such an organisation come from renting the buildings, and offering services to the participants"*. In fact, the campus organisation offers services that are mandatory to all participants, but also optional services, which are paid for depending on usage. These five service types are; 1) Technical and business development-, 2) Business support-, 3) General campus- (community), 4) Housing- and 5) Manufacturing services. A critical note, the funding from the regional government is likely to have contributed to the direct business model as well. Optional services are for example proactively searching for business opportunities, setting up projects, creating added value, and even participating in projects along with the participating firms; *"We go directly to the companies to interact, co-develop, and interlink with other organisations"*. This proactive role, or perhaps Promotor role, is quite unique among innovation campuses. This role includes the ownership, exploitation and development of the campus as an intermediary (more than) organisation or link between the different parties. Those linkages are realized through direct face-to-face contact, campus business development, organising of events and meetings for both campus residents and potential external partners (firms, research institutes and universities).

Clearly, from the beginning there has been a culture of Open Innovation and organisations acting on it. However, according to the expert; the **Dynamics of the Company Base** (5) remains an important factor to foster that culture. Through programs, trainings, and events, organized by Brightlands the Company Base is constantly affected by change and development. In fact, the campus organisation even creates its own start-ups and also scouts companies all over the world for possible acquisition. The reason for doing so is the recognized importance of a complete ecosystem. Startupbootcamp for instance, illustrates the great investments that Brightlands (and partners) take in order to maintain or enhance the dynamics of Chemelot. In fact, such a program costs over one million per edition. The campus community provides high quality mentors in relation to finances, IPR, legal, generalists, etc. The commitment of the campus participants is essential according to the expert: *"We only commence with the programme when all pre-conditions are favourable"*. Such start-up acceleration (e.g. saving up to a year and a half) benefits the start-ups as well as the campus community. Seemingly, the success of the Brightlands Chemelot Campus lays in their founding origin, the clear profile setting, strong campus actors, complete ecosystem, and especially a strong and multi-functional (intermediary) support organisation.

4.5.2 Pitfalls: The deterring effect of the main actor

The expert identified two main difficulties or pitfalls during the development of the innovation campus. In fact, the campus started with relatively old and dilapidated buildings and complementary **Facilities** (1) after the transfer from DSM. According to the expert: *"these facilities were hardly a strong showcase for the campus"*. The expert illustrated that attracting businesses proved to be quite difficult when the companies saw their prospected buildings. Quite a few of linkages did not succeed because of the absence of high-end facilities. On the other hand, this difficulty resulted in a company portfolio that was not located at the campus for its direct facilities but for its concept, thereby creating strong complementary actors. The dominant attitude of DSM in the beginning of the campus development ought to be quite a deterrent for new companies. DSM regarded the campus as; their own turf and only after putting the Triple Helix Approach in place, this attitude changed. *"The DSM*

attitude costs us quite a bit of leads". In other words, a strong **Evident Knowledge Carrier** (2) was really important for the development of the campus, but the initial attitude of DSM did not confirm with the open innovation idea and proved to be a great obstacle. Identifying a third pitfall proved to be quite difficult for the representing expert, but in some ways, the same principle of 'being dependent' initially applied to the campus **Support Organisation** (3). However, the difficulties in relation to this dependence to DSM were according to the expert relatively manageable.

4.5.3 Process: Becoming and remaining world leader

This paragraph provides a comprehensive process model illustrating the campus development trajectory of the Brightlands Chemelot Campus.

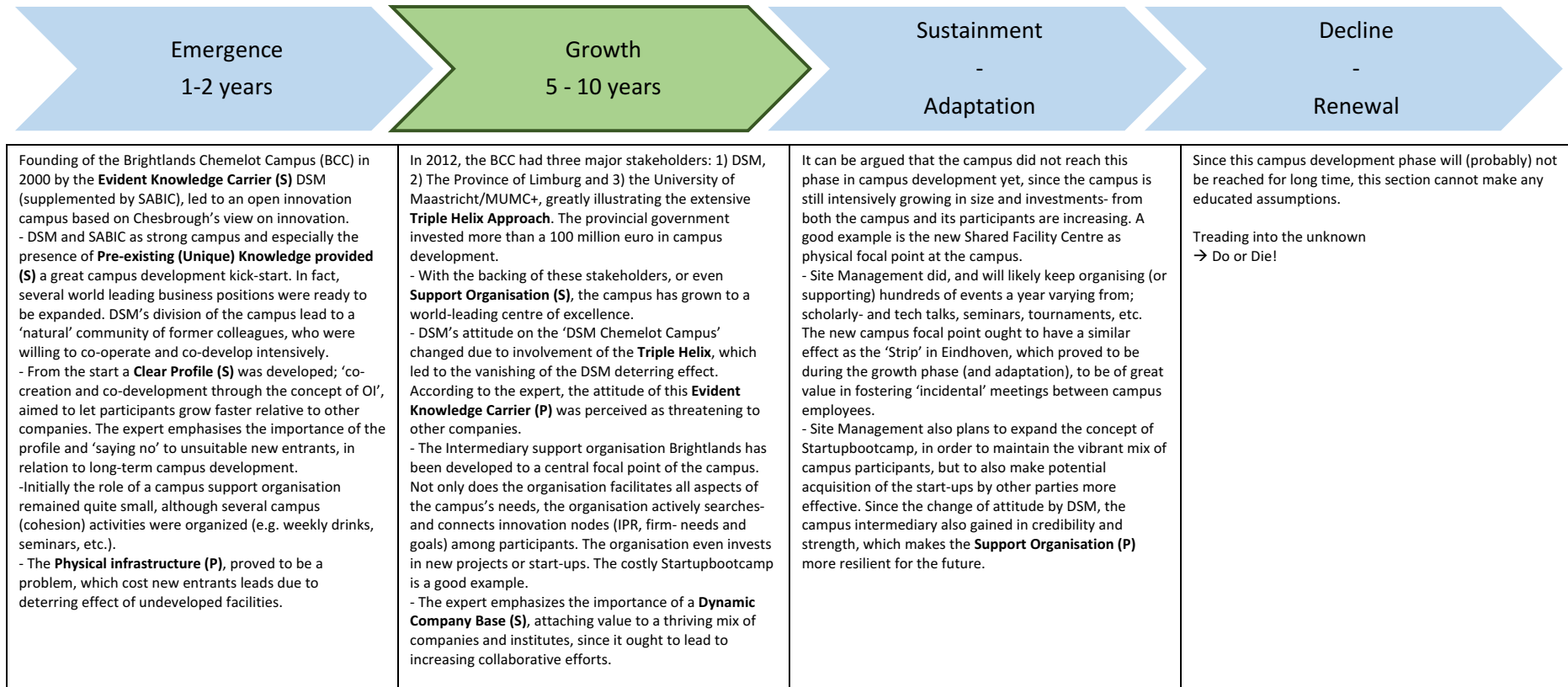


Figure 7 - Brightlands Chemelot Campus development trajectory

Legend: S: Factor potentially leading to success, P: Factor potential pitfall.

Figure 7 illustrates the different phases of Brightlands Chemelot Campus development by sketching the different factors identified by the BCC expert in a campus life cycle context. The following paragraph is dedicated to a cross comparing case analysis.

4.6 Cross-comparing cases

This last section of this multiple case analyses will summarize the main insights gained from the different interviews with the campus experts. Despite the fact that all of the fourteen available factors from the factor-framework were identified as important by at least three experts, only seven factors were highlighted and stressed by the campus experts as highly valued throughout the successful development of their respective innovation campuses. As stated in paragraph 2.3, the most valued factors per campus have been categorized on a scale of one till five (with one being the most valued), based on experts explicitly stating the factor value and the derivation of the transcribed data (supported by evaluation mechanism) and are categorized in Table 7.

Table 7 - Success factors in relation to five top innovation campuses.

Success factors identified per case/campus (S)	LBSP	Wageningen Campus	Kennispark Twente	HTC Eindhoven	Brightlands Chemelot campus
S1 - Evident Knowledge Carrier	1.	3.	4.	3.	4.
S2 - Support Organisation(s)	3.		3.	2.	2.
S3 - Pre-existing (Unique) Knowledge			5.	1.	1.
S4 - Dynamic and/or Growing Company Base	2.	4.	1.	5.	5.
S5 - Clear Profile/Right Vision	4.	1.	2.	4.	3.
S6 - Talent/Staff Attraction	5.	5.			
S7 - Brand Name		2.			

Legend: Distribution top 5 success factors per campus (1,2,3,4,5, with 1 being most valued) with Blue: Academic-driven, Grey: Both Academic/Business driven, Green: Business driven.

In general, all campus experts acknowledged the absolute value of a strong **Evident Knowledge Carrier (S1)**, a **Dynamic and/or Growing Company Base (S4)** and a **Clear Profile/Right Vision (S5)**, making no distinction between the different campus types. A strong Evident Knowledge Carrier (S1) is considered to have a major impact on the campus, not only as source of knowledge, but also as strong anchor actor representing the campus interests and being an external (international) link to potential partners. As a way of protecting the campuses long-term interests, the representing experts state the importance of a clear campus profile (S5). A clear campus profile and strong selection- and acquisition mechanisms, should ensure that the vast majority of potential new campus participants comply with the specific campus context. In fact, the Wageningen Campus attaches great value to their profile as 'Gateway to smart food in a green world' and even utilizes it as a campus-branding tool. The third success factor, which also all campus experts agree upon is; a Dynamic and/or Growing Company Base (S4). This factor is perhaps best illustrated as a dynamic participant-portfolio of a campus, with a mix of thriving start-ups, SME's, Multinationals and Research Institutes within the campus Profile. Most campuses attempt to support their respective start-up scene to improve their individual prospects, but also to enhance the campus dynamics. Most innovation campuses founded (or are planning to) a campus Incubator to be able to provide start-ups

with the tools they need during their development. In turn, four of the five experts (Wageningen Campus expert excluded) emphasise the value of a campus **Support Organisation** (S2). According to the experts, most campus support organisations do not only facilitate the basic campus necessities (e.g. infrastructure, maintenance, etc.), but also quite often act as an Intermediary campus organisation. The organisation as metaphorical centre of the campus, could aim to promote the campus, organises the selection and acquisition of new campus entrants, organises social campus events and can even take a more intensive and pro-active (business) role. The campus intermediary could have a pivot role in the campus environment in relation to several supporting- or guiding activities. In fact, the organisations could attempt to provide advice and guidance (e.g. financially, strategically, Legal etc.) for the campus parties who require such support (mainly start-ups) through for example mentoring- or boosting programmes. Interestingly, the intermediary organisations from BCC and HTCE even proactively search for business opportunities among campus participants and also firms in the adjacent surroundings. Another remarkable, but repeating phenomenon highlighted by all campus experts was the value of the **Triple Helix Approach**. Although perhaps the Triple Helix can be considered to be an individual factor, most campus experts regarded the Triple Helix as an encompassing support organisation, which is committed to strengthen the innovation campus. In fact, the expert from LBSP expressed the role of local government as a supporting partner in developing basic infrastructure, issuing permits, and in improving living conditions. In other words, the local government ensures important prerequisites of the innovation campus, completing the model of networked relations among industries, universities and governments. The BCC followed a different approach, since the Triple Helix actors embody the three main campus stakeholders (DSM, the Province of Limburg and the University of Maastricht), thereby ensuring full commitment and strong support from these partners. The other campuses are also involved in Triple Helix partnerships in one-way or another; with as result the campuses seem to have a preferred status over other organisations.

In slight contrast with academic-driven campus support organisations, the business oriented innovation campuses seemingly attempt to direct their participants towards a more open innovation approach or culture, in which co-development and co-creation is increasingly encouraged. However, as the experts clearly indicated; open innovation is no single construct and does not mean full information exposure, but embodies a more modular approach to knowledge sharing. The HTCE Expert also stated that: "*open innovation is not obligatory for the campus participants, but a viable option when engaging in more collaborative partnerships*".

Although most campus experts seem to agree on the major success factors (S1, S4, S5), Table 7 clearly illustrates a few differences on the remaining factors between the academic-driven campuses and the business-driven campuses. The representing experts from the academic-driven campuses LBSP and Wageningen Campus, identified the different factors in quit a similar fashion, although the level of importance per factor varies quite a bit. The **Talent** factor (S6) for example, has been identified by the academic-driven experts; as an important prerequisite for campus success, but also as a result of a successful campus.

The factor-similarities between the business-driven campuses HTCE and BCC however, are quite clear. These campus experts pinpointed the same relevant success factors in almost a similar level of importance (only factor S1 and S5 slightly differ). While the business-driven 'case stories' somewhat differs, the importance of the factors assumed by the experts to be greatly contributing to campus success are almost equivalent. These findings illustrate the similarities among- and the differences between the types of innovation campuses. Kennispark Twente as being both academic- and business driven identifies factors to be important for campus success in the same way as the business-driven campuses, although with differing levels of valuing. All in all, despite the diverse rating of the different factors, especially the factors S1, S2, S4 and S5 seem to be of great importance

for the different campuses in general. Comparing the identified pitfalls however, results in quite a different distribution (Table 8).

Table 8 - Pitfall factors in relation to five top innovation campuses.

Pitfall factors identified per case/campus (P)	LBSP	Wagen-ingen Campus	Kennispark Twente	HTC Eindhoven	Brightlands Chemelot campus
P1 - Evident Knowledge Carrier				1.	2.
P2 - Support Organisation(s)	2.	2.	3.	2.	3.
P3 - Dynamic and/or Growing Company Base			1.		
P4 - Clear Profile/Right Vision		3.			
P5 - Capacity for (open) innovation and R&D	3.				
P6 - Access to Finance/Venture Capitalists	1.		2.	3.	
P7 - Physical Infrastructure					1.
P8 - Capacity for achieving Campus Consensus		1.			

Legend: Distribution top 3 pitfall factors per campus (1,2,3, with 1 being most valued) with Blue: Academic-driven, Grey: Both Academic/Business driven, Green: Business driven.

The pitfall distribution of the different factors shows a more scattered landscape. In fact, only factor P2 and P6, were identified by most campuses as difficulties or pitfalls that the experts experienced during campus development. However, the experts' reasoning in identifying pitfall factors greatly differed per campus situation. The HTCE expert for example faced difficulties in gaining **Access to Finance** (P6), due to an investment-stop at the campus by Philips. Philips selling the campus to Ramphastos has solved this issue and even opened up financial opportunities. Kennispark Twente on the other hand, mainly faces difficulties in obtaining finances for the (expansion of) campus support organisation, while some start-ups have trouble obtaining the necessary private investments. The factor **Support Organisation** (P2) however, was identified as a more common problem, which mostly stems from lack of organisational independence (business-driven) and shortage of punching power as organisation (academic-driven). The **Evident Knowledge Carrier factor** (P1), has been identified by the business-driven campus experts as being quite problematic during the initial stages of campus development. In fact, both campus experts emphasised the difficulties of the main campus Actor (DSM at BCC and Philips at HTCE) having a too dominant presence and thereby deterring potential campus participants. Relative to the success factors identified by the campus experts, the pitfall factors are much more difficult to convert to a single notion. It appears that apart from some exceptions (P1 and P2), the pitfall factors are more situational or campus depended.

In this chapter, the individual campus development trajectories all have been described in a comprehensive process model based on the factors that were most valued by the campus experts. In order to compare the relevant factors valued per campus, Table 8 illustrates the eight most prioritised factors (both potential- success and pitfall) in relation to their nature and functioning throughout a certain timeline.

Table 9 – Comparing campus development trajectories and the related factors (both potential- success as pitfall).

Factors	1 – 3 years	3 – 5 years	5 – 10 years
Evident Knowledge Carrier	Strong anchor actor (university or multinational) taking a leading role: Investing in the campus intellectually, financially and setting up the campus organisation. Conduct selection and acquisition of new organisations fitting the profile. Building a plan.	Maintaining strong campus positioning, preferably aided by a campus intermediary. Attract new organisations from all different levels focuses on stimulating the campus. Beware of being to dominant (detering effect). Keep investing if possible.	Preferably transfer the ‘campus power’ to intermediary organisation to avoid dominance deterring effect and to strengthen intermediary. Ideally now, there are more strong actors.
Support Organisation (s)	Often starts with the evident knowledge carrier acting as an (unnatural) support organisation aiming to support campus start (see evident knowledge carrier)	If founded, the support organisation should aim to foster external promotion, social campus cohesion (through events, and programmes) and to focus on selection and acquisition of new organisations. Beware of strong actor dependency.	Become the campus intermediary, acting as thriving innovation factor. Responsible for dynamic company base, providing guidance for firms, linking innovation nodes, promotional activities and enable Triple Helix. Incorporate specialities. If possible the organisation takes a proactive role, searching for new opportunities.
Pre-existing (Unique) Knowledge	Situational depended, but there is no direct influence. Can provide a great kick-start due to high-class knowledge positions, skills, and regional cluster focus.	If present, this knowledge base can still provide advantages for newly attracted and established firms for developing (world) class business or knowledge positions.	Becoming less relevant, since the innovation campus starts to become its own source of knowledge, already having exploited the existing sources.
Dynamic and/or Growing Company Base	These years form the start-up phase, making it difficult to already built a dynamic company base. Nevertheless, the leading party should start building a clear (profile fitting) company base.	Becoming increasingly important due to campus dynamics. Selection and acquisition fitting the profile by leading party appears to be of great importance. Possibly start with incubator or firm guiding programmes. Do not just focus on one type of organisation, but aim to attract all relevant parties.	Acknowledged as greatly important, since all parties benefit from one another (e.g. knowledge spill overs, sharing facilities, attracting talent, joint operations, etc.). Aim to attract varying parties keeping the campus ‘healthy’. Firmly use the campus profile. Grow sideways with campus participants.
Clear Profile/Right Vision	Of absolute importance, since it determines future activities and prospects. All future campus activities should be directly linked to the campus profile. Possible stopping sign model to ensure the right organisation attraction. Explore OI possibilities.	Guiding principle throughout campus development. Since, during the first three years it could have been financially attractive to acquisition less suitable organisations, now it is important to use a strict focus during selection and acquisition. Explore OI possibilities.	Guiding principle, but should perhaps be slightly altered. Evaluate the profile based on changes in the influencing surroundings. Keep building on the campus profile and if necessary, perhaps tighten the stopping sign model. However, beware of potential deterring effects if the profile becomes too narrow.
Talent/Staff attraction	Initially possibly difficult to specifically attract new talent during the first campus development stages. However, if pre-existing knowledge and brand name exist, immediately exploit those factors, since attracting talent is likely to be an influencing success factor.	Attracting talent remains relevant throughout all stages of campus development, since a lack of talent devalues the campus functioning and output.	Attracting talent remains relevant throughout all stages of campus development, since a lack of talent devalues the campus functioning and output. Focus on positions lacking the necessary talent.
Brand Name	Initially it is likely that during the first stages of development there is no significant campus brand name to build upon. However, possibly use brand name of strong campus actor or region/cluster the campus is located in, in order to attract talent, finances and for other promotional activities.	During this stage perhaps the campus brand name is starting to rise. If possible, use the brand name of the campus and otherwise strong actors for promotional activities. Which activities are most relevant is situational depend.	Campus brand name might now be well established. Use it as business card and ensure that campus parties do the same. Aim to fully utilize the brand name in order to attract new talent, firms, research institutes, partnerships and other relevant resources. Great promotion tool.
Capacity for (open) innovation and R&D	When there is no existing culture of OI, the campus organisations will initially have their hands full with ensuring innovative capacity for themselves. However, if possible start to connect different innovation nodes and prepare (based on profile) new entrant for the idea of OI.	Depending on campus industry, culture, financial status and technological stands, start preparing the campus parties to establish (new) collaborative activities. Initially, sharing facilities and explaining the value of (joint) innovation, could slowly set the pace towards OI. If OI culture already exists, aim to foster these activities and ‘test’ the proper settings.	OI does not have to, but could be more incorporated into the campus culture. However, it appears that introducing OI can prove to be quite difficult (difference between academic- and business driven campuses). Do not ‘sell’ OI as the only way to go, but attempt to customize the OI principle to the needs of the campus residents. Could be both a potential success of bottleneck factor.
Access to Finance/Venture Capitalists	The availability of finances greatly influences the initial stages of campus development. Investing in campus facilities, potential projects, promotion, etc., can be quite costly. However, being creative, while having financial restrictions might attract the ‘proper’	With the likely introduction of a support organisation in this stage, access to finance affects becomes important for them as well. Could be a potential pitfall or bottleneck during bot campus and campus organisational development. Access to finance also becomes	During this growing phase, gaining access to finance is essential for the established campus organisations and for potential new start-ups as well. A shortage could also hinder new collaborative activities and thereby blocking potential OI. The campus intermediary organisation can

	campus organisations locating on campus because of campus profile. Access to finance is also of great importance for new firms that need to invest. Could provide a kick-start.	increasingly important for campus participants, especially start-ups. Obstacles in obtaining finances can greatly affect campus development.	also be affected, resulting in a less effective organisation with limited strength (e.g. for promotion, connecting innovation nodes, guiding programmes, etc.)
Physical Infrastructure	Does appear to be highly valued. However, the absence of suitable and perhaps even high-end facilities can greatly hamper campus development. This factor is directly linked to the evident knowledge carrier and the related access to finance. Although this factor can contribute to success, it can certainly become a bottleneck.	During the growth stages, the physical infrastructure will become increasingly important, since innovative activities might call for specific high end laboratories, test labs, etc. However, this factor appears to be growing alongside the campus development, since new campus participants (sizable) often bring new facilities.	Becoming increasingly important. The physical infrastructure is highly valued and companies seem to increasingly make usage of shared facilities. Possibly, the campus-owner ensures facilities through rent, or campus firms contribute to facilities and share (or not). In addition, new high-end companies need high-end facilities.
Capacity for Achieving Campus Consensus	Could prove to be quite challenging, negatively affecting campus cohesion. Aligning campus interests is of key importance. Especially academic-driven campuses seem to struggle with aligning interests of both university and campus companies.	If the interests of campus participants are aligned, it is likely that it contributes to the dynamics of the campus. However, differences of organisational goals make it difficult to act as one. Beware for the dominant actor to overcast other campus parties. A support organisation can aid in aligning interests.	Since the campus profile should be leading, the campus participants should have a general consensus about the campus direction, activities and responsibilities. A strong support organisation could prove to be effective in bridging the different campus interests (if they exist)

As Table 9 illustrates a set of general activities potentially aiding in campus development and ultimately campus success. Although in order to develop Table 9, some small assumptions had to be made, the model emphasises the importance of the different factors, but in addition illustrates the changing nature of identified factors.

This chapter being mainly dedicated to the experts 'most valued' factors influencing potential campus success, does not mean that the other factors identified by the experts are not relevant. In fact, all fourteen factors have been identified to be of importance by at least three experts (see Table A1), indicating that all factors are relevant. In addition, the campus experts quite often illustrated potential interaction effects between the different factors. For instance, both experts from HTCE and BCC attach great value to the vigour of their intermediary support organisations, but there should probably not be any underestimation of the actual effect of sufficient access to finance on the strength and effectiveness of these support organisations (see Table 9). In turn, as illustrated by the physical division at Kennispark Twente between the former business park and the university grounds, the geographical proximity factor is likely to affect the trust and social cohesion factor, indicates some sort of interaction effect. This interaction effect could imply that factors should not be considered as stand-alone constructs, but as important indicators that might affect each other and thereby its value, that can be described as necessary- (mostly valued) and sufficient (identified and to certain extent valued) factors. The sufficient factors are likely to be required in 'good shape' in order to support, or to not negatively affect the necessary factors; thereby both factor types influencing campus success.

Chapter 5 Drawing conclusions on innovation campus success

This chapter is dedicated to closing a gap in academic literature by illustrating the main findings of this study, whereas chapter six aims to translate these findings to the complex practice of the HTSP ultimately aiming to answer the underlying research question; *“What are the factors that are likely to make the High Tech Systems Park a success and what does the High Tech Systems Park organisation have to do in order to achieve that HTSP success?”*

5.1 Key findings and conclusion

This paper’s literature study resulted in a set of specific success factors that in general, ought to be relevant in relation to innovation campus success (e.g. derived from; Arthurs, et al., 2009; Su & Hung, 2009; Tavassoli and Tsagdis, 2014; and BCI, 2009). In fact, despite the little academic attention on this specific subject, answering SRQ1; *“What factors does literature constitute as necessary factors in obtaining campus success”*; has led to the development of a factor-framework (see Figure 3), in which fourteen different factors are highlighted. As potential success factor or even as possible pitfall or bottleneck, these factors are likely to contribute to innovation campus success.

The literature findings from SRQ1 were used as foundation for conducting a comprehensive multiple cases analysis. In order to investigate the five ‘campus cases’ and to obtain more in-depth information on the potentially relevant factors, SRQ2 has been used as guiding principle; *“What did innovation campuses comparable to the HTSP do in order to become successful?”*

After the analyses it became evident that the five innovation campuses showed quite a bit of common ground on the relevant factors, which expressed by the representing campus experts, are of crucial importance in achieving success for their respective campuses. As categorized in Table 7, a total of seven different factors were identified by the experts as their top five most important contributors to campus success, while in contrast eight factors were identified as experienced bottlenecks or pitfalls (Table 8). In addition, the case analyses indicated that in varying levels of significance, all fourteen factors from the factor-framework are relevant for building campus success. The findings indicate that all factors (especially the most valued) are relevant throughout campus development, although the actual value and functioning of the factor can change, depending on the environmental situation per development phase. In fact, Table 9, which has been derived from the multiple case trajectories, illustrates eleven factors throughout three stages of campus development spanning approximately one to ten years. In addition to the most valued or most important factors, the other factors are considered to be of value as well. In fact, the findings suggest that there is sort of interaction effect between the different factors, which implies a certain relationship between (some of) the factors (see Table 9). These two factor ‘types’ can probably be described as necessary- (most important) and sufficient (identified and valued to a certain extent) factors. It is likely that the sufficient factors are required to be in ‘good shape’ in order to support, or at least not to negatively affect the necessary factors. These findings seem to support the notion of the campus experts, arguing that all factors are somehow important for campus success.

Analysing the cases resulted in another finding, which became evident due to the strong emphasis the experts attached to the ‘Triple Helix Approach’. All experts highlighted the Triple Helix in one way or another, but the main function of these partnerships appears to be on enhancing the campus support base and to assist in facilitating the campuses’ basic needs (e.g. government: infrastructure, permits, promotion; university: students, facilities). However, one expert expressed that regional government actually invested in their campus, extending their support base even further. Whereas

one could argue that the relationships from the Triple Helix can be accommodated by the Networking factor, the experts attach such a great value to these partnerships, that the Triple Helix should be a stand-alone factor. The same principle applies on the concept of Open Innovation, which were highly regarded by the business-driven campuses and carefully, but increasingly valued by the other campuses. As Huizingh (2011) stated that OI cannot be seen as a single construct, but more as varying degrees of openness, there should probably be a factor developed that enables that train of thought. All experts considered (a certain version of) OI to become increasingly important in the future.

Literature initially made a distinction between the 'founding origins' of innovation campuses, such as the Science & Research Park and Open Innovation Campus (BCI, 2009). In turn, differences between business- and academically driven campuses were supported by the findings of this study. Participating organisations at a business-driven innovation campuses such as HTCE and BCC appear to be mainly interested in enhancing business growth and profit through collaborative innovation efforts, and thereby through campus success. Firms that are located at an academic-driven innovation campus, such as LBSP and the Wageningen Campus are likely to be there for the same 'business' reason. However, the university as strong evident knowledge carrier, which is likely to be the main booster of the campus, will probably aim to enhance and increase knowledge creation through collaborative efforts (academic success). At such a campus, participating organisations might experience varying interests, but that does not mean the different parties cannot achieve their individual goals (e.g. knowledge creation, and/or business growth). The apparent balance between business and academia at Kennispark Twente carefully illustrates the potential compatibility of successfully combining the campus perspectives.

Chapter 6 Recommendations for the HTSP organisation

In this second to last chapter, the emphasis lies on translating the findings of this study to the complex reality in which the High Tech Systems Park Organisation has to operate in, which initially led to the SRQ3: *“In what stage is the HTSP currently situated and what steps should the organisation take and avoid to come to the desired outcomes”?*

6.1 From the ideal academic world, through the complex reality, to the High Tech Systems Park

Literature and the findings of this study suggest that the underlying idea of innovating through co-development-, co-creation-, or other innovative network activities, is to enhance business growth, increase knowledge creation and possibly to attract and retain top (technical) talent. When comparing the five cases with the HTSP, the two business-driven campuses High Tech Campus Eindhoven and Brightlands Chemelot Campus and to a certain extent Kennispark Twente, appear to be more closely related, relative to the other campuses. These three campuses underline the idea of innovating through collaboration in order to enhance business growth, to improve market share, or to enlarge profits. In chapter four (Table 7 and 8), the business-driven campus experts mainly stressed five factors potentially leading to success and three potential pitfalls or bottlenecks, namely; 1) Pre-existing (Unique) Knowledge, 2) Support Organisation(s), 3) Evident Knowledge Carrier, 4) Clear Profile/Right vision, 5) Dynamic and/or Growing Company Base 6) Access to finance/Venture Capitalists, and Physical Infrastructure. Although in different degrees of importance, the same factors appear to be applicable to Kennispark Twente as well. Due to the close similarities between these campuses when it comes to the campus orientation (mainly business), it can be argued that taking notice and learning from these success factors (supplemented by the experienced pitfalls), can ‘make or break’ HTSP success. Since the HTSP has been founded quite recently, the campus is currently situated in the emerging development phase. At the moment, the campus is undergoing a physical transformation. Although still few in numbers, newly locating campus participants are building (or planning to build) new facilities, while other physical elements are changed as well, all located around the Shared Facility Centre. In addition, there are advanced plans to realise an Incubator.

The following paragraph focuses on translating the top five success- and three pitfall factors identified by the business-driven campuses, to the HTSP. The factors will be discussed individually in the context of the HTSP, in which several recommendations will be provided. Every factor section ends with a couple of concrete recommendations, which are highly important and aimed to advice on short-term actions. In addition to the most valued factors identified by the business-driven campuses, the other factors (also from academic-orientation) are likely to be relevant as well. That is why these sufficient and necessary factors are (partly) incorporated in the HTSP development model as well (see Figure A1), in which more concrete recommendations are included in relation to the specific campus development phase.

6.1.1 Working towards a successful High Tech Systems Park

Similar to the other two business-driven campuses, for the HTSP, the **Pre-existing (Unique) Knowledge (S1)** factor is not under direct influence of the HTSP organisation. Luckily however, the region of Twente is well known for its widespread (approximately 1200 companies) expertise in high tech systems and materials (Kennispark, 2016) also illustrated by Thales. Both business-driven experts stated that unique knowledge leads to unique business propositions and is therefore as ‘campus kick-start’ during the HTSP emergence phase of great importance. We do need to recognise

that in addition to the knowledge kick-start, both business-driven campuses were initially greatly invested in, which also contributed to a successful starting phase. This knowledge success factor embodies a solid- and highly fertile foundation to explore and build new businesses or to exploit existing ones. For the HTSP it is key to chart that pre-existing (unique) knowledge within the Twente Cluster and to develop plans to profit from that knowledge.

- Identify and map the (technologically related) knowledge and expertise in the Twente region also highlighting the different potential innovation nodes.

With Thales (Nederland) as strong actor and potential **Evident Knowledge Carrier (S3)** in high tech systems at the HTSP, the innovation campus has a great 'knowledge starting point' and supplements to the first success factor. However, that does not mean that other knowledgeable regional parties from the High Tech Systems Cluster Twente should not be involved in the HTSP. In fact, Thales could and should take a leading role as source of knowledge for the HTSP and the participating firms, as initially Philips did at the HTC Eindhoven and DSM and SABIC for the Brightlands Chemelot campus, but from a facilitating perspective. These statements perhaps require some explanation; when Thales aims to present itself and is planning to act as the most dominant actor on the campus, it is likely that the **Evident Knowledge Carrier** as potential success factor simultaneously becomes a potential pitfall (**P1**). In fact, both Philips and DSM were very dominant during the initial stages of their respective campuses, which resulted in great difficulties in attracting new businesses and other organisations to the campus. Both representing campus experts stated that the dominant attitude of the 'strongest' campus actor resulted in a threatening and deterring effect for potential new participants, which cost the innovation campuses a lot of leads and thereby partnerships. With the University of Twente being closely located to the HTSP, the innovation campus could benefit from a second Evident Knowledge Carrier. However, direct-researching projects, in which both parties can complement each other, are advised in order to keep the focus of both the University and the HTSP in balance. In fact, the HTSP could link directly to the Mesa+ laboratory at the University of Twente, concerning high tech chip developments. Although effectiveness of the T-Xchange programme is still under evaluation, the joint efforts from both Thales and the University of Twente are a great first step in developing solid and beneficial partnerships.

- In addition to Thales, quickly search for a second and preferably third evident knowledge carrier. Whereas the University of Twente could be an option, ideally a strong business oriented actor (multinational) ought to be acquired for the campus, on which its participants can lean on.
- Beware of Thales and other actors taking too much of a dominant attitude, which can be perceived by other parties as threatening.
- Incorporate Thales personnel as much as possible, since they will initially act as HTSP ambassadors. Clear communication is key.
- Start communicating to students directly, since they are likely to develop the next start-up.

Not only the business-driven campuses, but also LSBP and Kennispark Twente greatly value the success factor **Support Organisation (2)**. In practice this factor can take many forms; an intermediary campus organisation however, is considered to be essential by most representing campus experts. For all campuses, the intermediary campus organisation takes a facilitating role, with differing characteristics per individual campus. As we identified in chapter five, campus support organisations do not only facilitate the basic campus necessities (e.g. infrastructure, maintenance, etc.), but can be focused on promoting the campus, ensure selection and acquisition of new organisations, organise social and technical events and can even take a more intensive and pro-active role. The campus support organisation should have a pivot role in the campus environment in relation to several activities. For example, the support organisations of LBSP, Kennispark Twente, HTCE and BCC aim to stimulate campus social cohesion through events such as tech-talks, seminars and campus drinks for its residents, but also occasionally for other interesting parties. The organisations also attempt to

provide advice and guidance (e.g. financially, strategically, etc.) for the campus parties who require such support (mainly start-ups) through for example a mentoring programme. Most of all however, the intermediary organisations from BCC and HTCE proactively search for business opportunities among campus participants- and firms in the adjacent surroundings. More than the academic-driven, the business oriented innovation campuses attempt to direct their participants to a more open innovation context, in which co-development and co-creation is encouraged. However, as the experts clearly stated: open innovation is no single construct and does not mean full knowledge or skill exposure, but a more modular approach to knowledge sharing. Support Organisations, other types of support organisations (internal/external) such as an Incubator organisation or Knowledge Exchange Office can support the leading campus organisation. It could even be argued that the Triple Helix Approach is relatively similar to a supporting organisation (or multiple), which can support the relevant innovation campuses. All in all, these organisations seem to facilitate and support the other important success factors, such as attracting talent, or building a dynamic company base. The two business-driven campuses seem to thrive due to the support of their campus Intermediary, which therefore ought to be relevant for the HTSP as well. In fact, a strong HTSP organisation is very likely to be of great value for the campus' development. The HTSP organisation should at least have the activity capacity to promote the campus externally, enable networking in-and external of the campus, link- and support development of new businesses (potentially via serendipity) and provide guiding programs for the campus participants. The representing HTC Eindhoven expert however, did warn for a 'depended' character of such a **Support Organisation (P2)**. Initially, Philips was directly linked to the campus organisation, making it quite difficult to function objectively and therefore effectively.

- Establish an independent intermediary campus organisation that is able to comply too the business needs of the HTSP participants. Include enthusiastic employees who posses the necessary skills. Beware of the HTSP support organisation being to Thales dependent.
- Start organising events dedicated to High Tech Systems, Innovative Collaboration, and other relevant topics. Include as many external companies as possible, since it could prove to be an effective selection tool.
- Commence or continue extensive lobbies with potential Triple Helix partners. Triple Helix support in relation for the basic HTSP needs is very useful, while a strong support base via financial commitment would be ideal.
- Establish an Incubator, aimed to develop the dynamics of the HTSP company base.

An independent campus organisation is therefore of great importance. In current reality, the HTSP does not have the same financial resources as the other two business-driven campuses, making it quite difficult to produce a similar level of man- and punching power. In the case of the HTSP a creative solution is likely to be required. Participating campus organisations and other interested parties (such as Thales, Oost NV, the Province of Overijssel, University of Twente and Saxion University of Applied Sciences) could contribute financially and in manpower to an intermediary campus organisation. However, given the current development stage of the campus, the initiative should be taken by Thales and the organisation should attempt to include other parties as soon as possible. Such an organisation could be of great value for the development of the campus. In the long run, the organisation could alter its business model based on the Brightlands Organisation, by offering specific paid services to the campus participants. Thales could also play an important assisting role for such an intermediary organisation by offering services relevant for campus participants so the campus organisation does not have to. For example, campus participants who require guidance in Financial-, Intellectual Property-, or Human Resources Management, could be assisted by the experience and skills of the main campus actor; Thales. Similar constructs could apply to other campus stakeholders, thereby supporting the creation of a lean and agile intermediary organisation for the HTSP, which stimulate innovative collaboration activities among the campus participants.

- Ensure that the support organisation provides guiding programmes (especially to start-ups). Perhaps using the Thales facilities, skills and experience.
- Think about offering 'special' optional services to the campus participants (e.g. business development, technological assistance, factory testing, etc.).

It is crucial that the HTSP Support Organisation acts in accordance- and within the **Clear Campus Profile (S4)**, especially in relation to the acquisition of new participating campus organisations. All campus experts emphasise the importance of such a clear profile, since all parties' involved need to be able to connect with each other on the bases of aligned interests, capacity, and supplemented skills. The HTC Eindhoven expert clearly stated the long-term advantage of saying no to organisations that do not fit the profile. The same principle applies for the HTSP, while keeping in mind the necessity of 'first participating firms', which are necessary to start the campus development. In that stage, being too picky is very difficult for the HTSP, especially due to financial restrictions. In the long run, the campus Profile can gain in strength through an effective Triple Helix approach, aimed to result in a widely supported vision. Other parties 'committing' to the HTSP will enhance involvement financially and in other types of support. Improving the **access to Finance and Venture Capitalists (P3)** could be an interesting result of the Triple Helix approach and would stimulate innovative investments at the HTSP.

- Develop a clear sketch of the knowledge and expertise of both Thales and the HTSP. Not only Thales Hengelo, but the complementing subsidiaries in the Netherlands as well.
- Develop a clear campus profile that is strictly linked to the High Tech Systems theme. Develop an effective and strict stopping sign model, since strict firm selection could be beneficial on the long run.
- Assist new organisations in getting access to financial resources and perhaps provide financial guidance (no direct financial support). Aim to involve venture capitalist in the campus development (e.g. Cottonwood?)

Another weighty factor identified by all campus experts, is to build a **Dynamic and/or Growing Company Base (S5)**, which should also be the premise for the HTSP. Such a dynamic environment should be the responsibility of the HTSP Support Organisation, since that organisation should take care of the selection and acquisition process. All innovation campus experts emphasise the importance of such dynamics and highly recommend a strong variety of different levels of companies (within the campus profile). Especially the contribution of start-ups to the ecosystem ought to be of great meaning and should be of major interest to the HTSP. An independent Incubator (support) organisation could be a viable option for attracting, stimulating and guiding start-ups, who are relevant within the campus profile. The HTSP Support Organisation could also direct their attention to the 'start-up champions' Kennispark Twente. Both parties could profit from an exchange of knowledge and facilities in relation to the start-ups. By doing so, start-ups can be accommodated depending on their stage of development and the stage-related wishes and needs. Again, the campus Support Organisations of both innovation campuses should meet in the middle, but it would be recommended for the HTSP to take the initiative. Figure A2 Illustrates the potential partnerships between the High Tech Systems Park and Kennispark Twente, where they can meet up at overlapping start-up scene.

- Do not underestimate the value of a dynamic and/or growing company base. Attempt to attract as many organisations (fitting the campus profile) as soon as possible, thereby contributing to the campus dynamics.

Another option to create a vibrant start-up scene, would be attempting to lock-in into existing Startupbootcamp programs (e.g. at the HTCE, or BCC initiated programs). However, such an option would remain quite costly and is especially suitable if there already exists a selection of start-ups

ready to participate. The start-up connection with Kennispark Twente therefore seems to be the better option.

- Attempt to use the start-up expertise and company base of Kennis Park Twente. Ensure that the HTSP can provide a great next step for growing firms.
- Another option would be to co-contribute to already functioning Startupbootcamps, improving selection and acquisition and providing start-ups with the opportunity to grow.

To sum up; all of these factors, both success and pitfalls represent different points of interests during the development of an innovation campus such as the High Tech Systems Park. For the purpose of providing the HTSP organisation with a comprehensive overview concerning the variety of activities relevant to the specific factors and relevant to the respective phases of campus development, Figure A1 has been developed as well. The translation of factor findings to the HTSP, especially the business-driven factors, should be taken into account earnestly, since these factors are an important prerequisite of innovation campus success and neglecting them is likely to result in the undoing of the HTSP plans. In addition, the findings of this paper especially stress the importance of an encompassing campus organisation, which has the availability of all the necessary capabilities in relation to their task as support organisation. The HTSP Intermediary Support Organisation(s) as the centre of campus activities should be aimed to foster the HTSP in building a future with a dynamic campus environment, in which innovative collaboration among campus participants can thrive.

Chapter 7 Implications

The analysis of collaborative innovation among organisations in the area of successful innovation campuses entails some implications that are worthwhile.

7.1 Paper's contribution

Prior to the commencement of this research in innovation campus success, it became clear that an increasingly amount of scholars highlighted the function of networks in innovation- processes and output (e.g. Freeman, 1991; Porter, 2000; Ritter and Gemünden, 2004; Boschma & Frenken, 2010). As stated earlier, this accelerated increase in number of studies in the field of innovation has led to a vast variety of network related- theories, concepts and methodologies (Ozman, 2009). The literature investigation of this paper highlighted that the innovation campus concept remained quite undeveloped in the academic field of innovation research. Literature was missing a comprehensive take on the innovation campus concept, a strong body of factors potentially contributing to innovation campus success and the potential pitfalls or bottlenecks that innovation campuses might face during their development.

By following the literature pattern from the networking perspective, to the clusters concept, and into the direction of innovation campuses, this paper improves our understanding about the different collaborative constructs, their overlap, complementarity and the possible shortcomings in literature. The literature derived factor-framework provided a solid foundation for the empiric part of the study. The multiple case analysis in this research, in which five different top innovation campuses in the Netherlands were investigated, provided a valuable and extensive body of data for in-depth exploring the innovation campus phenomenon. Analysis of these cases resulted in a solid confirmation of the value and interaction effects of the fourteen factors, thereby providing literature with an encompassing framework of factors relevant for innovation campus success. In addition, the case analyses revealed two continuously returning constructs that should possibly be included in the factor-framework, namely the 1) Triple Helix and 2) Open Innovation factors.

This paper did not only focus on factors potentially leading to success, but also on potential pitfalls or bottlenecks, which innovation campuses might have experienced during campus development. By doing so, our perspective and understanding of factors and constructs, which are relevant for campus success, are greatly enhanced. In addition, the differing values of the various factors and the campus development trajectories identified per case, resulted in additional time-bound factor dimension. The identified differences between the relevant factors in relation to business- and academic-driven campuses seem to comply with the current literature perspective on potential differences in cluster- origins and functioning. However, these findings provide a useful insight into the similarities and differences between academic- and business-driven campuses success and functioning. For instance, differences in campus- vision, nature of support organisations and talent attraction, while at the same most factors are relevant for both types of campuses, just by other means. All in all, this paper contributes in extending our understanding of innovation campuses success and their development trajectories.

The following two paragraphs are devoted to reflecting on this paper's explorative investigation and proposing suggestions for future research.

7.2 Reflecting on research limitations

As with probably all academic investigations, some limitations need to be recognized regarding this study as well. Reviewing 'that' what could have been done differently during the investigation, could therefore be quite useful in identifying this study's limitations. This research has a qualitative and exploratory nature and examined merely five specific cases in depth, resulting in limitations in terms of generalization, which is why this paper does not claim any solid statistical representativeness. Yin (2009) however states, that despite a relatively small case sample and the usage of qualitative research approaches case study research can result in analytic generalization. The other three mature Dutch campuses, and perhaps even campuses in other development stages could have been included as well. Since this study covers five out of eight Dutch mature innovation campuses, the analytic results are probably limited to the Dutch context. That is because it is likely that in other countries, factors that influence (externally) an innovation campus and the region it operates in can be quite different. In fact, (regional) differences in political-, socio-economic- and for instance technological settings are relevant factors over which an innovation campus has no influence, while at the same time these factors can negatively or positively affect the functioning of an innovation campus and ultimately campus success. Although for every campus a high-level expert has been interviewed, the amount of interviews was limited to only one per campus, resulting in a potential, but relatively small bias for results of this explorative study. In this paper it has been acknowledged that valued factors, which were identified during the interviews are directly linked to their respective individual case. In other words, the factor 'Support Organisation', which is relevant for the success of Kennispark Twente, can probably not be transferred directly to the HTCE, since the actual structure, functioning, and background of the factor could vary quite extensively. However, the development trajectories of both academic- and both business-driven campuses were fairly comparable, which seemingly has led to relatively similar values of the factor constructs.

7.3 Suggestions for future research

The multiple case study analyses highlighted potentially very interesting sub-topics for future studies. In fact, the Triple Helix Approach (Leydesdorff & Zawdie, 2010) and the Open Innovation concept (Chesbrough et al. 2006; Huizingh, 2011) came up repeatedly during the semi-structured interviews, while the fourteen factors derived from literature did not (sufficiently) cover these constructs. Studying the effects of (in) effective Triple Helix partnerships on innovation campuses and the actual functioning of such collaborative structures, perhaps including campus intermediary organisations, could signify a very interesting factor for prospective studies. Studying the OI concept at the innovation campus level by investigating 'if' and especially 'how' open innovation in such a campus environment actually works, 'what' the preconditions are and 'why' there are likely differences in OI per campus could be interesting as well. In this OI context, or perhaps in a context of its own, the differing natures of academic- and business driven campuses should be further explored as well.

During this study, mainly local governmental policies and influences have been taken into account (also when illustrating the Triple Helix Approach). However, studying the effects for the innovation campus on a more macro scale could prove to be of value as well. Concepts such as the National Systems of Innovation approach (Lundvall, 1988) have been investigated extensively in relation to different environments of innovation (e.g. at firm-, cluster and network level). Although several governments already have developed national innovation policies that also affect innovation campuses, there is, to our knowledge, no literature backing of the effects (positive or negative) of such national policies on the functioning of innovation campuses. A last suggestion for investigations to come is that it could be worthwhile for researchers to apply longitudinal research methods. For instance, studying innovation campuses in different development stages and thereby obtaining a more in-depth perspective into their development trajectories and campus performance over time should provide valuable new insights.

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Appendix I Extended factor model

Table A1: Factors potentially resulting in campus success or pitfall.

Factor (potential success or pitfall)	Internal or External perspective	General Factor description (Potential Activities)	LBSP	WUR	KT	HTCE	BCC
Geographical proximity	Internal/External	Internal and external closeness/focus (e.g. proximity among campus participants or between other actors, such as; University, policy makers and financial institutions)					
Physical infrastructure	Internal	Basic: Energy, Communication, Transport, etc. Specialized: Laboratories, Research Institutes, Conventions Centre, etc.					
Willingness and Capacity for (Open) innovation/R&D within- and among firms (Entrepreneurial perspective)	Internal/External	Investing as campus participant in enhancing R&D capacity (Knowledge, Skills, Facilities) and could move towards are more Open innovation approach (initial task Promotor role Actor).					
Clear Profile/Right Vision	Internal	Developing a broadly supported campus Profile and Strategy among participating- Firms/Institutes, campus Support Organisations, and Policy Makers.					
Capacity for Achieving campus Consensus	Internal	Clear communication in relation to campus- strategy and future plans creating value and to align campus interests.					
Evident Knowledge Carrier	Internal	A strongly acting anchor tenant; (Technical) University, Multinational firm, University Medical Centre.					
Pre-existing (unique) Knowledge	Internal/External	Local or Regional Knowledge culture. No direct influence, but important prerequisite. Campus relevant Technologies/Industries in the region preceded the campus.					
Dynamic and/or Growing Company base	Internal	Diverse portfolio of firms and organisations of all sizes in order to increase dynamic culture. Mix of thriving start-ups, SME's, Multinationals and Research Institutes.					
Trust/Social Cohesion	Internal	Among campus- firms, institutes, and Support Organisations. Stimulating trust through strong communication, clear vision, events and successful (small) collaborations.					

Networking	Internal/External	To increase knowledge integration, added value and link to international market. Stimulating local- and extra local collaboration among campus firms and between firms and other actors (e.g. Support organisations, policy makers).					
Support Organisation(s)	Internal/External	Intermediary campus- or other types of Organisations (Incubator, Knowledge Exchange Centre, etc.), perhaps through paid campus services; campus promotion, Social cohesion, Providing (Financial, IPR, HR) guidance (Competence support), Coordinating R&D projects, Inter-firm and firm-university cooperation, and stimulating spin-offs.					
Access to Finance/Venture Capitalists	Internal/External	Essential (especially for start-ups) for stimulating innovation. Originated from the Government, Financial Institutions, Venture Capitalists and Industry, to the firms and institutes.					
Brand name	External	Utilizing the Brand name. E.g. Strengthens the attraction of investment and venture capital, new firms, skilled workers, complementing the marketing of campus firms.					
Talent/Staff attraction	External	Obtaining talent from outside the campus, due to regional atmosphere, government efforts, campus Brand name. Selling the campus.					

Legend: Full factor-framework in relation to external/internal perspective and 'which' factor applies to 'which' innovation campus (Blue; factor complies to general description, Grey; factor complies to certain extend. High Tech Campus Eindhoven: HTCE, Brightlands Chemelot Campus: BCC, Kennispark Twente: KT, Wageningen Campus: WUR and Leiden Bio Science Park: LBSP.

Appendix II Semi structured interview

Semi-structured interview in exploring Innovation Clusters

The aim of this interview is to gain insight into the most important factors for developing a successful innovation campus, a special focus is set on innovative collaboration activities between geographical closely-knit organisations. By attempting to find useful information in relation to the research questions (Yin, 2009; Babbie, 2010), semi-structured interviews are an effective explorative method. The initial questions form a guideline throughout the interview. However, the follow-up questions will be of key importance in obtaining more in-depth information.

- **Case-sketch:**

In 2015, The High Tech Systems Park has been founded at the former Thales grounds in Hengelo as an innovation campus for high-tech companies. The innovation campus has defined the mission of the organisation to create an innovative business climate for its residents in order to enable them to innovate- and grow faster, and to create a work environment that appeals to the best in order to attract future employees. High Tech Systems Park clearly states that the focus of the located companies is on high tech systems. However, these statements mainly illustrate the HTSP organisation's intentions. The terrain of Thales Hengelo ought to be transformed from a regular business park where originally physical production sites dominated, into a 'High-Tech' innovative environment. Thales founded the High Tech Systems Park as an institution that ought to act independent from the founding organisation.

In fact, Thales Hengelo initiated the start of the HTSP by building not only new high-end facilities for its own organisation, but also by building a Shared Facility Centre (SFC) for the High Tech Systems Park. The SFC ought to function as the centre and meeting point at the to be developed HTSP. The first participating firms are already located on the premises or have started to build their own facilities. Additionally, testing facilities such as a Field Test Centre, Group Competence Centre, Environmental Test Labs, and a Materials lab, are only to be expended and are being offered to the campus participants. Being aware of their geographical location and thereby mapping possible threats and opportunities, Thales Hengelo will aim to use their position to their advantage. The close presence of sources of knowledge as for example Kennispark Twente, the University of Twente, as well as other types of resources are expected to be of value to the HTSP.

Future HTSP organisational endeavours are aimed at attracting other new businesses; exploring new end extending existing ties with knowledge institutes, and improving governmental ties. The aim of these activities is to create a successful innovative high-tech campus.

However, in order to develop an innovative campus, in which the creation of new businesses or the creation of new value in all its forms is most relevant, it is important to not make unfounded assumptions. In order to obtain more in-depth information while keeping an open mind, five

innovation clusters or campuses that are in a sense comparable to the HTSP are being highlighted. This comparability indicates that several campus variables are similar. This semi-structured interview with the representatives of these five environments aims to highlight the different factors in relation to developing a successful innovative environment. The job functions of the interviewee within the campus organisation are very interesting for this research since the interviewee represents an organisation which experienced several stages of development that are likely to be relevant for the High Tech Systems Park.

In this semi-structured interview, the main questions will be leading. However, follow-up questions will encompass an important part of the information gathering, and therefore are likely to be used frequently in order to obtain in-depth information. The main guiding question will be: *“What did innovation campuses comparable to the HTSP do in order to become successful?”*

Starting point:

General Information - Input Interviewer:

Name:	Description campus opposed to HTSP:
Gender:	Cluster organisation - Description of the organisation:
Age:	Function title and descriptions - related tasks - timeline:
Innovation campus/cluster:	
Description of the cluster:	

- First of all, I would like to thank you for participating in this research.
- For the purpose of this research, I would like to audio tape this conversation. This enables me to use the data in a more effective manner. Do you agree with this?
- Introduction:
Keywords: **Innovation Cluster/Campus, HTSP** (founded 2015), **Becoming successful, wide range of facilities** (Field-test centre, Environmental test labs, Group Competence centre, etc.), **HTSP organisation** (Governance), **Five case models from eight of the biggest Innovation campuses, what are the next steps? What should be done? Not the end product has the focus but the process to get there does.**
- Do you have any questions prior to this interview?
- If not, I would like to start with some general information followed by a few main questions.
- Based on your answers I will ask follow up questions in order to obtain as much relevant information as possible.
- When answering the questions. Would you bear in mind what the relevant timeframe is in relation to you answers?
- If you are ready, I would like to start the interview.

Question 1:

What are in your opinion, stories of success in relation to your innovation campus?

Or

What are the core elements that you consider your campus to be successful in?

Possible answer: Well X, Y, and Z are examples of....

Question 2:

Could you elaborate on how this element (these elements) developed? What were in your opinion, the critical steps that led to success? (Elements: X, Y, and Z)

Question 3:

In Hengelo, the HTSP organisation is planning their future moves to develop the HTSP into a successful innovation cluster. There are likely to be some dos and don'ts, or in other words success or pitfalls.

- From your experience, do you remember difficulties that you or others faced in developing/managing your innovation campus?
- Continuing follow-up: What would you perhaps have done differently, or, if I may so blunt, what mistakes were made? How should these pitfalls be avoided?

Question 4:

It could be said that the HTSP organisation is in the first phase of developing the HTSP into a successful innovation cluster. However, the organisation is quite uncertain about what steps to take, or in other words, how to organize.

- Do you perhaps have any tips about how the HTSP organisation should organize themselves and what other steps they should take?

To sum up:

Potential questions if necessary:

- Looking back at the first questions, do you recognise specific and/or critical elements when comparing your innovation campus to the High Tech Systems Park? What are they? Why do you think these occur?
- To what degree (from a scale from one till seven) would you value the following factors in relation to the backbone organisation of the Innovation campus?

Explanation:

--

- I think that we covered all relevant sections. Would it be all right, if it becomes clear that little additional information is necessary, I contact you again?
- Thank you very much for your participation in this research.

List of factors that should be mentioned during the interview (check off):

- Types, structures, frequency, value, etc.

See extended factor-framework Table A1.

Appendix III Translation model High Tech Systems Park trajectory

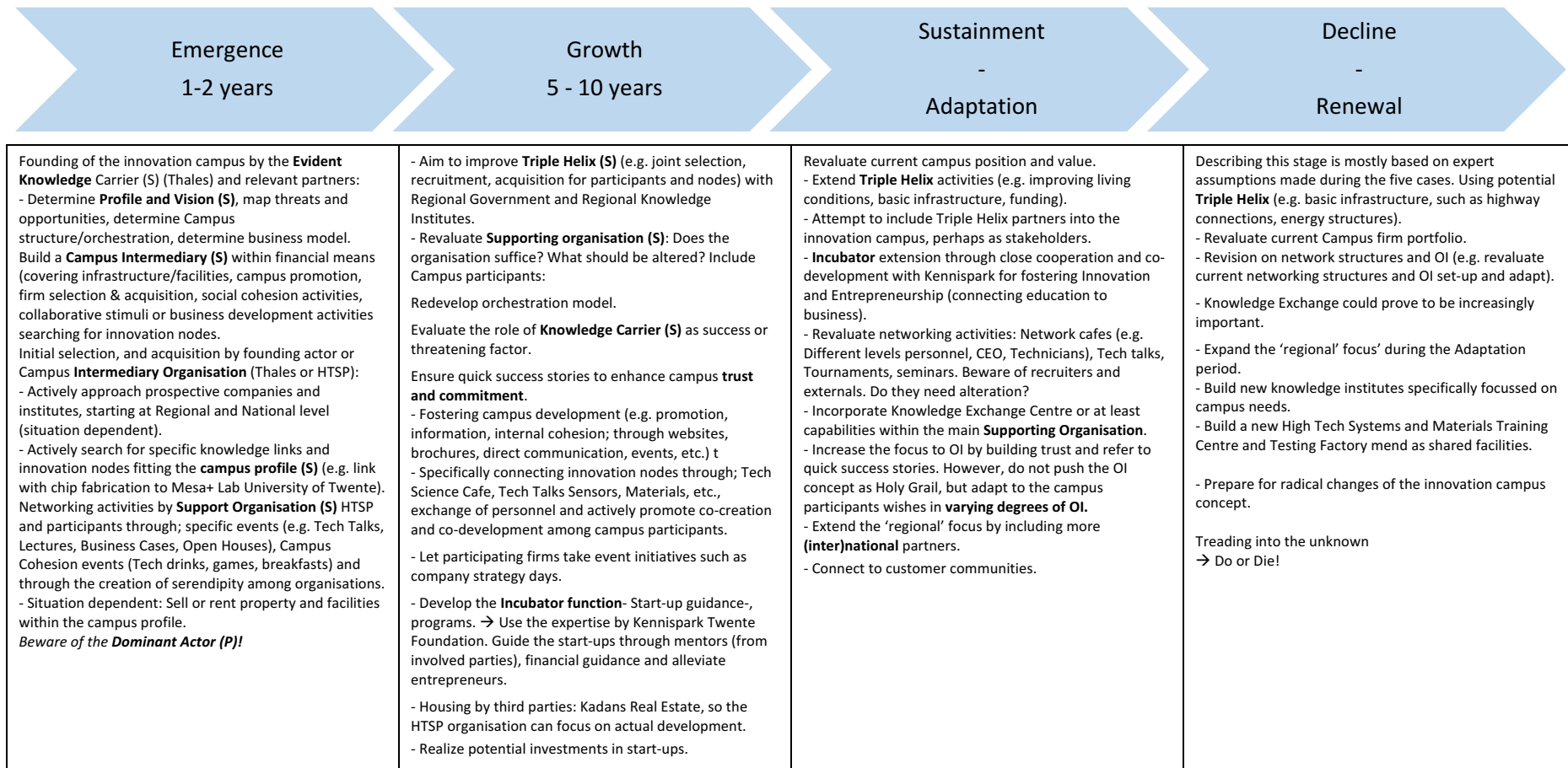


Figure A1 - Sketch development trajectory of High Tech Systems Park

Appendix IV Cluster within a cluster

Legend: Blue: High Tech Systems Park Red: Kennispark Twente Green: Start-ups.

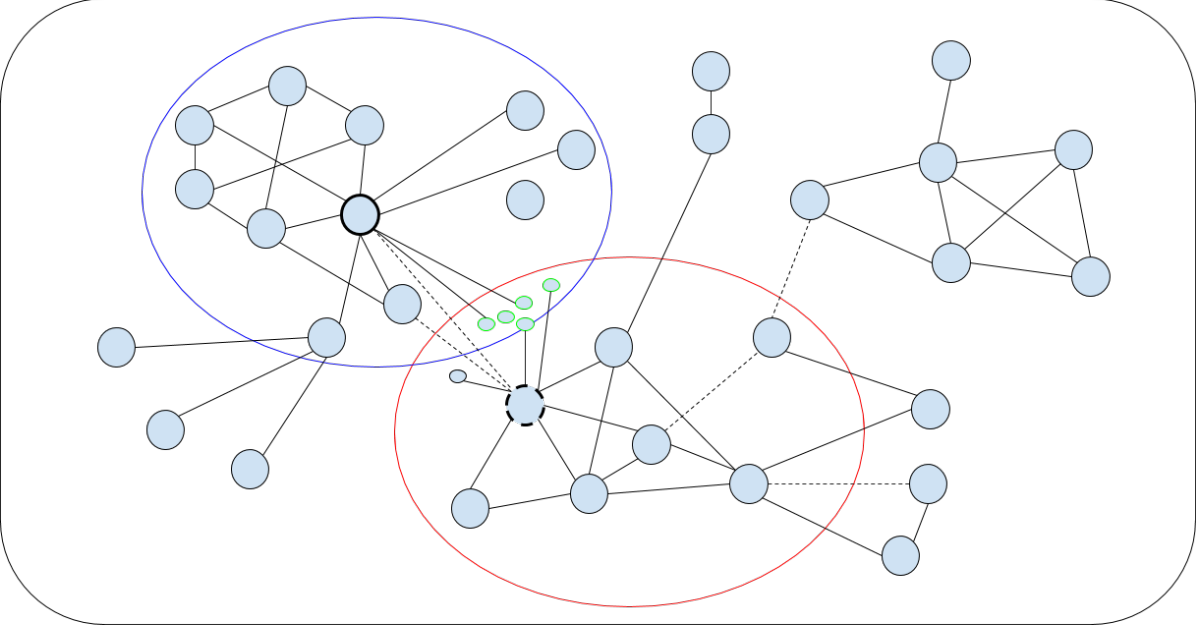


Figure A2 - Example of HTSP and Kennispark Twente in the Twente Region.