Open innovation

analysis of business spin-offs on the High Tech Campus Eindhoven

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Open innovation: Analysis of business spin-offs on the High Tech Campus Eindhoven

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Abstract

Today, many innovative companies are turning to new business strategies, particularly by transcending established firm boundaries with use of open innovation. Business spin-offs (BSOs) are independent startup firms formed by employees that left an existing company to grab the market opportunity. The open innovation strategy seemed to be a very good response to the difficulties they face, but it was unknown so far how important the strategy is to them. Therefore, the aim of this thesis was to develop a well founded understanding of the factors that make BSOs survive and succeed, and what specific role open innovation plays.

The High Tech Campus Eindhoven (HTCE), an area with relatively many BSOs, forms the setting for this research. The empirical findings, based on five case studies, show there are several direct and indirect success factors that help young BSOs to survive. Open innovation is one of the indirect factors that plays an important role in the early phase, but when the firm grows 'the doors are kept more closed'. Further, openness is more related to and influenced by other factors than theory would suggest. Also, open innovation is not more used on the Campus in a formal sense than in the region outside. However, the level of knowledge share via informal ways is higher on the Campus, what is an important advantage to the established BSOs.

The findings are used to extend and adjust existing literature on this topic, and as a starting point for further development and improvement of management and strategy of young business spin-offs, in particular with regard to open innovation issues.

Keywords: innovation, open innovation, knowledge exchange, business spin-off, High Tech Campus Eindhoven, ecosystem, multiple-case studies.

Executive summary

This paper is the result of my master thesis project conducted on business spin-offs. The study focuses on measuring the value added by the use of open innovation, and how this concept is related to other critical/success factors that determine the survival chances of BSOs (located in a knowledge-based business ecosystem).

Introduction

Most research in field of high tech BSOs deals with the background characteristics, including the motives why entrepreneurs set up such a firms. However, it is much more interesting, and especially helpful to BSOs, to know more about their ways of survival. Only a few investigations are done about the startup and survival of business spin-offs specifically, and even less research is done about the added value of open innovation in it. This means that a grey area in the literature exists about the relationship between the concepts 'open innovation' and 'business spin-off'. The use of open innovation seems to be a very attractive strategy to BSOs if one looks at their characteristics, but it is unknown so far to what extent they use it and how important openness is to them. Getting into more detail about BSOs can provide us deeper insights in their business strategies and their way of survival, perhaps with use of open innovation. This graduation study seeks to fill in that specific literature gap.

The High Tech Campus Eindhoven is an area in the Netherlands where open innovation is used and where relatively many BSOs are established. Despite of the amount of investigations written about the Campus, it remains unclear what the specific contingencies of this open innovation network are to BSOs. Therefore, the HTCE is the geographical field that forms the setting for this research. Altogether, the aim of this study is to find out what the critical factors are for BSOs to survive and succeed (in the ecosystem of the HTCE), and what specific role open innovation plays.
To be clear, critical success factors are elements necessary for an organization to achieve its mission. It is a critical factor or activity required for ensuring the success of a company or an organization.

The main research question is:

- *How important is the use of open innovation (in terms of knowledge exchange), for the survival and success of business spin-offs in the high tech industry?*

This raises four sub-questions:

- *Which critical factors are important for BSOs in the process?*
- *To what extent is open innovation profitable for BSOs?*
- *To what extent have the critical factors and determinants of open innovation been important for BSOs (on the High Tech Campus Eindhoven)?*
- *What kind of conclusions can be drawn for survival strategies of BSOs, including the use of open innovation, based on this study?*

Literature background

This part explains why the study to BSOs in combination with open innovation is important. First, when searching for research about spin-offs one will find most cases only about university spin-offs (USOs), and almost nothing about BSOs. Second, most research related to open innovation in field of young, small firms is focused on startups or SMEs. They have a lot in common with BSOs, and this can lead to some proposition, but as in the aforementioned case of USOs, there are still some important differences. This makes it impossible to generalize the research findings.

Further, the first two sub-questions are answered by a review of literature about spin-offs as well as the concept of open innovation.
It is shown that the relation with the parent firm and some other critical factors help BSOs to survive and succeed. If these factors are analyzed and related to open innovation, some of them can actually be seen as prerequisites of the use of open innovation. Next to the fact that they indirectly influence the survival chances of spin-offs, they also seem to influence how open a BSO can be to other firms.

This part of the study also explains why open innovation is the strategy a growing number of high tech firms use nowadays. Differences between the old strategy and the new one are explained, and the benefits of open innovation are described.
Open innovation seems to provide more opportunities to firms than closed innovation does, and these opportunities are especially interesting to young startups. The main underlying drivers for firms to open up their innovation are market turbulences, increasing R&D costs, scarcity of resources and uncertain market demand. Open innovation provides many advantages that can compensate for these problems, and so, open innovation can be seen as an indirect success factor for the survival of BSOs.

Finally, several propositions are made that have to be tested for in the empirical analysis. For example, the need to be open will decrease in all probability when the BSO grows, and open innovation benefits may be more readily achieved in regional clusters. The latter means that the High Tech Campus Eindhoven may increase the advantages of the open innovation method, what seems to increase the attractiveness of young BSOS to establish there, instead of outside the Campus.

Conceptual model

Based on the theoretical background, a conceptual model is created. This model is an aggregation of the pool of theoretical success factors that are determinant for the survival and success of BSOs in their early stage. It also shows the proposed relationship between the factors and open innovation. The empirical findings will be compared to the conceptual model. This will show whether the model has to be reshaped or not, and thus, in what way the theoretical findings differ from reality.

Method

In this case it is unknown if there is a real relationship between the critical factors, the determinants of open innovation, and the strategies of BSOs to survive. Only a conceptual model could have been modeled yet to describe what relationships may be present based on theory. To discover what the relation is between these three concepts, qualitative research is the best method for the empirical analysis.
To clarify, data are collected in close proximity to a specific situation; they strongly depend on their specific context. Besides, there is a small number of BSOs at the Campus, what makes it difficult to get reliable quantitative results out of it. Moreover, qualitative studies focus on naturally occurring, ordinary events in natural settings, that make it possible to capture what real life is. Also, it is adequate for studying relationships, and it is possible to go beyond the 'snapshots' of only measuring 'what' and 'how many'.
More specified, multiple case studies are used to answer the research question. First, the case study is especially useful when the research question is in the ‘how’ or ‘why’ form. Second, the depth and complexity of case study data can illuminate and help to understand the inter-relationships of such correlated factors. Third, exploratory case studies can be very useful for exploring new processes and behaviors, as they help to explain why certain BSOs use specific kinds of business strategies, and why they apply/avoid using open innovation. Fourth, having more cases provides a more convincing test than just one, and claims for generalizability can be made more convincingly by coordinating and aggregating evidence from a number of individual case studies.

Furthermore, a set of semi-structured interviews with key decision makers from different companies is used for the multiple case studies and is the main provider of information to this report.

Several outlines were drawn to bound the research field. The research is focused on high tech business spin-offs in their early years (maximum of 3,5 years old). These Dutch BSOs should be originated from several large parent firms (minimum of 100 employees). The selected business spin-offs should also be situated in the region around Eindhoven. Due to the strong selection criteria, five BSOs participated in total. Data was collected from the participating spin-off companies till no new information showed up anymore.

Empirical analysis and results

This part is used to analyze how important the indirect success factors are and how they are related to each other, what the direct success factors are, and which factors the use of open innovation influence. It is also used to discover the real benefits and barriers of the 'open innovation network' of the Campus. In short, it is tried to find the link between the use of open innovation and the other parts of the conceptual model. With these findings the third sub-question is answered.

Based on this study some success factors described in the previous chapters can be confirmed, like support of the parent firm, the importance of informal networks and trustful relationships, and the usefulness of a high reputation. Therefore, overlap exists between the conceptual model and the findings from the empirical analysis. On the other side, the study also shows there are differences between theory and the reality. This has resulted in a revised model, available in appendix F.

The differences in the origins of the BSOs determine the kind of relationship with the parent firm. When the relationship is weaker with the parent, open innovation is applied to a lesser extent between them. Also, when BSOs grow the relative inflow of external knowledge decreases in general, because they will increase their level of internal R&D. The external knowledge acquisition from the parent firm is reduced, and as a consequence, the startup will be less reliant on its parent when it starts to grow and becomes successful. In turn, openness between the parent firm and the BSO will decrease. BSOs most often apply open innovation at the lower level of formality. So, open innovation is used via informal ways in particular. Moreover, the spin-off companies only use open innovation in the applied technologies. This means that no core knowledge is shared with others, except the parent firm. During the evolution, the spin-off company has to be more careful about its use of open innovation. In the beginning a BSO can be free in forming new relationships, but when the firm starts to grow it has to consider much better which partners to work with and which ones not.

It can be argued that establishment on the HTCE is not enough in itself to reap the benefits from this area. The context from this ecosystem is more complicated than theory suggests. It is shown that several requirements have to be taken into account to take advantage of the Campus.
Furthermore, on the one hand, the HTCE is seen as an attractive area due to the mix of companies, high quality facilities and a pleasant working environment. On the other hand, the power of Philips, the focus on the high end of the market, and the resulting high prices are seen as problematic to startups such as new non spin-offs. However, for BSOs with origins in Philips, the HTCE seems to be a good place to locate. For them, a strong network, startup resources and exchange of knowledge might be powerful enough to compensate for the high establishment costs though.
Lastly, when a Campus-located BSO starts to grow, it will be less reliant on the Campus in general.

Conclusion and limitations

This final part of the thesis provides answers to the fourth sub-question, and to the main question eventually. The answer to the fourth sub-question can be seen as a summary of the previous

sub-question answers: it describes the critical factors, the benefits and pitfalls of open innovation to high tech BSOs, and the relationship between the critical factors and open innovation.
The answers have a twofold role: they fill in the existing theoretical gap, and they can help to improve the strategies of business spin-offs by means of a managerial policy.

Answer to the general research question:

Based on the empirical part of this study it can be stated that open innovation is really helpful to BSOs, but the strategy has some more pitfalls and difficulties than theory actually described. The strategy is restricted to more rules and agreements than one would think of. Nevertheless, it is a very useful strategy for starting spin-off companies, especially in their early years with scarcity of startup capital, knowledge and other resources. Open innovation offers some advantages, and most of them overlap with the theoretical success factors. Besides, some remarkable contradictions and some patterns not covered by previous literature have been found too.
To confirm the theoretical proposal, open innovation is a factor that can definitely add value to BSOs on a wide front, but it is not the most important success factor, given that its use depends on availability of the indirect external success factors. Without them open innovation would not make sense. The use of open innovation also works the other way around. When the BSO is more open, it seems less difficult to build up good relationships and get the right technology, explicit and tacit knowledge, and other resources via the parent firm and the network. This shows that the interrelation is high between open innovation and the other indirect success factors.
As these factors are strongly related to open innovation, the strategy is especially important in the startup period of the BSO. If the firm starts to grow, some factors will become more important than others. As a consequence, the relation with reference to the usability of open innovation will also change. To clarify, the parent firm and the ecosystem get less important and the personal network grows. The usefulness of informal ties decreases, and formal ties get more important. Also, competition increases, even as the protection of knowledge and IP. These important changes, make the firm become more closed than before. It shows that the application of open innovation is a very dynamic process.
Altogether, the role of open innovation will change over time and the importance of this strategy to BSOs will decrease (to some extent), in all probability.

From theory it could not be made clear how important the HTCE is for BSOs during their evolution process. The empirical analysis showed that, in a formal way, the Campus firms do not share significant more knowledge compared to firms outside the Campus. However, the HTCE stimulates the amount of informal relationships of business spin-offs with other companies. The informal use of open innovation is most important on the Campus. This means that the people working on the HTCE stimulate the use of open innovation in the ecosystem, not the situated firms.

Further, the method that is used has some clear shortcomings, which are dealt with as far as possible. Some problems could not have been prevented though.
First, the study is not longitudinal, which prevents uncovering changes in the situation. Instead of observing the participating firms during their different life phases, I could only ask the BSOs to what extent they used open innovation during their evolution. Second, the research is conducted in a single business ecosystem, with a small population of BSOs that met the selection criteria for this study. It decreases the generalizability, or external validity, of the outcomes and conclusions for other high tech ecosystems. Third, the bias that the research method may have brought to this study is that all findings are based on the interpretation of the researcher. The findings are not based on exact facts, but on relative interpretations of the interviews and documents. Some findings are, therefore, more trustworthy than others.

Preface

This thesis is the result of my graduation project for the Innovation Sciences Master Program at Eindhoven University of Technology (TU/e). The two-year Msc program taught me to integrate both social and technical knowledge, and provided insight in relation to technology and innovation. To clarify, the study taught me to view things in an 'innovation sciences perspective', a broad lens with special attention to technical innovation and its embedded context. I also learned to design and evaluate public policies, private business strategies and actions of other kind of organizations.
This final assessment offered me the opportunity to make use of my knowledge and experience gained during the last two years, and to turn my thoughts into a realistic work. Next to this, my international semester fuelled my interest towards strategies and decision-making processes on a firm-level.
Altogether, this is reflected in my investigation about the use of open innovation by business spin-offs in the high tech industry. Decisions are made on firm-level, but the bigger picture of the firm's ecosystem has to be kept in mind as well. This made the topic a perfect choice to start my thesis about.

I have experienced the graduation project as a very exciting and challenging period in my life. It required a great deal of self-discipline and independence, but that made me feel even more satisfied afterwards. To be honest, I could not have written this thesis without the support of various persons. First of all, I would like to express my gratitude to Dr. Bert Sadowski, my first supervisor, who mentored me through the whole project. His rigorous attitude has truly motivated me to perform better. He pushed me to stay sharp and critical towards my graduation project, and he pointed me in the right direction when needed. Besides, my gratitude goes to my second assessor, Dr. Johanna Höffken. Without her support, I would not have the chance to finish the thesis. I have been receiving support in form of guidance, clear feedback, and new ideas.
Furthermore, I would like to thank Jos van Erp for his inspiring enthusiasm and personal support. Jos helped me to find suitable firms for interviews and how to make them join my study. Also, he helped me to be self-confident and professional during the interviews.
Next, I want to thank my co-students Leonie Hermanussen and Sjoerd de Wildt who have helped me a lot with thinking of valuable suggestions and solutions when I struggled with my research.
Also, I would like to thank all people at the High Tech Campus Eindhoven who have made this study possible. I want to show appreciation to the interviewees in particular. Without their input, it would not have been possible to gather the essential empirical evidence.
Finally, I would like to express my gratitude to my dear friends, family, brother, girlfriend and most of all, my beloved parents, who have all supported me in their own way. These people gave me the motivation and persistence needed during this graduation journey.

I have enjoyed this challenging master thesis project and I hope that I can share some of the pleasure and interest with you whilst reading.

Daniël Timmermans

Eindhoven, January 2014

List of abbreviations

BLS	BedLeave System
BSO(s)	Business spin-off(s)
CEO(s)	Chief Executive Officer(s)
EO	Entrepreneurial Orientation
HTCE	High Tech Campus Eindhoven
HTSM	High Tech Systems & Materials
IAC	Inkjet Application Centre
ICT	Information and Communication Technologies
IP	International Property
JDP(s)	Joint Development Program(s)
NC	Network Capability
OEM(s)	Original Equipment Manufacturer(s)
PCB	Printed Circuit Board
PIS	Philips Innovation Services
PR	Public Relations
PTV	Prime Technology Ventures
R&D	Research and Development
SEM	Scanning Electron Microscope
SME(s)	Small and Medium-sized Enterprise(s)
TU/e	Eindhoven University of Technology
USO(s)	University spin-off(s)

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1. Introduction

Today's fast-moving high tech environments have become highly internationalized and exposed to global competition. In addition, sources of innovation have become widely dispersed, are changing rapidly, and increasingly go beyond the resources available to individual companies (Hagedoorn & Duysters, 2002; OECD, 2008). This makes it quiet difficult for small and medium sized enterprises (SMEs) to survive, especially in the early life stage. Moreover, these firms are financially constrained and thus perform limited R&D investments. Also, they lack a track record that can show their quality, and they miss the complementary assets (Lee, Lee, & Pennings, 2001; Walter, Auer & Ritter, 2006). Adopting open innovation can help firms to get access to resources, knowledge, distribution channels and startup capital that would otherwise be out of their reach (Heap, 2010; Lindegaard, 2011; Vanhaverbeke & Cloodt, 2006). Therefore, SMEs are turning to new ways to manage their innovation processes and encounter the difficulties, particularly by transcending established industry and firm boundaries with use of open innovation (Enkel & Gassmann, 2010; Gassmann, Enkel, & Chesbrough, 2010; Normann, 2001).

Open innovation means that companies benefit from both external and internal ideas by deploying outside (and in-house) pathways that can lead to new products or processes. Open innovation can offer a lot of advantages to firms like the exchange of technological knowledge and resources. Cooperation with partners is basically the fundament of the open innovation strategy (Chesbrough, 2003; Chesbrough, Vanhaverbeke, & West, 2006). With open innovation comes the need to create value networks that include all the potential categories of external partners that can support innovation effort (Lindegaard, 2011). Partners are just necessary to survive in the market environment (Adner & Kapoor, 2010; Teece, 1989).
So, business networks and open innovation are important for the survival of SMEs in general. In an environment where knowledge is the key economic resource and where open innovation is applied, one can experience the increasing importance of technological SMEs, high tech startups in particular.

One of the specific groups among the SMEs are business spin-offs (BSOs). Business spin-offs are "new firms created by individuals breaking off from existing companies to create (competing) companies of their own in the same industry" (Garvin, 1983, p. 3). The previous research findings seem to count for BSOs too, but there is a fundamental difference between all the kinds of SMEs: startups, small companies, a variety of spin-offs, etc. Research about SMEs almost never includes BSOs, and so, the findings are not generalizable to that kind of firms in particular.
BSOs are most often small, young firms, progressive, focused on innovation, and with a marginal amount of own resources (Garvin, 1983; Rese & Baier, 2011). Most research in field of spin-offs deals with their background characteristics, including the motives why entrepreneurs set up such a firms (Autio & Kauranan, 1994; Dahlstrand, 1997; Martınez & Urbina, 1998; Roberts, 1991). However, it is much more interesting, and especially helpful to BSOs, to know more about their ways of survival. Only a few investigations are done about the startup and survival of business spin-offs specifically (e.g. Chesbrough & Rosenbloom, 2002), and even less research is done about the added value of open innovation in it. This means that a grey area in the literature exists about the relationship between the concepts 'open innovation' and 'business spin-off'.
The use of open innovation seems to be a very attractive strategy to BSOs if one looks at their characteristics, but it is unknown so far to what extent BSOs use it and how important open innovation is to them. Therefore, the question raises whether or not the use of open innovation is important to the survival and success of business spin-offs in particular. Getting into more detail about BSOs can provide us deeper insights in their business strategies and their way of survival, perhaps with use of open innovation. This graduation study seeks to fill in that specific literature gap.

1.1 Research definition

This chapter provides a short overview of the rationale behind the study. The introduction has pointed to some gaps in the literature and clarified the motives for my research. Now, the research definition will follow, and thereafter the general research question is described. Then, the research project is situated and the design is presented. The end of the chapter provides an overview of the report structure.

A famous area in the Netherlands, where open innovation is used and where relatively many BSOs are established, is the High Tech Campus Eindhoven (HTCE). Therefore, the HTCE is the geographical field that forms the setting for my graduation research about high tech business spin-offs. A lot of investigations are written about the High Tech Campus (e.g. Azeredo, 2006; van der Borgh, 2007; van der Borgh, Cloodt, & Romme, 2012) and about business ecosystems (e.g. Brainport Industries, 2012; Iansiti & Levien, 2004; Moore, 1993), but not about the BSOs operating at the HTCE. So, in this paragraph, after a short introduction to the Campus, I will explain why it is interesting to do research about business spin-offs located at the HTCE.

The Campus is a knowledge-based business ecosystem, or geographical 'hotspot', in which companies are located in close proximity to each other. There is growing recognition that these hotspots are key to economic development (European Commission, 2002; van der Borgh et al., 2012). The combination of dense social networks and geographic co-location has been critical to the genesis of many high tech regions (Bunker Whittington, Owen-Smith, & Powell, 2009). However, there are two discussions going on about the value of the HTCE. The first one is about the value of open innovation to the Campus firms, the second about the value of the Campus to startup companies. According to Brainport Industries (2012), the HTCE is an ecosystem in light of the adopted open innovation strategy, based on a network of closely cooperating partners. The closely connected network of firms using a joint open innovation strategy has been very important to the success of the HTCE in the course of time. It promotes shared research, exchange of knowledge and development of new products, services and technologies. Despite these positive words about the HTCE, there are also firms that do not perceive anything of the open innovation network. They have less interaction with other firms, see no shared vision or common direction and just do not feel they are part of the Campus (Azeredo, 2006). The question is what motivates them to stay on the Campus.
The object of the Campus is to generate opportunities for co-operation, creating valuable partnerships and turning ideas into new business ventures, such as spin-offs (Brainport Industries, 2012). According to High Tech Campus Eindhoven (2013), the Campus offers enough possibilities to startups (including young spin-offs); there are more than 40 starters established. So, the Campus seems to be attractive to new firms. In opposite, van der Borgh (2007) argues that the current HTCE-concept does not support the emergence of startups. From analysis it appeared that the Campus aims at the high-end of the market. The price to be located at the Campus is very high, what makes it difficult for startups to establish there. Some other investigations show that many small players work together in the open innovation network of the HTCE to capture a market share. Without cooperation this would almost be impossible and it would be difficult to survive in the high tech market (Hagedoorn & Duysters, 2002).

Altogether, it is clear that contradictions exist about the value and 'open innovation atmosphere' of the Campus, and this might also count for the established BSOs there. Despite of the amount of investigations written about the Campus, to date, it remains unclear what the specific contingencies of the open innovation network are to business spin-offs in this ecosystem. It has to be investigated why BSOs use open innovation or why not. Is open innovation the main reason why BSOs locate at the HTCE, or is it a financial reason, the reputation of the Campus, or something else?

In other words, the *aim of this study* is to find out what the critical factors (also known as success factors) are for BSOs to survive and succeed (in the ecosystem of the HTCE), and what specific role open innovation plays. This will probably teach us more about strategies of these Dutch business spin-offs to succeed in the high tech sector and will give us deeper insight in the value (e.g. competitive advantages and/or disadvantages) of open innovation. Eventually, this should lead to recommendations for young BSOs, in particular with regard to open innovation issues in the future.

1.2 Research question

Based on the literature about (business) spin-offs, open innovation, and the High Tech Campus Eindhoven, it is important to get a better understanding of the relation between these three concepts. Therefore, the following general research question can be formulated:

- *How important is the use of open innovation (in terms of knowledge exchange), for the survival and success of business spin-offs in the high tech industry?*

Hence, a number of sub-questions is defined that must be answered to get the final answer to the main question of this thesis. The four sub-questions are:

- *Which critical factors are important for BSOs in the process?*
- *To what extent is open innovation profitable for BSOs?*
- *To what extent have the critical factors and determinants of open innovation been important for BSOs (on the High Tech Campus Eindhoven)?*
- *What kind of conclusions can be drawn for survival strategies of BSOs, including the use of open innovation, based on this study?*

1.3 Situating the research project

To make my research more detailed I focus on the startup and survival of Dutch BSOs in their early stage in the high tech industry. According to one scheme of classification (Bosma, Acs, Autio, Coduras, & Levie, 2009), these spin-offs should not be older than 3,5 years. More about this classification will be explained in the method section.
Former research on this topic has focused on the ecosystem level of analysis. In this study I focus on the firm level. This means that the results will be recommendations only for managers of business spin-offs, especially for Campus-located BSOs that use the open innovation strategy.

My research is part of a general project about open innovation networks at the HTCE. The project is initially conducted by a team of three Master of Science students of the Innovation Sciences program and a supervisor of the Technology, Innovation & Society Department of the Eindhoven University of Technology (TU/e). This project is all done with support of High Tech NL. High Tech NL brings firms and universities into contact with firms located at the HTCE. See figure 1 for an overview of the topics that are addressed during the project by each of the students.

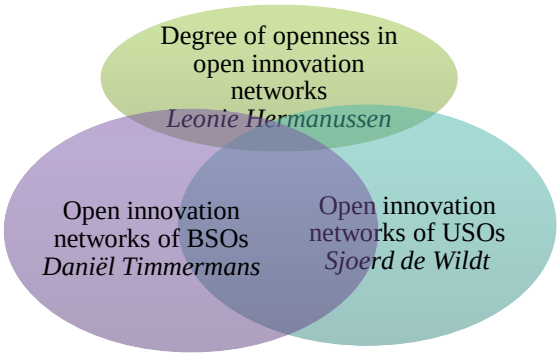

Figure 1. The open innovation project.

1.4 Research design

As a first step, I determined the relevant bodies of literature for this study and wrote a literature review based on this. The domain of this review is defined in terms of all research in the area of (business) spin-offs and open innovation. This is derived from different kinds of documentation: more than sixty publications, reports, and working papers are collected. The first two sub-questions will be answered from this literature review. As a second step, from this literature selection I coded the main factors fostering or discouraging spin-offs, and how they are related to open innovation, into a conceptual model. After this, the preliminary set of critical success factors, that can support or hinder the BSOs in their market survival, were examined in practice and I searched for missing factors that also influence BSOs' survival chances. To be clear, critical success factors are elements necessary for an organization to achieve its mission. It is a critical factor or activity required for ensuring the success of a company or an organization.

Further, the empirical analysis point out the real success factors, and copes with the comparison between the real added value of open innovation to BSOs (on the HTCE) and the findings from literature and, where needed, indicates areas for re-design. Moreover, the empirical research is qualitative and explorative and is based on a case study approach. This part will answer the third sub-question.

Finally, this study concludes with possible points of improvement for business strategies of BSOs (on the HTCE), and with an addition to the marginal amount of literature currently written about business spin-offs using the open innovation strategy. It answers the fourth sub-question, even as the general research question. Figure 2 provides the structure of my research design.

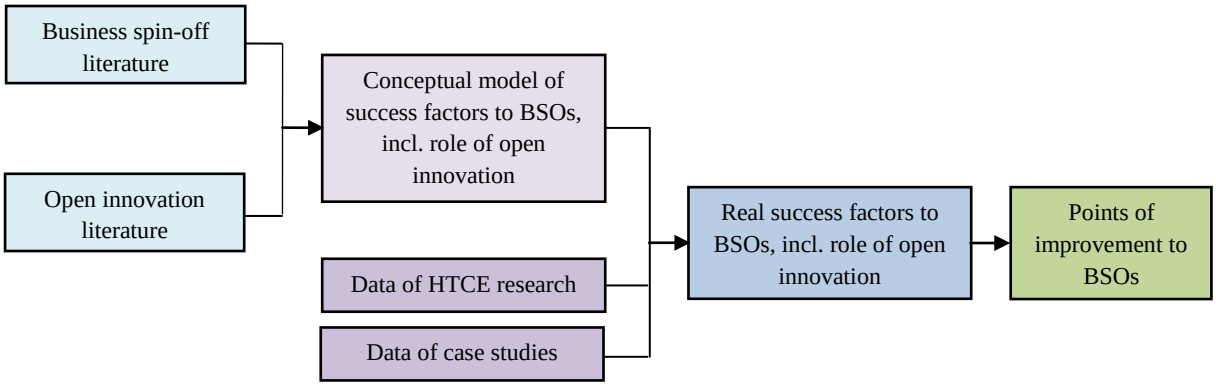

Figure 2. The research design.

In order to be clear, the first two sub-questions are derived from the light blue boxes of the research design. The third sub-question is based on the bottom two purple boxes of the research design. Both the fourth sub-question and the general research question deal with the right hand side of the research design (dark blue and green boxes).

1.5 Report structure

To give a better overview of the following parts of my report, the research structure is shown in figure 3. The report contains four sections. In chronological order these are the literature background, the conceptual model and method, the empirical analysis, and the conclusion.

The literature background is covered by the second chapter. Chapter 2 describes the concept of business spin-offs and shows the theoretical success factors important to them. It also describes the concept of open innovation, explains the advantages and disadvantages of the strategy in general, and proposes how BSOs should use open innovation at best for their startup and maintenance.

The section of the conceptual model and method, is covered by two chapters. Chapter 3 provides the conceptual model. The conceptual model is basically the summary of the theoretical background imaged in one figure. It functions as a bridge between the theoretical and the empirical part of this study. Chapter 4 provides the research method. This method section explains how the empirical part of the study is set up.

The empirical analysis presents an analysis of previous research about the HTCE and empirical results of case studies. This is written down in chapter 5 and 6, respectively. The chapters explain what factors are important in reality to BSOs and how they are related to open innovation. Subsequently, theoretical and empirical results are compared in the last phase.

Chapter 7 fills in the last section of the study: it answers the main research question, it makes a proposition for improvements of BSOs' strategies (established at the HTCE), and it fills gaps in the literature with new information about business spin-offs. Also, the limitations and future research direction are written about in this chapter.

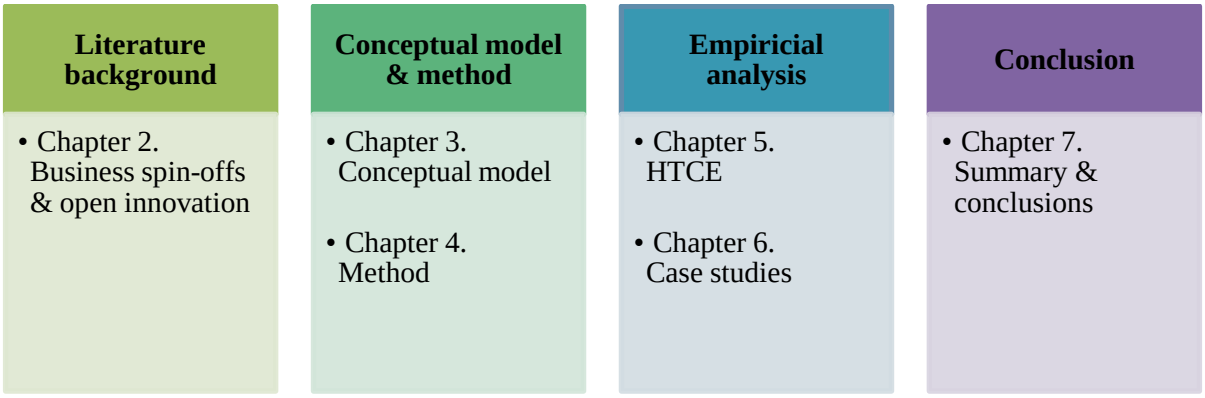

Figure 3. The report structure.

Literature background

Chapter 2. Business spin-offs & open innovation

2. Business spin-offs & open innovation

This chapter provides a literature background of the concepts 'business spin-off' and 'open innovation'. It is first explained why the study to BSOs in combination with open innovation is important; the grey area in the literature is made visible. Thereafter, the chapter is split up into two parts. The first part contains a literature review of spin-offs, and the second part contains a literature review of open innovation. Finally, a summary of this chapter is given, in which the first two sub-questions, '*Which critical factors are important for BSOs in the process?'* and *'To what extent is open innovation profitable for BSOs?',* are answered.

2.1 Descriptions

To start with, descriptions of the basic terms used in this report are given below.

Innovation: "An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. An innovative firm is one that has implemented an innovation during the period under review" (OECD & Eurostat, 2005, p. 46).

R&D: "The research activities of a firm are defined as the engagement in basic and applied research to acquire new knowledge and direct research towards specific inventions or modifications or existing techniques. Development activities include the development of new products or process concepts or other new methods to assess whether they are feasible and viable" (OECD & Eurostat, 2005, p. 36).

High Tech: High tech basically relates to high technology industries. "If the average spending of turnover of a sector on R&D exceeds 4%, the sector is being classified as high tech" (Smith, 2000, p. 10). A drawback of using R&D intensities as determinant is that R&D-intensive companies can occur in low tech sectors, and non-R&D-intensive companies can occur in high tech sectors as well (Barge-Gil, 2010). There is no definition of high tech that encompasses the exceptions. Nevertheless, literature agrees on several aspects that are common to high tech companies. The most important traits of these companies are: high R&D intensity, high R&D expenditures, and technologies for fast moving markets (de Jong & von Hippel, 2009; Harbia, Amamoub, & Andersonc, 2009).

Knowledge-based business ecosystem: A knowledge-based business ecosystem is a social and economic environment providing specific value sources that individual companies seek in their continuous quest for performance improvement. These ecosystems are confined to small geographical areas (also called geographic hotspots), for example, park- or campus-based initiatives, not including entities covering larger geographical areas, such as technopoles and innovation networks. A business ecosystem consists of a set of knowledge-intensive companies, organizations or groups of people that depend on each other and thereby influence each other's effectiveness and efficiency, and as such need to be located in close proximity. Furthermore, it extensively draws on high tech knowledge, in contrast to industrial estates that tend to have other priorities (Iansiti & Lavien, 2004).

2.2 Theoretical gap

Most research in field of business spin-offs deals with the background characteristics, including the motives why entrepreneurs set up such a firms (e.g. Autio & Kauranan, 1994; Dahlstrand, 1997; Martınez & Urbina, 1998; Roberts, 1991). However, it is interesting, and especially helpful for BSOs, to know more about their business strategies, since starting spin-offs face a number of difficulties mainly associated with a lack of resources and entrepreneurial skills. It is difficult for them to survive, especially in the early life stage. Therefore, getting into more detail about BSOs can

provide us with better insight in their way to survive and succeed. More specified, very little is known about the role of open innovation and networking in their strategies. So, I also attempt to uncover the role of the open innovation strategy in the value creation process of high tech BSOs.

Business spin-offs, also known as corporate spin-offs, spin-outs or starbursts, are "new firms created by individuals breaking off from existing companies to create (competing) companies of their own in the same industry" (Garvin, 1983, p. 3). However, the term 'spin-off' has also been applied to new firms created by university and laboratory scientists seeking to develop further the commercial possibilities of their research.
When searching for research about spin-offs one will find most cases only about university spin-offs (USOs), and almost nothing about BSOs. Studies have examined different aspects of USOs, such as the characteristics and programs of parent organizations (Bray & Lee, 2000; Rappert & Webster, 1997; Rogers, Takegami, & Yin, 2001; Smilor, 1987), spin-off/parent conflicts (Steffensen, Rogers, & Speakman, 2000), and barriers to technology transfer (Geisler & Clements, 1995; Pérez & Sánchez, 2003; Van Dierdonck & Debackere, 1988). In opposite to this large amount of research about the university spin-offs, a marginal amount of research is done about business spin-offs. Only a few investigations are done about the startup and survival of business spin-offs specifically (e.g. Chesbrough & Rosenbloom, 2002). The problem is that, although the business spin-offs and university spin-offs have some commons, there are considerable differences. Therefore, the two kinds of spin-offs are not generalizable. The basic difference is that BSOs derive from a commercial entrepreneurship, while USOs emanate from a non-profit organization (Braaksma & de Jong, 2005). The majority of the findings about spin-offs in general, described in the next section, is based on research only about USOs, and so it does not directly count for BSOs too. Both the similarities and the differences between the two kinds of spin-offs give interesting knowledge about spin-offs, and also provide direction to which aspects of spin-offs I need to focus on in my case study interviews.

As can be seen from the introduction most research related to open innovation and networks in field of young, small firms is focused on startups or SMEs. They have a lot in common with BSOs, and this can lead to some proposition, but as in the aforementioned case of USOs, there are still some important differences. This makes it impossible to generalize the research findings.
For example, start-ups pursue entrepreneurial strategies that focus on the accumulation of intangible resources for survival or growth, and a firm's external networks form a major contributor to its performance. Their ability to mobilize extramural resources, attract customers and identify entrepreneurial opportunities, is conditional on external networks, since social relations mediate economic transactions and confer organizational legitimacy. Start-ups should pursue strategies focusing on the development of valuable networks with external resource holders in order to succeed (Lee et al., 2001). In other words, open innovation networks seem to be crucial for the survival and success of startups. However, startups are not directly the same as BSOs, so it has to be investigated whether these findings also count for BSOs in particular or not.

Furthermore, there is debate about the use of open innovation within small companies. Some theorist suggest that SMEs should not use open innovation, and others advise them to apply the strategy for certain. Since my study is about BSOs in their early phase, the debate is interesting to these kind of firms too: Is it helpful for BSOs to use open innovation or not? And if so, how important is it, compared to other success factors?

Altogether, it is clear that a literature gap, or grey area, exists about the combination of business spin-offs and open innovation. This gap can be filled by answering my research question.

2.3 Spin-offs

In this part general findings about spin-offs are described, such as background characteristics, the relation with the parent firm, and other factors that help to survive and succeed. These findings should give a better view of what spin-offs in general are, and should also provide insight in their ways of survival. At the end of each paragraph the findings are linked to high tech BSOs and their use of open innovation. Based on this part, the first sub-question is answered in section 2.6.

2.3.1 Background characteristics

Spin-offs are most often young, progressive companies, willing to pursue untested technologies, and regularly venture into areas shunned by more established, conservative firms (Garvin, 1983). Spin-offs are common in many high tech industries and others as well. They are in general highly successful in terms of competitiveness, innovation, survival and growth rates. Moreover, spin-offs realize more growth in terms of employment, sales volume and profits than the regular SMEs. Furthermore, they have a high degree of technology transfer into new markets and have positive effects on the socio-economic environment (Braaksma & de Jong, 2005; Dahlstrand, 1997). Spin-offs are both a result and a driver of the shift to a new era. In the Netherlands, about 30 business spin-offs are started every year in the high tech industry.

Roberts (1991) found that 50% of the spin-off founders established their firms while still working full time for their earlier employers. Personal contacts between the spin-off founder and earlier colleagues continued to be important after the startup, and sometimes they even resulted in other employees establishing small firms.

Roberts argues that spin-offs are more often formed from tacit knowledge (general technological skills) than from explicit knowledge (specific proprietary knowledge). The former is know-how that is sticky, complex and not easily to codify, the latter is easily to transfer, easily accessible and easily to codify. Tacit knowledge is only accessible through interactive learning and co-operation instead of contractual exchange (Pirnay, Surlemont, & Nlemvo, 2002; Dyer & Singh, 1998). Tacit capabilities enjoy a tight appropriability regime, under which a spin-off is almost assured of translating its innovation into market value for some period of time (Teece, 1989). Roberts' argumentation is supported by the findings of the study of Dahlstrand (1997); very few of the entrepreneurial spin-offs bring any explicit knowledge or assets from their previous employers, but start a firm based on their personal skills and experience.

There is a difference between USOs and BSOs in the motives to start a spin-off. USOs are mostly started to commercialize new technological knowledge. BSOs can also arise from other motives, like reorganization, specialization, and strategic choices (Braaksma & de Jong, 2005).

The main reason for the start up of business spin-offs is that the founder's ideas were not utilised by the previous employer. Members of established firms often become frustrated when their ideas are not endorsed by top management when they see a chance to capture a piece of a (new) market. Some of them start their own firm to get more freedom and more job satisfaction (van Praag & Versloot, 2007). Also, poor management is often cited as a reason for leaving to establish a firm of one's own. Occasionally, personal disappointments, such as the loss of an expected promotion or salary, lead individuals to opt for self-employment. The other common explanation for spin-offs, that new firms are founded because individuals expect to earn greater financial rewards in their new positions, is equally limited. The opportunity to earn capital gains from equity participation is thought to motivate many entrepreneurs and explain the start-up of many new firms.

People coming from an established firm who start a business spin-off are also motivated because of their information and start-up advantages, readily transferable technologies, and environments in which skilled human capital is already available (Garvin, 1983). Thus, the circumstances at the

previous employment, the new potential market opportunities, as well as the founder's personal motives are likely to influence the establishment of new spin-off firms (Dahlstrand, 1997). More about 'previous employment' follows now.

From these background characteristics and facts it can be proposed that BSOs are most often formed from tacit knowledge. Tacit knowledge seems to be more important than explicit knowledge at the moment of start, because skills and experience are of main value then. This makes clear that the parent firm has an important role in the startup of the business spin-off. However, it does not only provide the right skills and experience, it also provides startup advantages such as transferable (explicit) knowledge, technologies and network contacts. More about the importance of the parent firm is discussed in the next paragraph.

2.3.2 Parent company

This study focuses on spin-offs in their early stage, and therefore particular emphasis is placed on the relationship with the parent organization.

The main success factors for a spin-off are support of the parent firm and the way in which the supervisory relationship with the parent firm is arranged. Because of the large dissimilarities between the parent organizations, it seems natural that the continued relation between the university spin-off and the university, compared to the business spin-off and the private firm, is necessarily quite different. For example, a business spin-off can easily be a potential customer or a subcontractor to its parent firm, while this is more difficult for a university spin-off. Similarly, it ought to be more common for the business spin-off to develop a competitive relation to its parent organization (Dahlstrand, 1997).

Furthermore, university spin-offs should be more active in technology transfer than business spin-offs in order to overcome the early disadvantages of university entrepreneurs for company development. Nevertheless, Smilor (1987) found indications that business parent organizations could assist better than universities in providing benefits to a spin-off company. Established firms, and their network of customers, investors and suppliers, are often the most important external actors in the early phase of the spin-off. They can provide a practical mechanism for risk-taking and risk-sharing in the early and most uncertain stages of business development. Besides the extent to which they contribute to the transfer and support of different kinds of knowledge and resources can make the difference between survival and failure, and between fast and slow growth. External parties make an association between the parent firm and the spin-off and that increases the acceptability and benevolence towards the new firm, in case the parent firm is an appreciated firm too (Braaksma & de Jong, 2005).

Here, the business spin-off can be assumed to hold an advantage compared to the university spin-off. For example, production machinery are more likely to be found in a private corporation than in a university. Similarly, developed products, marketing channels, customer and supplier contacts and so forth, ought to be more common in the private organization.

Thus, the parent corporation can help to support the business spin-off firm in various ways (Dahlstrand, 1997). This support mostly depends on whether the spin-off is a competitor or not. From the BSOs, it is not surprisingly that 43% operates in the same business, 44% operates in a field related to the parent firm, while only 13% is engaged in totally different market segments (Braaksma & de Jong, 2005).

The importance of the parent organization in technology transfer has already been demonstrated by Roberts in 1991. He found that most of the 'hi-tech' entrepreneurs acquire the knowledge transferred to their own companies from their parent firm. This finding is supported by Rogers et al. (2001). They examined the high tech spin-off process through which a new company is formed from a parent organization. An investigation of 30 university spin-offs was conducted. Rogers et al. found that

support from the parent organization, such as by providing venture funding, business management advice, transfer of international property (IP), building space or other needed resources, is especially helpful to the spin-off company. Many parent firms have an incentive to make the spin-off succeed and therefore they often provide the necessary know-how and access to resources (Lee et al., 2001). It also explains why planned spin-offs usually maintain a close relationship with the parent organization during and after the spin-off process (Mustar et al., 2006).

Pérez and Sánchez (2003) studied the evolution of the technology transfer practices used by university spin-offs during their early years and the influence of innovation networks on the dynamics of technology transfer. The empirical results suggest that technology transfer and networking at university spin-offs decreased after their early years but at the same time the relationships with customers increased. Later on, university spin-offs also reduced their relationships with the parent organization.

Other studies have compared the start of spin-offs to non spin-offs (startup firms without a parent company). There is a higher degree of technological transfer from the earlier employer to the spin-off than to the non-spin-off, and the degree of technology transfer from the parent organization can be assumed to contribute indirectly to the development and higher growth of the spin-off compared to the non-spin-off (Pérez & Sánchez, 2003). This confirms the findings of Rogers et al. (2001). It was argued that the spin-off firms have an advantage of initially more developed products, and of technology transfer, from their earlier employment. These firms would thus initially not have the same need for inventive work, and could sooner have a ready-developed product, which accordingly can contribute sooner to increased growth. Also, the comparatively low need of initial innovative work could free resources to be used in the business development (e.g., marketing of products) and the growth of the firm. The non spin-offs would have to put greater emphasis upon the initial inventive work before they could start to expand. Hence, the degree of technology transfer from the spin-off parent can be assumed to contribute indirectly to the development and growth of the business spin-off. The background at the parent firm indirectly influences the spin-off's growth and performance, because the new firm is taken more seriously by external actors like customers and investors, compared to non spin-offs (Braaksma & de Jong, 2005).

Dahlstrand (1997) found that, after an initial ten-year period, the spin-offs were growing significantly faster than the non-spin-offs. However, no significant difference in the inventiveness was found between the two groups. Neither the growth nor the inventiveness could be explained by pre-spin-off variables, but it is speculated that the earlier employment within the spin-off parent has indirectly influenced the performance of the spin-off firms.

Lindholm (1994) found indications that the spin-off, but not the spin-off parent, was often well aware of the advantages (for both firms) of a continued relation with its parent. It was speculated that it is often the parent's low interest in a continued relation that hinders more substantial cooperation. So, his findings are more or less in contrast with findings of the previously described research results. A business spin-off may encounter problems when it proves to be successful. In this respect, it may be perceived as a threat to the established business of the parent company, because it can not only disrupt current technologies and ways of operating but also competes for scarce corporate resources (Chesbrough & Tucci, 2005; von Hippel, 1977). As a consequence, private firms only invest in new firms if these build upon current technologies and businesses, but much less in spin-offs that are unrelated to their current technologies and established ways of operating (Gilsing, van Burg, & Romme, 2010).

These findings suggest that two of the most important factors for the survival of BSOs are support of the parent company and the way in which they are related to each other. It is proposed that

a BSO receives less/no support if the firm is unrelated and not interesting to the parent firm, or if the spin-off is seen as a competitor. The BSO can count on support if it builds upon the parent firm's technologies and business ideas. Then maintenance of a close relationship to the established firm during and after the spin-off process is most probable.
Parent firms and their networks seem to be most important in the early phase of the BSO, since the startup company still needs to widen its personal network. The parent firm can provide marketing channels, customer and supplier contacts, startup capital, technological knowledge, and other kinds of resources. Moreover, receiving know-how (tacit knowledge) from the parent firm, seems to be very important to BSOs. The degree of technology transfer is so important that it indirectly influences the development and growth of the BSO. Therefore, the use of open innovation seems to be a very attractive option to business spin-offs, especially in their early phase when they are more dependent on the parent firm and its network. In general, it seems less difficult for BSOs to get the right technology and explicit and tacit knowledge from their parent firm via open innovation, compared to USOs and non spin-offs.

2.3.3 Own success factors

Next to the importance of the parent firm's support, some other factors are important for the survival and success of spin-offs.

Spin-off's network

In order for spin-offs to contribute to economic growth, they must survive and succeed. Unfortunately, new companies typically face financial problems in their early years, when partners and customers are difficult to identify and attract. An assured customer base is often vital to overcome these thin new markets, and can be achieved by an intensive networking process (Garvin, 1983). The argument of Garvin is confirmed both by Pérez and Sánchez (2003), and Shan, Walker and Kogut (1994): The establishment of close links with various partners is a key element of success for the survival and development of a spin-off, since network ties are a very powerful explanatory of innovation output.
Collaboration enables a spin-off to bring a product to the market faster and to cover larger regions. Due to their technological orientation, spin-offs may encounter problems in market sensing and market intelligence, particularly when dealing with foreign markets. Spin-offs therefore need reliable market partners to develop presence and reputation in these critical stages. Close relationships to high-status partners may provide young ventures with attributions of quality and reliability when their own actual quality is rather uncertain. For example, marketing and forming of public relations (PR) get easier for a startup with big names and brands (Stuart & Sorenson, 2003). Also, successful spin-offs require networks of many different players. They need to be integrated into networks allowing interaction between a wide variety of actors. Therefore, the existence and growth of spin-offs depend on their ability to make important and purposeful connections to such actors as the parent firm, suppliers, customers, financial investors, research institutions, and legal authorities (Mustar et al., 2006). It also helps when the spin-off is part of an OEM ecosystem; it gets highly profiled external feedback on the things which are done and it gets the possibility to create long-term roadmaps and fund R&D for these goals (Lindegaard, 2011).

As a spin-off, it can be difficult to find the right employees for the industry's critical design and production techniques in the early years. That is also a reason why the parent firm and network capabilities can be especially important during the startup of the business spin-off. It can directly provide mancraft or help to find the right employees for the BSO (Garvin, 1983).

The lack of management abilities and support to get financial resources and strategic alliances make their survival more difficult than for other companies. Anand & Khanna (2000) argue that firms

have to learn to manage their partnerships to be able to cope with contingencies resulting from intangible personal, organizational, and cultural attributes. Thus, one of the major contentions is that once a firm is spun out, its performance can be more fully understood by examining its abilities to build trustful relationships, to integrate the resources of external partners and to synthesize its activities with those of network partners. These aspects strongly overlap with the benefits described in the next chapter about open innovation.

Drawing on a database of 149 university spin-offs, Walter et al. (2006) investigated the impact of network capability (NC), defined as a firm's ability to develop and utilize inter-organizational relationships, and entrepreneurial orientation (EO) on organizational performance. Not only do the results suggest that a spin-off's performance is positively influenced by its NC, but the findings also indicate that a spin-off's EO fosters competitive advantages. Although no direct relationship is apparent between EO and sales growth, sales per employee, or profit attainment, it was revealed that NC strengthens the relationship between EO and spin-off performance. Firms should note that an entrepreneurial orientation, in and of itself, is not enough to compete in today's markets. Entrepreneurial ambitions alone do not create value and should not be seen as the fundamental force for the sustainable prosperity and growth of spin-offs.

The findings suggest that network partners are crucial for the survival of business spin-offs, especially when they just start up the business. A strong network consisting of many different players, including partners with a high reputation, is important. Network ties are a powerful explanatory of the innovative output, and since BSOs are described as innovative firms, these ties are indispensable for their performance. Without partners it is hard to capture a certain market piece, and this is even more difficult when the introduced product is totally new or introduced in a foreign country.
The relationship with network partners should be close, to build in more trust. With trustful relationships a BSO seems to perform better than with loosely coupled partners. When there is mutual trust, it appears to be that integration of resources from external partners will be easier and more often used. In other words, with trustful relationships business spin-offs can be more open to other parties.

Spin-off's property rights

In general, sectors with high technological opportunity conditions and a variety of technological approaches will be more conducive to the creation of business spin-offs. In addition to these technology related issues, the sectoral IP regime also affects the creation of business spin-offs. A sectoral IP regime refers to the extent to which inventions can be patented and these patents can be effectively defended against infringement (Gilsing et al., 2010).
Dahlstrand (1997) investigated the differences between BSOs and USOs on this topic. For example, while a private company often tries to keep research and technology within the firm, a university often encourages the transfer of the results to be used outside the university.
Kale, Singh and Perlmutter (2000) use the notion of relational capital to express the quality of a network. Their study suggests that a fruitful balance between learning critical capabilities from partners and protecting firm-specific competencies leads to the development of friendship, respect, and trust between interacting parties.

These findings suggest that especially BSOs shall try to keep knowledge for themselves and only give it away via licensing for example, since IP is in general more important to them than to USOs. This may block the use of open innovation to some extent. However, a balance in knowledge share seems to be the best option to BSOs: exchange of knowledge via collaboration with network partners is important, but some (core) knowledge has to be kept secret to maintain a market position.

Spin-off's capital

It is important to emphasize that not all segments of the high tech industry have a high incidence of business spin-offs. Some, because of the technologies involved, require large capital investments even early in their life cycles. This creates high entry barriers, deterring small-scale entrepreneurship. In these circumstances, spin-offs are relatively rare.

During their early years, spin-offs with inadequate financial resources face a critical disadvantage before they evolve into a full-fledged company. Young spin-offs well endowed with financial capital during their development period enjoy many advantages and thus can perform better. They can exploit a resource-rich market segment, which requires a great deal of initial investment for a venture to enter. Due to the financial resources these spin-offs are able to develop products, advertise, and recruit valuable human capital (Lee et al., 2001).

According to Mustar et al (2006), a strong network impacts the fund-raising of a spin-off. The more partners the firm has, the easier it gets to receive capital. Moreover, new ventures with founders having direct and indirect relationships with investors are most likely to receive venture funding and are less likely to fail.

Financial resources are not considered to provide sustainable competitive advantage, since such resources are neither rare, imitable, nor tradable. However, financial resources invested during the development period can be a big advantage, since they are positively associated with a high-tech spin-off's performance (Lee, et al., 2001; Mustar et al., 2006).

From these findings it can be stated that high tech BSOs need startup capital to survive. The higher the necessity of investments, the more difficult it gets to survive in the early phase. A large network of partners can help to overcome this startup problem, since there are more potential investors available. This means that BSOs should network heavily during their early phase, and even before they spin out of the parent firm, to build up a strong network to receive enough financial capital.

2.4 Open innovation

In this part it is explained why open innovation is the strategy a growing number of high tech firms use nowadays. It starts with the origins of open innovation, and differences between the old strategy and the new one are explained. Second, from literature the benefits of open innovation are described. Third, some factors/requirements are discussed that have a positive effect on the use of open innovation. Fourth, the differences between small and big firms that use open innovation are given. At the end of each paragraph the findings are linked to high tech BSOs and their use of open innovation. Based on this part, the second sub-question is answered in section 2.6.

2.4.1 From closed to open innovation

Many theorists have written about the shift from a closed innovation model, in which all aspects of the innovation process take place internally in a tightly controlled, highly secretive environment, to an open model, in which external partners play a key role in helping a company innovate (Lindegaard, 2011). The former model calls for self-reliance, because successful innovation requires control: 'Something good, do it by yourself'. It was important to invest as much as possible in R&D. This resulted in firstly market entry, which they protected with patents. The profits could be reinvested in more R&D (Chesbrough, 2003).

In closed innovation research projects are launched from the science and technology base of the firm. They progress through the process, and some of the projects are stopped, while others are selected for further work. A subset of these are chosen to go through to the market. This process is termed as closed because projects can only enter in one way via internal R&D, at the beginning, and can only

exit in one way, by going into the market via the firm's own distribution channels (Chesbrough et al., 2006). Figure 4 gives a schematical representation of the closed innovation model.

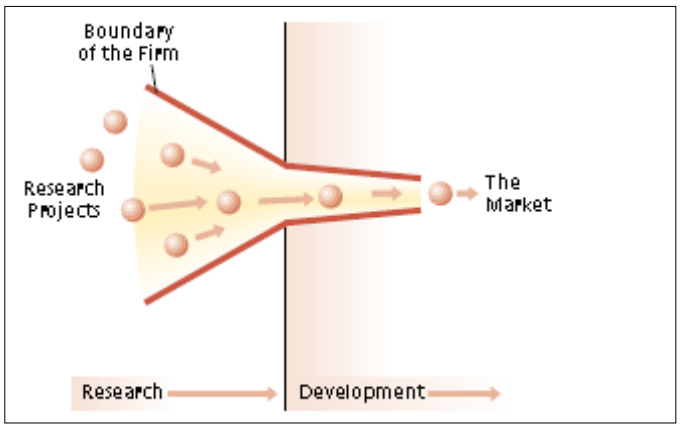

Figure 4. The closed innovation model (Chesbrough, 2003).

The benefits of scale and scope for internal R&D (relative to the external market) gave rise to a vertically integrated innovation model where large enterprises internalized their firm-specific R&D activities, and commercialized them through internal development, manufacturing, and distribution processes. AT&T's Bell Labs, Edison's Menlo Park and Xerox's PARC were exemplars of this type of innovation model and brought about many inventions and innovations during the twentieth century. However, these R&D organizations encountered difficulties when internal research generated spillovers that could not be internally commercialized. In some cases, such technology would be licensed to others, but in the majority of cases the technology waited either for internal development or its research proponents to leave the firm and develop it on their own in a BSO.

Towards the end of the 20th century, the closed innovation model eroded. The main reason was the dramatic rise in the number and mobility of knowledge workers, making it increasingly difficult for the large companies to control their proprietary ideas and expertise. A second reason was the growing availability of private venture capital, which helped to finance new firms and commercialize ideas from corporate R&D. If a discovery did not pursue in time, people could pursue it on their own. This shattered the closed innovation strategy (Chesbrough et al., 2006).

Over the past few years, many of the leading global companies have begun to embrace open innovation. The open innovation model can be understood as the antithesis of the closed innovation model. Useful knowledge is just widely distributed, and even the most capable R&D organizations must identify, connect to, and leverage external knowledge sources as a core process in innovation. Ideas that once germinated only in large companies now may be growing in a variety of settings, from the individual inventor, to the research facilities of academic institutions (Chesbrough et al., 2006).

Open innovation is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough et al., 2006, p. 2). Vanhaverbeke and Cloodt (2006) argue that heavy exchange of ideas and easy access to products is a prerequisite for open innovation.
Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology. It uses both external and internal ideas to create value, while defining internal mechanism to claim some portion of that value. Open innovation means that projects can be launched from either internal or external technology sources, and new technology can enter into the process at various stages. There are many ways how firms can exploit external knowledge.

Firms can for example imitate competitors (free-riding), license-in new technologies, consult with lead users or use open source software. Other scholars have studied the use of alliances and the construction of networks by firms as another means of actively seeking out and incorporating external knowledge into the innovation processes of firms (Chesbrough et al., 2006; von Hippel, 2005; Ye & Kankanhalli, 2013). In addition, projects can go to market in many ways as well, for example via out-licensing, or a spin-off venture, or just via the company's own marketing and sales channels (Chesbrough et al., 2006). So, there are many ways for ideas to flow into the process, and many ways to flow out into the market.
Figure 5 gives a schematical representation of the open innovation model, in which it has been made clear that the boundary between the firm and its environment is more porous (indicated with a dashed line).

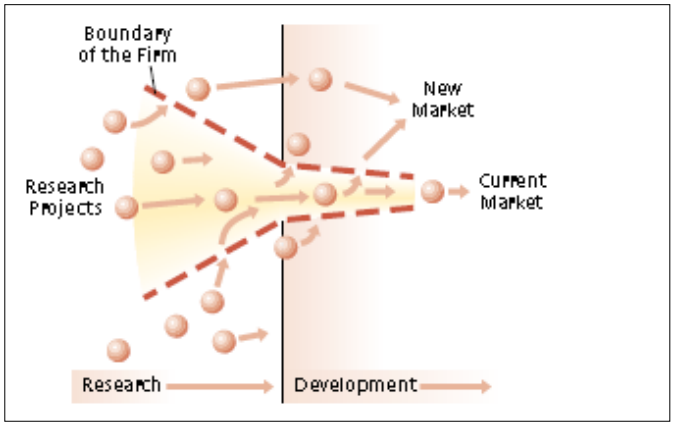

Figure 5. The open innovation model (Chesbrough, 2003).

2.4.2 Benefits of open innovation

As mentioned, the closed innovation model is completely focused on internal R&D, production and distribution, while the open innovation model takes into account the importance of using external resources, distribution channels, etc. This main difference leads to the following benefits of using the open innovation strategy. Some of the following benefits overlap with the success factors found in the previous chapter.

First, in the 'man of genius' mode of the closed innovation paradigm, the focus is on securing the best and the brightest people, and then trusting that research talent will come up with valuable new innovations that will somehow find a path to market to gain the 'first mover' advantage (Chesbrough et al., 2006). There is a strong possibility that the best people and the best ideas are to be found outside the organization. Failure to recognize this can hold a company back from realizing its full potential (Lindegaard, 2011).
With use of open innovation, companies actively seek people of genius from both inside and outside the firm to provide fuel for the business (Chesbrough et al., 2006). This might be an important benefit to BSOs, since they are small companies with a few employees only at the moment of start. The amount of internally created ideas is marginal, and therefore use of ideas from external people can be helpful.

A second difference between the closed and open innovation is the new and proactive role for international property management in the open innovation model. The closed innovation model treated IP as a byproduct of innovation, and its use was primarily defensive. This would enable firms to practice their internal technologies without being blocked or held up by external IP. So, with closed innovation a firm should avoid to share IP or profits with any outside source (Lindegaard, 2011).
In open innovation, IP is a critical element of innovation, since it flows in and out of the firm on a

regular basis, and can facilitate the use of markets to exchange valuable knowledge (Chesbrough et al., 2006). In field of IP exchange, open innovation seems to be more attractive to BSOs than closed innovation. Use of others' IP appears to be interesting to BSOs, but the theory also gives the impression that a firm's own IP should be licenced-out quiet easily to partners. Based on the former chapter about spin-offs, it is useful to share IP with close partners, but some knowledge should also be kept secret. For BSOs it appears to be more difficult to share IP, since they most often have a single/few patent(s) only. Sharing this knowledge means that a big part of the firm's core is already given away. In short, open innovation seems to be really helpful to BSOs for the flow-in of IP, but the startup has to be careful on what to share itself.

A third difference is how companies screen their ideas. Both models are adept at weeding out false positives (bad ideas that initially look promising), but open innovation also incorporates the ability to rescue false negatives (projects that seem to lack promise but turn out to be surprisingly valuable). Closed innovation is unable to rescue false negatives (Chesbrough, 2003).
Open innovation can rescue these false negatives due to its variety in output channels. For example firms can out-license the rejected project or form an external spin-off venture. Out-licensing allows another firm to utilize the ideas and see if they are valuable, and it provides additional funds to the licensing firm. A spin-off venture allows the technology to develop further outside the originating firm, and can perhaps make it profitable (Chesbrough, 2004). The BSOs participating in this study are the perfect examples of how to rescue false negatives. Nevertheless, a BSO can also use open innovation itself to rescue false negatives. The young firm can spin-out technologies into new ventures in turn, in case they are not relevant enough to the own company.

Fourth, according to Lindegaard (2011, p. 107): "Handling of risk is key to successful open innovation." With open innovation risks can be shared among partners, which is impossible in the closed innovation strategy. In a closed innovation system, all of the risks are borne solely by the innovating organization. It must pay for projects whether they ultimately succeed or fail. In an open innovation system, it can be an attractive option to diversify risk and share both market and technological uncertainty with outside partners (Bingham & Spradlin, 2011; Keupp & Gassmann, 2009). For BSOs the early stage is the most difficult one to survive and therefore it can be helpful to share risk with some business partners.

Fifth, companies that emphasize open innovation are more likely to create radical innovations and tend to sell a greater number of new products. This is especially important in the high tech industry. Companies pursuing closed innovation are more likely to exhibit a higher incremental product innovation performance. Radical innovations are new product or processes that do not have a market yet and customers, suppliers, and investors still have to be found. As a result, radical innovations require a value network perspective where the innovating company manages the external network with all the actors that are necessary to launch the new product offering. This is in sharp contrast with incremental innovations where a company can rely on existing relations with suppliers, channels and end-consumers. (Chesbrough et al., 2006) Incremental innovators are just better in creating continuous product improvements, in the low-tech industry for example (Inauen & Schenker-Wicki, 2012).
BSOs from the high tech industry often come up with radical innovations, and so, it appears to be more interesting to them to apply the open innovation strategy. However, the BSO really needs to seek actively for the right actors to achieve a successful market introduction of the radical product.

In table 1 a short overview is given of the main differences between closed and open innovation discussed in this paragraph.

Closed Innovation Principles	Open Innovation Principles
The smart people in our field work for us.	Not all of the smart people work for us" so we must find and tap into the knowledge and expertise of bright individuals outside our company.
To profit from R&D, we must discover, develop and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research in order to profit from it.
If we are the first to commercialize an innovation, we will win.	Building a better business model is better than getting to market first.
If we create the most and best ideas in the industry, we will win.	If we make the best use of internal *and* external ideas, we will win.
We should control our intellectual property (IP) so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

Table 1. Overview of differences between closed and open innovation (Chesbrough, 2003).

Next to the aforementioned benefits (opening up to talent from outside, out-licensing IP and false negatives, sharing risks and creating radical innovations), there are some other benefits of the open innovation strategy. These aspects of open innovation actually seem to be beneficial to all kind of firms, including BSOs. Research from Lindegaard (2011) shows that open innovation can speed the development and market launch of new products and services through acquiring external knowledge, bring more diversity to innovation, and improve the success rate of new products and service. Besides, open innovation addresses the issues posed by rapidly advancing science and technology. Further, utilizing external technology can help leverage a firm's business, both by filling in gaps within the firm's own road map, and by creating complementary products and services that stimulate faster and higher acceptance of the internal technology. In particular, innovating firms leverage and support their own R&D by increasing their openness in innovation (Drechsler & Natter, 2012; Chesbrough et al., 2006). More about the openness of firms is written down in section 3.3.

Open innovation stimulates the exchange of resources with third parties. The formation of exchange relations occurs among organizations primarily for two interrelated reasons: specialization and scarcity. Many organizations, especially SMEs, perform specialized functions and therefore must exchange with other organizations to obtain necessary resources and to market their output. Firms engage in R&D cooperation in order to complement their internal resources and accordingly team up with partners who control the relevant complementary resources (Levine & White, 1961; Miotti & Sachwald, 2003). The limitations on the availability of resources necessitate organizational interdependence, or creates resource dependencies, and foster specialization (Cook, 1977). Miotti and Sachwald (2003) prove that even rival firms cooperate with each other. Although it is quite rare high tech firms cooperate with their rivals, they do this to share resources and R&D costs. Chesbrough (2007) adds a third reason for cooperation. He proposes the that main underlying drivers of using open innovation are increasing R&D costs, a dearth of resources and market turbulences, such as shorter product life cycles. From these words it looks like that open innovation is the exact strategy to be used by most business spin-offs. In chapter 2 it was explained that spin-offs often suffer from scarcity of resources and startup capital. Furthermore, most young spin-offs are small firms specialized in a single product. It confirms the argumentations of the theorists about the use of cooperation to overcome the problem of scarcity.

2.4.3 Factors that influence open innovation

In reality it is of course not so simple that a company either uses the open or the closed innovation strategy. It is better to talk about a certain degree of openness.
The aim is to be open enough so that potential partners see a firm as the right partner of choice, and

the easiest to deal with (Heap, 2010). The degree of openness, for instance, reflects how broadly and intensively a firm uses external information in innovation. The larger the number of external sources of innovation, the more open will be the firm's search strategy and it can draw from a much larger pool of innovative ideas (Drechsler & Natter, 2012). For example, Philips collaborates with different external sources such as universities, competitors, customers, and suppliers in its innovation activities. However, prior research shows that being too open in innovation does not necessarily benefit a firm's innovation performance (Drechsler & Natter, 2012). While there may be an initial positive effect on openness, firms can over-search or come to rely too heavily on external sources of innovation (Dahlander & Gann, 2010). In particular, Laursen and Salter (2006) show that there is an optimal degree of openness in innovation for each firm in terms of collaborating with different external parties and internalizing their knowledge.
Being more open can help starting BSOs to create a larger network and use more external ideas for example. However, there might be the risk that they too heavily rely on external partners. So, it also seems to be that business spin-offs should find the right degree of openess.

Internal knowledge gap and competition

There are two major reasons why some firms have a low degree of openness. First, firms with internal knowledge gaps (market and technological information) are not open in innovation. The more unambiguous a manager becomes in defining knowledge in relation to an open innovation process, the more closed that 'open' innovation will become. Second, competitive threats decrease the probability of firms being open. Competition in the form of a high number of competitors constrains firms from opening up their innovation. When a high risk exists for other firms to easily imitate a firm's products, the firm will not jeopardize its competitive advantage by opening up innovation (Ridell, Röndell & Sörhammar, 2013). This competitive threat can differ per life stage of a firm, and therefore might influence the degree of openness during its evolution.
Competition can be a good reason for BSOs in their early stage to be more closed, but they also need to be open enough to be an attractive partner. When BSOs start to grow, an increase in competition is possible, and so, they have to be more careful about the knowledge-share with others. As a consequence, it seems to be that these spin-offs will have a lower degree of openness then. It has to be researched what influence competition in reality has on the openness of a business spin-off, including different life stages.

Stage of open innovation

In open innovation a company works with external companies during the entire innovation process. Open innovation goes deeper than just involving others in the idea generation phases; the contribution from outside the company must be significant. Everyone involved in an open innovation process focuses on problems, needs, and issues and works them out together. However, there is no consensus about the added value of open innovation to a firm in each of the stages of an innovation. According to Lindegaard (2011) open innovation is an approach that can work and should be used in any stage of the innovation process, not just in the early phases during the front end of innovation. However, Gobble (2012) suggests that open innovation is most important in the earliest phases of innovation: The path to market-commercialization to capture value in real terms is the central concern of open innovation.
These different perspectives make it interesting to find out how important open innovation is to BSOs in their different life stages, like the startup and growth stage (see figure 6). Based on the theoretical background of business spin-offs, it seems that open innovation offers more benefits to them in the beginning. Therefore, the firm should probably have a higher degree of openness in the startup and growth phase compared to later life stages.

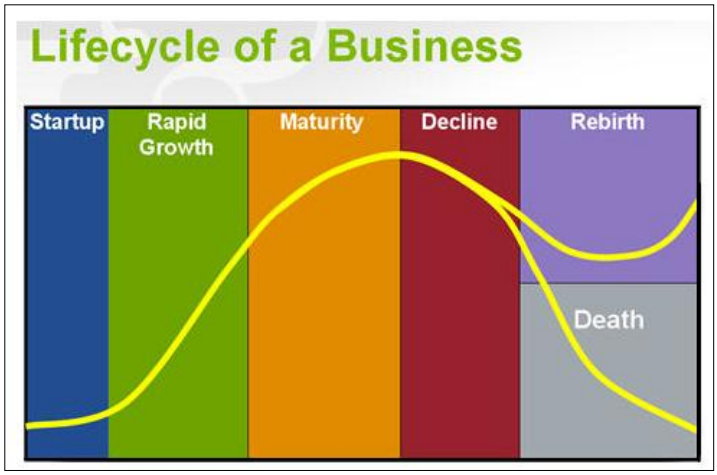

Figure 6. The lifecycle of a business: the yellow line indicates the business' performance (Bersin, 2008).

Absorptive capacity

A 'requirement' for a firm to be a successful open innovator is the absorptive capacity it has. "Absorptive capacity is the ability to recognize the value of new information (e.g. knowledge, intellectual property or technologies), assimilate and transform it for later use, and apply it to commercial ends" (Powell & Grodal, 2006, p. 77). Firms remain investing in R&D despite their reliance on external partners. They do this because opening up internal R&D and connecting to outside knowledge sources does not guarantee successful knowledge transfer from knowledge sources (Laursen & Salter, 2006). The absorptive capacity is essential to innovative capability. Cohen and Levinthal (1989) explain that new internally knowledge has to be developed to create the absorptive capacity to track and evaluate developments outside firm boundaries. Internal capabilities and external networks of technological start-up companies have a positive interaction effect on the start-up's performance (Lee et al., 2001).

R&D can be 'a ticket of admission' to potential partners. High-profile innovators are thus logically the most active R&D partners: they possess a wide array of high-quality R&D resources, which both makes them attractive partners and enables them to draw and absorb the most from co-operation (Miotti & Sachwald, 2003). The greater the partner-specific absorptive capacity is, the greater the potential will be to generate relational rents through knowledge sharing. High tech start-ups have been shown to have much higher R&D expenditure per employee than existing businesses and thus make a proportionally greater contribution to technology absorptive capacity (Dyer & Singh, 1998; Miotti & Sachwald, 2003; Dahlander & Gann, 2010).

However, information exchange is hindered when the parties have differential levels of absorptive capacity (Powell & Grodal, 2006). This can hinder the co-operation between firms. In short, firms should not only focus on external resources in open innovation, but also invest in own R&D to get into contact with the business partners they are looking for.

From these findings it can be suggested that BSOs should develop internal knowledge to be not totally dependent on external sources, and to increase the ability to absorp external ideas. Besides, with internal R&D business spin-offs seem to be more attractive to partners, what can make it easier to build up an external network.

Trust

Another important antecedent of open innovation is trust, which is defined as "the belief in others' good intent and concern, competence and capability, and reliability. It is developed based on past experience, reputation, and trust propensity" (Ye & Kankanhalli, 2013, p. 7).

Bradach and Eccles (1989) claim that trust increases the willingness to share resources and information exchange, because the fear of opportunistic behavior by one of the exchange partners is alleviate. The greater this share of resources and knowledge, like encouraging transparency and reciprocity, and discouraging free riding, the greater the potential will be to generate network benefits (Dyer & Singh, 1998). Trust also increases when the partners knew each other already before the cooperation, when the partners are equal in the network, and when they are open to necessary changes (Geykens, Steenkamp, Scheer, & Kumar, 1996). In short, trust is considered essential for the emergence and repetition of cooperative behavior (Gulati, 1998).
Trust can be very helpful to BSOs to build up a close network. Also, a trustful relationship with the parent firm might already be available at the spin out moment, what makes it easier to continue the collaboration. A BSO will possibly be more open to partners when the level of trust is high. For BSOs it can be hard to build up a trustful network if they are too much focused on protection of knowledge and IP, or if its potential partners are too closed. From these findings it can be stated that openness of a firm also influences the networking process. So, there is interdependency between the two concepts.

Network

Relationships are central in open innovation: cooperation with others is basically the fundament of the strategy. With open innovation comes the need to create networks that include all the potential categories of partners that can support innovation effort (Chesbrough et al., 2006). So, networking is a prerequisite for the use of open innovation, what confirms the findings of chapter 2.

A reason why firms, especially SMEs, are teaming up with each other is technological complexity (Rese & Baier, 2011). Networks are established to absorb externally developed knowledge (Chesbrough et al., 2006). By networking outside their boundaries, SMEs can complement their limited internal R&D with knowledge generated by external actors and obtain access to external complementary assets. Such networking activities help overcome SMEs' liability of smallness and let them gain access to national and international sources of new knowledge (Colombo, Laursen, Magnusson, & Rossi-Lamastra, 2012). Teece (1989) showed how cooperation between companies increases knowledge gain and reduces the inherent waste of duplicated effort. Networks have been found to have beneficial returns on innovation such as increased patenting rates, improvements on existing products, and new product creation, faster time to market, and access of new markets. By providing access to complementary skills, scale and scope benefits, and a broader knowledge base, network ties positively influence firm innovation (Chesbrough et al., 2006).

In open innovation, some firms need to identify external knowledge and incorporate it into the firm; others seek external markets for their existing innovations. The pathways of network ties create opportunities for both types of open innovation. Accessing a network allows a firm to fill in a specific knowledge need rapidly, without having to spend enormous amounts of time and money to develop that knowledge internally or acquire it through vertical integration. Similarly, networks can facilitate (or result from) efforts to commercialize internal technologies, such as through creation of a spin-off. Even though using networks to tap into external knowledge is potentially relevant for companies in all industries, networks are especially well suited to the high tech industry. In these knowledge-intensive industries joint problem-solving is paramount and partnerships secure access to financial and other resources for developing innovative technologies (Chesbrough et al., 2006). That is why a network is most important to high tech firms, especially for the ones that have higher risks and uncertainties like high tech startups (Rese & Baier, 2011).
However, networking may divert resources and management time from the company's core business, may generate unintended knowledge leakages to network partners, may require (too) heavy investments in absorptive capacity, or may increase personnel turnover. These challenges are

especially severe for startups. Subsequently, SMEs' resources for building and utilizing relationships to external parties are normally more limited than what is the case for larger firms. Also, they lack a track record that can show their quality to potential partners (Colombo et al., 2012).

Based on the facts that 1) networks are important for the use of open innovation and 2) networks are especially important for high tech startups, it appears to be that early stage BSOs can have a lot of benefits in return from networking. Meanwhile, BSOs suffer from scarcity of (human) capital and other resources, so they have to build up their business network very efficiently. They also need to be careful whom to collaborate with, to reduce knowledge leakages and improve their reputation.

Furthermore, knowledge flows are guided by the formal institutionalized and the less visible informal interrelationships of those involved in innovative activities. Formal ties are contractually agreed upon, planned channels for knowledge exchange between organizations, such as a strategic alliance. Informal relationships are multiple, repeated, trust-based relationships. An open innovation strategy would need to recognize the external knowledge opportunities possible through informal network ties (Chesbrough et al., 2006).

Many studies of informal relationships stress the significance of trust. Informal ties lead to a higher degree of trustworthiness among business firms (Powell & Grodal, 2006), and from the previous paragrapgh it is made clear that trust is very important to build up a strong network in turn. Firms can lower the production costs and get access to complementary capabilities and specialized knowledge through informal relationships with key suppliers (Lorenzoni & Lipparini, 1999). Dahl and Petersen (2004) report that informal networks increased on knowledge sharing and employee's knowledge acquisition. These findings confirm that firms share valuable knowledge with informal contacts. Tallman (2004) found that these informal networks may emerge as the result of the cultural environment of clusters and science parks. They can be stimulated by the interaction of workers, social events and formal routines (Azeredo, 2006).

Formal and informal ties both seem to be important to BSOs in general. However, during the startup phase of a firm, getting involved into social relationships is priority. To achieve that, informal network ties are more important than formal network ties. The 'open innovation culture' of the HTCE, the interaction of workers, and social events on the Campus seem to stimulate the amount of informal networks of business spin-offs with other companies. This could possibly give them an advantage compared to young spin-offs or other kinds of startups outside the Campus.

Geographic concentration

The geographical location of the firm can influence the success of the open innovation strategy. Open innovation benefits may be more readily achieved in regional clusters (or business ecosystems), since the effect of networks on innovation is magnified by geographic proximity. Marshall (1920) firstly noted regions that are rich in ideas (and thus knowledge) will attract economic activity.

With knowledge at the centre of the open innovation model, knowledge networks constitute a new asset for high tech companies. Economists, who emphasize the importance of tacitness and cumulativeness of knowledge, localized learning, and externalities associated with proximity, claim that geography and proximity still matter for innovation. They have also pointed out the benefits of localization on economic growth, such as reduced production and transport costs leading to increased access to markets and economies of scale, specialized labor markets, and the lower costs of accessing information locally. Research confirms that membership in a local community increases innovation benefits (Mustar et al., 2006).

The combination of dense social networks and geographic co-location has been critical to the genesis

of many high tech regions (Bunker Whittington et al., 2009). Startups in those regions have long recognized that collocation enables them to tap into necessary knowledge (Chesbrough et al., 2006). Colombo et al. (2012) argue that SMEs often create linkages with other SMEs in districts or geographical clusters for the exchange of resources and knowledge. Both Kogut (2000) and Brown and Duguid (2000) even go a step further: They argue that in a technology cluster, the network of relationships among participants is the primary source of knowledge. Firms consider physical co-location as an important factor enhancing knowledge dissemination. Although co-location is not required for the transfer of explicit knowledge, it is a great benefit to the exchange of tacit knowledge, as described by Hislop (2005). The exchange of tacit knowledge depends heavily on social interaction, and is made much more efficient by co-locating professionals (Gupta, Tesluk, & Taylor, 2007). Spillover effects occur broadly across industries, but they are accelerated within close geographical locations (Owen-Smith & Powell, 2004). On the one hand, this helps BSOs located in an ecosystem to receive external knowledge more easily. On the other hand, it should make them aware of a greater risk on knowledge leakages.

Further, the types of ties forged by companies locally may be those most apt to signal membership and engagement with local partners, rather than those distant ties that provide the most timely access to information constrained by norms of exclusivity or secrecy. Thus, local ties may be more of the type that can be maintained openly. For example, regional channel connections are more often financially based venture capital ties, or R&D agreements between firms and universities. On the opposite, distant ties are characterized by less certain, more arms-length types of agreements, such as legal arrangements designed to ensure that only the parties to a tie benefit from the information that is exchanged. Geographic distance suggest that proximity could be used to capture strength characteristics of social ties more generally. So, in local networks the ties are stronger, and these 'thick' ties can render local alliances more efficacious than distant, more formal, ties can do (Bunker Whittington et al., 2009).

The findings from this paragraph make clear that SMEs and startups benefit from geographic co-location, and so it seems to be that high tech clusters are of advantage to BSOs (in their early phase). The characteristics of local ties fit perfect to the High Tech Campus, and so, for young Campus BSOs it seems to be more beneficial to have local ties instead of distant ties. These spin-offs might even more often use and benefit from open innovation than BSOs outside such a region. It has to be clarified what the influence of the high tech cluster is on the use and importance of open innovation. Therefore, a thesis about BSOs located at the HTCE and outside fits exactly to get insight in this topic. More detailed information about the ecosystem of the HTCE is provided in chapter 6.

2.5 Small vs. large companies

According to Lindegaard (2011), small companies are defined as those that only have one key product line. They may have many employees, but all those workers are focused on developing, producing, and selling just that one product line, like the spin-offs in this research.
There are differences between small and big companies in the way they intersect in open innovation. Small companies have different resources, different needs, and different ways of contributing to an open innovation relationship. Adopting open innovation can help small companies get access to resources, distribution channels or startup capital that would otherwise be outside of their reach (Heap, 2010; Lindegaard, 2011; Vanhaverbeke & Cloodt, 2006). According to Colombo et al. (2012), SMEs can reap greater benefits from open innovation than their larger counterparts, as external collaborations can compensate for the scarcity of internal resources and competences. Besides, smaller firms derive more value from network linkages than larger firms, presumably because smaller

companies are more uncertain about their business. Shan et al.(1994) examined the association between interfirm cooperation and the innovation output of startup firms in the biotechnology industry. The results show that a startup's number of cooperative relationships has a positive effect on its innovative output. Further, results show that startup innovation output does not attract large firm relationships but rather depends on them. Startup size has no effect on commercial ties, indicating that large startups do not attract more established firm partners than small startups. Since SMEs cover business spin-offs in their early phase, it seems to be that the latter can benefit a lot from open innovation and network links. An open innovation network can compensate for the scarcity of resources and capital within a BSO. Furthermore, it seems to be that BSOs need a large network, including big players, to reach a higher firm performance. This confirms the conclusions drawn from the previous chapter.

On the one hand, big players like Philips can give small companies a lot of help. On the other hand, small companies can lose their voice when they collaborate with larger, more powerful organizations. Another risk is that the flexible, creative, small organization gets 'frozen' into rigid work practices by its larger partner (Heap, 2010). The amount of risk offloaded by one party may be considerably greater than the amount of risk the other party assumes. In general, for small companies this asmmetry is not a problem, because small contract firms are often more than willing to accept some risk. This creates innovation opportunities via external efforts that are simply impossible with closed innovation approaches alone (Bingham & Spradlin, 2011).

In many cases small companies only have a little role to play in open innovation ecosystems. They get the backseat and the big companies take the driver's seat. Big companies prefer to be in control of their projects, whereas smaller companies do not even get a choice unless they have something unique to offer, which is rarely the case (Lindegaard, 2012). This is why Lindegaard argues that small companies are not big enough to engage with open innovation; they just do not have the organizational infrastructure, and need, to engage with open innovation. However, Vanhaverbeke and Cloodt (2006) state that an organization which is highly dependent on other organizations' support or deliverables actually strives to open its innovation processes to its cooperation partners. Open innovation is not only linked to openness with regard to access to a product, but is an overall strategy to provide stimuli and improve the conditions for companies which contribute to the innovation process. So, the argumentation of Vanhaverbeke and Cloodt is in sharp contrast with Lindegaard's ideas about the use of open innovation within small companies.

According to Heap and Lindegaard, it can be suggested that young BSOs should not use open innovation, because they are too small and get the backseat then. In opposite, Vanhaverbeke and Cloodt would probably advise BSOs to apply the open innovation strategy, especially when they are in the early phase. This discussion actually leads to the big question whether open innovation is suitable for BSOs or not. From my study it will be made clear what the best option is.

2.6 Summary

- *'Which critical factors are important for BSOs in the process?'*

The part of the literature background about spin-offs provides insight in the importance of several success factors for the startup and survival of spin-offs. First, skills and experience gained at the parent firm are important for the start of the BSO. Second, the relationship with the parent firm is determining for the amount of help the spin-off can count on. The parent firm can provide marketing channels, customer and supplier contacts, mancraft, startup capital, technological knowledge (especially know-how), etc. Moreover, its reputation indirectly supports the spin-off company. Third, a BSO should work on strong and trustful relationships with a variety of actors, including recognized

companies. With trustful relationships BSOs can be more open to partners. It also helps when the spin-off is part of an ecosystem, then the firm most often gets support from the surrounding companies in many ways. Next to the fact that a BSO should have the ability to build trustful relationships, it should also have the ability to synthesize its activities with those of network partners. Fourth, for starting spin-offs it is necessary to get a balanced share of knowledge with the partners. Some information should be shared, and some has to be kept secret. Fifth, startup capital is a prerequisite for survival. A large network of partners, including relationships with investors, makes it more likely to receive enough venture funding. Finally, a BSO should have the ability to integrate the resources of external parties.

If these factors are analyzed and related to open innovation, some of them can actually be seen as prerequisites or determinants of the use of open innovation. Next to the fact that they indirectly influence the survival chances of spin-offs, they also seem to influence how open a BSO can be to other firms. In short, these factors are:

- Stay closely connected to the parent firm for support, in case it is not a competitor;
- Use the parent firm's network to get knowledge and resources during the early stage;
- Build up a strong and trustful network of various partners, inclusive investors and recognized companies;

As mentioned, these findings are mostly based on studies about USOs, so it has to be found out if these success factors also count for BSOs in particular, and what their influence on the use of open innovation is. From further analysis it will also be clear whether these success factors change in importance for BSOs over time and what their effect on the openess of the firm is. Nevertheless, from these findings I suggest that the use of open innovation seems to be a very helpful strategy to business spin-offs to survive and succeed, especially in their early years with a scarcity of startup capital, (tacit) knowledge and other resources.

- *'To what extent is open innovation profitable for BSOs?'*

Open innovation seems to provide more opportunities to firms than closed innovation does, and these opportunities are especially interesting to young startups, like early BSOs. The main underlying drivers for firms to open up their innovation are market turbulences, such as shorter innovation and product life cycles, increasing R&D costs, scarcity of resources and uncertain market demand. Open innovation provides many advantages that can compensate for these problems, and so, open innovation can be seen as an indirect success factor for the survival of business spin-offs at such. Here, the profits are listed that are presumably most important to BSOs. The general advantages, like 'open innovation advances science and technology' and 'it brings more diversity to innovation' are left out; only the characteristics that are helpful to a firm's own business are summed up. These profits are checked for and tested in the interview sessions.

- It is possible to use people, knowledge and resources from inside and outside the company;
- IP does not have to be kept for private use only, but can flow in and modestly flow out of the firm and enhances the knowledge exchange;
- Open innovation makes it possible to save false negatives;
- It reduces risks and uncertainties by providing more chance to build up a strong network;
- Open innovation can speed the development and market launch, and improves the success rate of new products and services;
- It provides more distribution channels and possibilities for startup capital (via network);

- External technology can fill in business gaps, and creates complementary products and services that stimulate faster and higher acceptance of the internal technology;
- Open innovation makes it easier to stay specialized in a certain product or process.

There is an optimal degree of openness in innovation for each firm. For young BSOs it seems they have to be more open compared to mature firms. They need to build up a network, share resources, etc. When they grow, it appears to be less important to share everything; inhouse R&D can increase, even as the amount of capital, knowledge and resources. So, the need to be open will decrease in all probability.
Unambiguous management and competition may lower the degree of openness. As one can read from chapter 2, most BSO managers are very ambitious, so this will not be a major problem to them. However, competition may have more influence on their degree of openness. If competition is high in the high tech sector, even BSOs will be more closed innovators. Competition constrains firms from opening up their innovation.

So far, it is unknown in which life stage(s) open innovation is most important to BSOs. Based on the benefits open innovation offers, it seems to be important for the startup of BSOs anyway. Later life stages, like the decline stage are unimportant to this study, since the focus is on the early phase.

For BSOs it is also important to retain a piece of internal R&D, instead of licensing-in every piece of knowledge from external sources. The absorptive capacity positively affects a spin-off's ability to exploit the opportunities presented in external relations. A BSO that creates enough internal knowledge is an attractive partner and enables itself to draw and absorb most from co-operation.

The network is the fundament of the open innovation method. A startup's number of cooperative relationships has a positive effect on its innovative outputs. For a starting BSO in the high tech industry, collaboration with network partners seems to be one of the most important aspects to survive. From previous research it is important for BSOs to cooperate with large firms, since the spin-offs' innovative output depends on them. Furthermore, a BSO should invest in absorptive capacity to profit from the network externalities. The benefits of networking strongly overlap with the open innovation benefits. Networks have beneficial returns such as a broader knowledge base, joined problem solving, minimized uncertainties, access of new markets, and reduced amounts of time, capital and other resources to develop knowledge internally. BSOs suffer from scarcity of (human) capital, so they have to build up their business network very efficiently. They also need to be careful whom to collaborate with, to reduce knowledge leakages and improve their reputation.
Trust increases the willingness to share resources and is considered essential for the emergence and repetition of cooperative behavior. Therefore, BSOs that use open innovation should build on trustful relationships to benefit even more from their strategy.
Informal ties lead to a higher degree of trustworthiness among firms, and so, they increase on knowledge sharing and employee's knowledge acquisition. Moreover, firms can lower the production costs and get access to complementary capabilities and specialized knowledge through informal relationships with key suppliers. Therefore, informal ties seem to be more important in the startup phase of a BSO. Later on, the use of formal connections will be more important probably. It is argued that the HTCE stimulates the amount of informal networks of business spin-offs with other companies. This could possibly give them an advantage compared to other startups outside the Campus.

Open innovation benefits may be more readily achieved in regional clusters, since the effect of networks on innovation is magnified by geographic proximity. It leads to interesting advantages for BSOs: business ecosystems make transfer of tacit knowledge much more efficient, reduce production and transport costs, create knowledge spillover and make it easier to use specialized labor markets.

The characteristics of local ties fit perfect to the High Tech Campus. Thus, the High Tech Campus Eindhoven may increase the advantages of the open innovation method, what seems to increase the attractiveness of young BSOS to establish there, instead of outside the Campus.

Finally, although BSOs can get a lot of help from big companies, they should be aware of the fact that big players, such as Philips, can exploit them. Spin-offs can lose their voice, flexibility and creativity when operating in a network with large firms. This can hinder the possibility to use open innovation.

This chapter's findings are incorporated into the conceptual model, provided in chapter 3.

Conceptual model & method

Chapter 3. Conceptual model

Chapter 4. Method

3. Conceptual model

Based on the theoretical background, a conceptual model has been created (figure 7). This model is an aggregation of the pool of theoretical success factors that are determinant for the survival and success of BSOs in their early stage. It also shows the proposed relationship between the factors and open innovation. The model should provide more structure and accentuates what to focus on in the empirical part of this thesis. The empirical findings will be compared with the conceptual model afterwards. This will show whether the conceptual model has to be reshaped or not, and thus, in what way the theoretical background differs from reality.

3.1 Structure of model

As can be viewed on the next page, the model consist of three basic parts. The first part (blue box in figure 7) displays the factors that indirectly influence the survival and succes of BSOs in their early phase (red box in figure 7). These factors actually determine the acces of the BSO to the direct success factors. The indirect factors are divided into two categories: 'indirect external success factors' and 'indirect internal success factor'. The first group is called external, because these factors lay outside the firm's direct influence and cannot be corrected every moment. The indirect internal factor is formed by the use of open innovation. The business spin-off can decide itself to what extent it uses open innovation.

The second part (purple box in figure 7) displays the direct success factors for the startup and survival of BSOs. These elements are also divided into two categories: 'direct external success factors' and 'direct internal success factors'. The direct external factors are formed by the requisites collected from external parties, like startup capital, the necessary knowledge and technologies, and other resources. The direct internal success factors are formed by the qualities and characteristics of the BSO itself.

The third and final part (green box in figure 7) shows the factors that influence the openess of a firm. Like the other parts, this part is divided into two groups: external and internal factors that influence open innovation. The factors can stimulate (e.g. scarcity of resources and increased R&D costs) or hinder (e.g. competition and IP protection) the openess of a business spin-off.

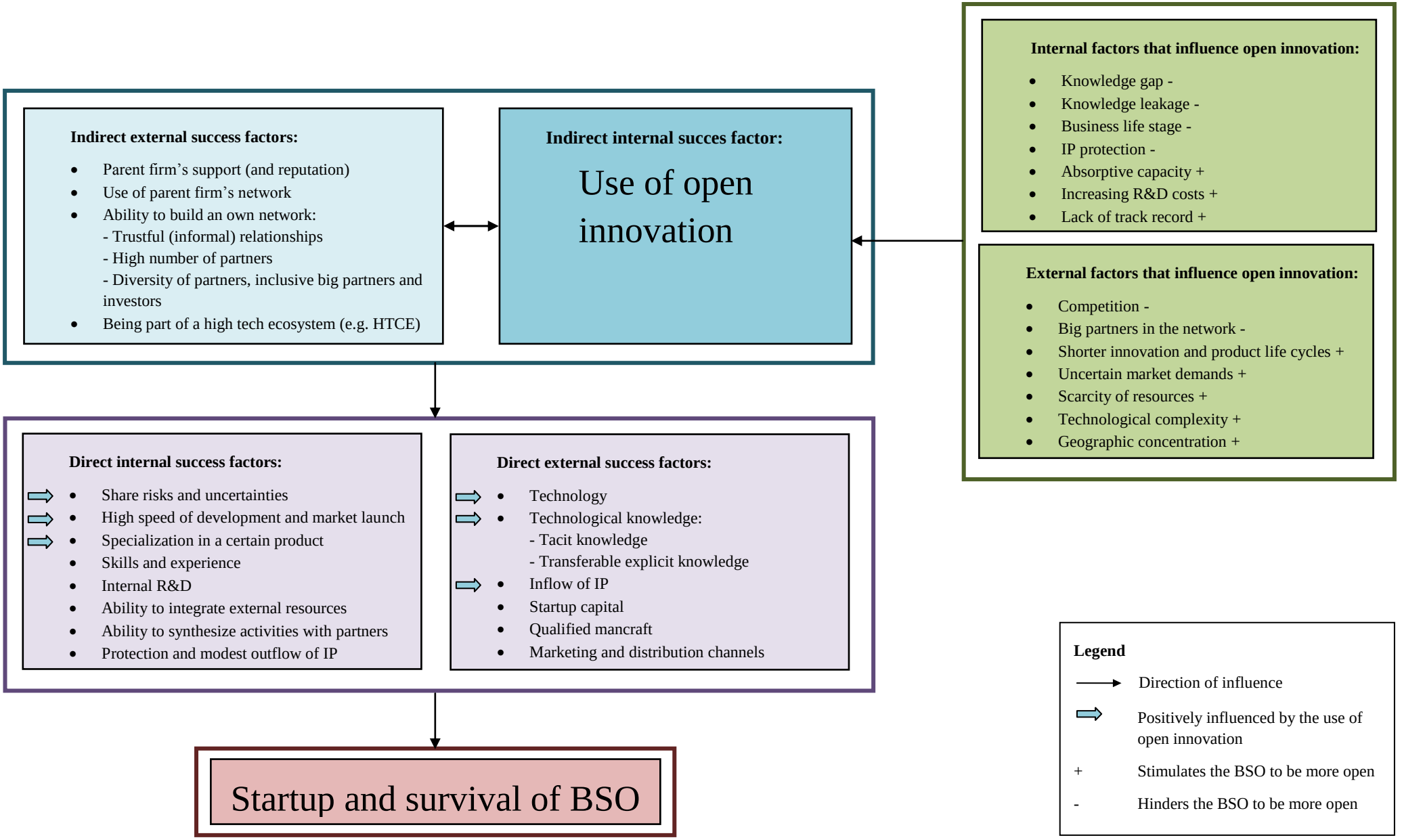

Figure 7. The conceptual model.

3.2 Explanation of factors

As mentioned, the indirect success factors are the factors that are neccesary to receive the direct success factors. For example, a firm needs to have a strong and trustful network to obtain marketing and distribution channels, external knowledge and startup capital. The indirect external success factors influence the complete set of direct success factors. Of course some indirect factors have more influence on certain direct factors than others. As example, the parent firm is most important to receive the neccesary technology and tacit knowledge, and the skills and experience of the BSOs' founders have been gained there. For the indirect internal success factor, or open innovation, the situation is different. Open innovation does not affect all of the direct factors. The direct success factors stimulated by open innovation are indicated with a blue arrow in front.
Based on the theoretical background one could argue that more factors are stimulated by open innovation, like employment of qualified mancraft and obtainment of startup capital. However, these factors are indireclty influenced by the use of open innovation. To clarify, open innovation makes it easier for a BSO to build up a business network, and as a consequence, the probability to find qualified people and startup capital increases. So, the factors that are not indicated by a blue arrow are influenced via the network of the BSO, which is influenced by open innovation in turn.

The indirect external success factors are required for the use of open innovation. Thus, open innovation can be better used when the business spin-off has a good relationship with its parent firm and with the parent firm's network, when it has a large and diverse network (with trustful and informal relationships) and when the firm is situated in a high tech ecosystem such as the HTCE. Being part of a high tech ecosystem increases the probability to receive the needed resources from other companies, and therefore, it influences the openness of the BSO in a positive sense. The use of open innovation also works the other way around. When the BSO is more open, it seems less difficult to build up good relationships and get the right technology, explicit and tacit knowledge and other resources via the parent firm and the network. In short, there is a strong correlation between the indirect success factors.

The internal and external influential factors stimulate or hinder the BSO to be an open innovator. It has to be mentioned that there is no relation between stimulance/hindrance of open innovation and the succes rate of the firm. From the literature it is made clear that every BSO has its own optimal degree of openess. Sometimes a stimulating/limiting factor is postitive for the survival of the firm, but can also be negative. For example, the conceptual model shows that 'competition' hinders the firm of being more open. When competition increases the spin-off company will be more closed to the outside world, but this does not mean that it is negative for the survival of the firm. Furthermore, the internal and external factors that influence the use of open innovation contain some aspects that can also be found in the success factor parts. As example, 'big partners in the network' limits the business spin-off to be more open. In contrast, the company should have 'a diverse network including large partners', according to the indirect external success factors. Another example, 'IP protection' hinders the young startup of being more open, but 'protection and modest outflow of IP' is also a direct success factor to survive. These examples confess that the factors that stimulate/hinder the openess of a firm are not directly postitve/negative for the startup and survival.

Finally, the conceptual model is formulated more simplified and better structured than the described theory actually suggests. From theory it is made clear there exists more correlation and interdependency between and within the success factor groups. For example, protection and modest outflow of IP leads to development of trustful relationships, and the parent firm is needed to build up an own business network, startup capital is necessary to set up an internal R&D unit, and competition normally increases IP protection.

4. Method

To answer the general research question, *'How important is the use of open innovation (in terms of knowledge exchange), for the survival and success of business spin-offs in the high tech industry?'*, the conceptual model is used in combination with empirical findings for which the method is described in this chapter. First, the method used for this analysis is explained and justified step by step. Second, it is explained what kind of data are considered for my empirical study and what the selection criteria were to get the right data. Third, the actual data used for this study are described (e.g. which firms participated, how many business spin-offs among them, and how many interviews I did).

4.1 Type of research

4.1.1 Level of analysis

Research about the HTCE can basically be done at two distinct levels of analysis; the individual firm level and the ecosystem level. At the ecosystem level the focus is on the macro-culture, shared beliefs and assumptions that all ecosystem members hold on open innovation, etc. This is not interesting to me, since I only focus on the BSOs. That is why my research is done at the individual firm level (i.e. transactions of resources and knowledge between BSOs and their network partners). This will serve to more effectively achieve insight in the business strategies and value of open innovation to business spin-offs located at the Campus.

4.1.2 Qualitative, explorative research

In this study I try to discover what the relation is between the critical factors, the determinants of open innovation and the strategies of BSOs to survive. With these insights I want to write policy implications for the BSOs (located at the Campus) and fill in the literature gap. To expose relationships between concepts, qualitative research is more suitable than quantitative research. Therefore, the empirical part of my study is based on qualitative research.

Only a marginal amount of previous research has been done about open innovation in combination with BSOs. In particular, previous studies have not acknowledged three important features of value creation by open innovation networks. First, data are collected in close proximity to a specific situation: value creation typically involves dynamic processes that strongly depend on their specific context. This value creation process is the product of exchanges between the BSOs and their network partners, and therefore is subject to localized ways of behavior. Second, qualitative studies focus on naturally occurring, ordinary events in natural settings, that make it possible to capture what real life is. It is adequate for studying relationships, and it is possible to go beyond the 'snapshots' of only measuring 'what' and 'how many'. This gives a strong opportunity to understand the latent, underlying, and non-obvious issues. Qualitative data provide potential for revealing complexity, what is related to this case. Third, the objectives of business spin-offs in the HTCE ecosystem are heterogeneous and not solely driven by one product or offering that these companies are trying to get to the market (van der Borgh et al., 2012). Besides, there is a small number of BSOs at the Campus, what makes it difficult to get reliable quantitative results out of it. A common feature of qualitative projects is that they aim to create understanding from data as the analysis proceeds. This means that the research design of a qualitative study differs from that of a study that starts with an understanding to be tested, where often the hypothesis literally dictates the form, quantity, and scope of required data.

There are three options to fill in the qualitative research: descriptive, explanative and explorative research. The latter fits best in my study. The objective of exploratory research is to identify key issues and key factors. This is actually the step before explanative research. In this case it is even not known if there is a relation between A and B. The real advantages and disadvantages of open innovation for BSOs have not been defined yet, and the relation between open innovation and the

success factors of business spin-offs also has to be found. Only a conceptual model could have been modeled to describe what relationships may be present based on theory. In other words, the key issues and key factors still have to be explored in practice. That is why the explorative research method fits best in this context. In short, a qualitative, explorative research is the best choice to answer my research question.

4.1.3 Case study approach

Since my empirical research contains particularly information from several cases studied, it is called a case study approach (Yin, 2003). In short, a case study is an in-depth, empirical investigation of a single instance or setting to explain the processes of a phenomenon in context. Related to my study, the clinical nature of the case study arises from its dual purpose to improve the performance of the spin-off firms as well as to analyze and understand the underlying processes in this specific case.

There are several reasons that justify the case study approach for this qualitative, explorative research. First, the case study approach takes the contextual conditions into account (Yin, 2003). It is grounded in 'lived reality'. As this thesis is about empirically studying BSOs located at and/or close to the Campus, the context is relevant to the phenomenon under study. To clarify, with this study I go 'into the field', and the issue is not studied theoretically or in abstract. Furthermore, case studies provide an integral image and acquires more aspect knowledge than other methods. Besides, the context is important for the acceptance of the solution in the wider organization (Verschuren & Doorewaard, 2000). Second, the case study is especially useful when the research question is in the 'how' or 'why' form (Yin, 2003). In this instance the empirical research tries to identify how open innovation creates value to the BSOs. Furthermore, it is important to know how influential the different success factors are, and how they are related to the use of open innovation. The depth and complexity of case study data can illuminate and help to understand the inter-relationships of such correlated factors. Third, exploratory case studies can be very useful for exploring new processes and behaviors, as they help to explain why certain BSOs use specific kinds of business strategies, and why they apply/avoid using open innovation (Eisenhardt, 1989; Yin, 2003). Finally, case studies can answer research questions; however, unlike experiments, the variables cannot be tightly controlled and manipulated. So, a case study uses multiple sources of evidence, called triangulation, to improve construct validity and reliability (Yin, 2003). It is argued that triangulation will help improve construct validity and reliability because it forces the researcher not only to rely on a single source of information. In this study triangulation is necessary, because there are less relevant researches done, and there is a small selection of firms that could be used, and thus information should be collected from various people's minds and documents. Related to this study, several primary and secondary data sources are used. The empirical research requires this data to converge in a triangular fashion.

Stake (1995) made a threefold distinction of case study types. He emphasized that the number and type of case studies depends upon the purpose of the inquiry. An instrumental case study is used to provide insight into a particular individual case. An intrinsic case study is undertaken to gain a deeper understanding of something else. The study of a single case is used as an instance of a wider phenomenon in order to obtain a better general understanding of it. The collective case study, also described as multiple case studies (Yin, 2003), is the study of a coordinated set of cases in order to inquire into a particular phenomenon to gain general understanding. Cases are studied comparatively in order to explore similarities and differences. Having more cases provides a more convincing test than just one, and claims for generalizability can be made more convincingly by coordinating and aggregating evidence from a number of individual case studies (Stake, 1995). As I want to compare multiple cases with each other in order to strengthen the conclusions of my research, the collective case study is most suitable.

4.1.4 Generalization

The value of qualitative research lies in the particular description and themes developed in context of a specific site. Particularity rather than generalizability is the hallmark of qualitative research. However, there are a few discussions in the qualitative literature about generalizability, especially applied to case study research in which the inquirer studies several cases. To clarify, generalization is the formulation of general concepts from specific instances by abstracting common properties. Yin (2003) feels that qualitative case study results can be generalized to some broader theory. The generalization occurs when qualitative researchers study additional cases and generalize findings to the new cases. It is the same as the replication logic used in experimental research. However, to repeat a case study's findings in a new case setting requires good documentation of qualitative procedures, such as a protocol for documenting the problem in detail and the development of a thorough case study data-base (Creswell, 2009). This means that, for now, a part of my study can only be generalized for the BSOs located in and around the Campus. Nevertheless, replications of this research within other contexts could increase the generalizability to a higher level, thinking of a national or even a global scale. Another part of this thesis can probably be transposed beyond the original sites of study. Furthermore, Stake (1995) emphasizes that statistical generalization cannot be the primary aim of case studies but rather the opportunity to learn from them. In order to achieve this, the researcher should try to maximize the variance of characteristics being studied. So, I have tried to select different business spin-offs in the data set, of course within the boundaries of my research topic. More about the firms selected is written in section 5.3.

4.2 Interviews and documentary data

A set of semi-structured interviews with key decision makers from different companies is the main provider of information to this report. A semi-structured interview is flexible and allows new questions to be brought up during the interview as a result of what the interviewee says (Tellis, 1997). Interviews have the advantages that they focus on case study topic and provide perceived casual inferences (Yin, 2003). However, interviews may involve incomplete recollection, reflexivity and biases from poor questions and response (Tellis, 1997). To overcome these disadvantages, interview schemes are predefined. Although a single interview can hardly be replicated, different interviewers can come up with similar interviews using the same interview guide. Using a structured design of the interview gives the opportunity to prevent superfluous information, to collect comparable data and to make reliable and meaningful observations. Structured interviews prove construct validity and give insight in the relationship between constructs and measures. Another contribution to the construct validity is the use of multiple sources of evidence (Gilsing et al., 2010). This is done by interviewing many respondents about the same construct.

Before these interviews are executed, another source of information is used to get more insight in the added value of open innovation to BSOs. Documentary data are collected from three previous investigations about the HTCE, including data from interviews and surveys. By assessing this documentary data the interviews could be prepared thoroughly and the information of the interviewees could be carefully interpreted, checked and enriched. In turn, this establishes construct validity during the case study.

4.3 Firm selection

In this research the focus is on Dutch BSOs from large parent firms, defined as: parent firms with a minimum of 100 employees (Braaksma & de Jong, 2005).

The research is focused on business spin-offs in their early years. Recommendations are written for small BSOs younger than 3,5 years old. The latter made my research specify on the start-up and

survival of the BSOs in their early phase. To make the term ‘early years’ more specific, the following categorization scheme of entrepreneurial businesses is used (see figure 8). The life cycle of the entrepreneurial process looks at individuals at the point when they commit resources to start a business they expect to own themselves (nascent entrepreneurs); when they currently own and manage a new business that has paid salaries for more than three months but not more than 42 months (new business owners); and when they own and manage an established business that has been in operation for more than 42 months (established business owners). Figure 8 summarizes the entrepreneurial process and definitions. In this research the ‘new business owners’ group is focused on (Bosma et al., 2009). This means that the spin-offs investigated should be market players for more than 3 months and with a maximum of 42 months. So, they are in a very early stage of their life cycle.

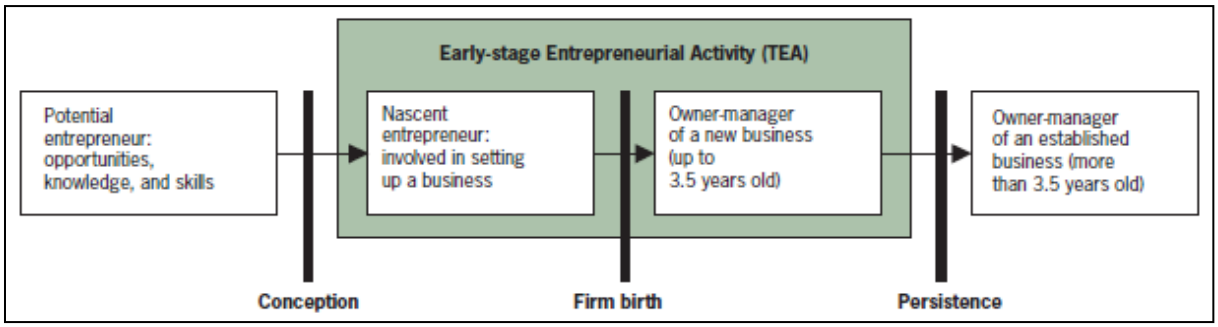

Figure 8. The entrepreneurial process and definitions (Bosma et al., 2009).

To clarify this choice, an OEM at the Campus like ASML, once a spin-off from Philips, is already such a big business player for a long time that it might be too difficult to get information about the success factors and influence of open innovation in the early years as a market operator. Younger firms are just into that process and can directly give answer on what they do to survive and how they use open innovation. Also, large successful BSOs are almost not distinguishable from ‘normal’ firms. Then it would not make sense to focus my research on BSOs in particular.

However, to keep enough spin-offs suitable for my interviews the firm age had to be increased to a maximum of 5 years old. I needed spin-offs with different ages, to get more insight in the degree of openness in the evolution of BSOs. Next to the age, responding firms were selected on their location and parent firm. This is done to find out what the influence of being located outside the Campus is on the use of open innovation. Moreover, most spin-offs at the Campus come from Philips, so spin-offs with other parent firms were needed to find out what the influence is to be a spin-off from Philips or from another company.

After careful screening, 6 out of 11 spin-offs located at the HTCE were contacted for participation in this study. Furthermore, 3 out of 6 spin-offs outside the Campus that met one or both of the aforementioned requirements were approached. The excluded spin-offs were too old, too large, or even bankrupt. An overview of the business spin-offs can be found in appendix A. One of the spin-offs, located at the Campus, is set as the bench-mark for my research and the others are compared to. This made it easier to figure out whether age, parent firm and location influence the use of open innovation under BSOs.

4.4 Data collection

Purposive sampling was used to collect the data, because it groups participants according to preselected criteria relevant to the research question (Creswell, 2012). It fits seamlessly with my firm selection process. The willingness at the HTCE to join the study was relatively low; in total, 2 out of 6 approached BSOs at the Campus agreed to participate in this study (33% of the key informants identified). Most suitable firms that did not want to participate were not interested or were too busy.

Besides, one firm did not join, because it was afraid of giving away too much (secret) information about the business. This is remarkable, because it feels like a contradiction to my study about the openness of BSOs. From the 2 participating Campus firms, the bench-mark was chosen to compare all of the other BSOs with. In chapter 7 it is explained which company is chosen as the standard. From the suitable BSOs located outside the Campus, the willingness to give an interview was optimal. All of the firms joined the study (100% of the key informants identified). Thus, 5 BSOs participated in total. Appendix B presents the list of participating firms and interview data. In one instance two respondents represented the spin-off participating in this study, the rest of the participating spin-offs were represented by one interviewee each of them. The respondents included chief executive officers (CEOs), founders, owners, and several (unit) managers. See appendix C for more information about the interviewees' backgrounds.

Purposive sample sizes are determined on the basis of theoretical saturation (the point in data collection when new data no longer bring additional insights to the research questions). Purposive sampling is therefore most successful when data review and analysis are done in conjunction with data collection (Creswell, 2012). Thus, data was collected from the participating spin-off companies till no new information showed up anymore. The data collection, interpretation, and analysis overlapped, because that allowed to take advance of flexible data collection. This flexibility was used to refine the interview guide during the research, and to add interviewees that knew specific information about a certain topic (van Burg, 2010). Appendix D presents the final version of the semi-structured interview scheme used for this study. During the interviews no reference was made to the different value sources of open innovation networks that might (dis)advantage a firm, to prevent any bias to occur regarding these topics. During the interviews extensive notes were taken and the interviews were audio recorded (with permission of the interviewee) to prevent loss of information.
The recorded interviews have an average duration of 58 minutes and a total duration of 291 minutes. See appendix B for more information about the interviews. The recorded conversations were written out in order to analyze the data in detail afterwards. Through taping and transcribing the interviews the reliability of the data collection is enhanced (Yin, 2003). Moreover, the interviewees checked the reporting of the interview, which also improved the construct validity. In general, the interviewees answered all of my questions and were very open during the conversations. Afterwards, they only made some marginal corrections to the content of the transcriptions, and two of them deleted some very specific information that had to be kept secret.

Empirical analysis

Chapter 5. High Tech Campus Eindhoven

Chapter 6. Case study: Analysis of BSOs

5. High Tech Campus Eindhoven

Previously, section 1.2 already hinted there are contradictions about the quality and added value of the HTCE. This chapter can be seen as an introduction to the case study of chapter 7. Based on findings from three previous studies about the HTCE, the indirect external success factors from the conceptual model are tested and the real benefits and barriers of the 'open innovation atmosphere' of the Campus are discovered in this chapter. Before these findings are described, some background information about the High Tech Campus Eindhoven is provided. At the end of the chapter a conclusion is written down.

5.1 Quality of HTCE

5.1.1 History

Since the last two decades, company borders are fading and people become more and more interconnected. As a reaction to the changing environment Royal Philips Electronics initiated the High Tech Campus Eindhoven in 1999, an ecosystem in which companies can find one another. Philips established the HTCE to act as a single location for all its national R&D activities. Philips wanted to create a community where businesses and people could find each other, inspire each other and overcome technological challenges together. The label of 'open innovation' has been adopted to define its emerging strategy and preferred work approach (van der Borgh et al., 2012). In light of the open innovation strategy, a situation where companies benefit from both external and internal ideas, the HTCE evolved into a technology centre with a global reputation. The reputation was an important reason for many firms entering the HTCE, and subsequently, these new residents also appropriated from the ecosystem's reputation (High Tech Campus Eindhoven, 2013; OECD, 2008). The atmosphere of openness and the concentration of high-end knowledge facilities produced considerable interaction between the researchers and firms. Knowledge sharing and mutual inspiration generated a definite boost for the innovative capacity of the organization. To further accelerate this process, Philips decided in 2002 to open up the Campus to other technological companies, and in 2006 the campus was opened up entirely. Many new companies discovered the hotspot, ranging from local startups to established global players. Nowadays government, knowledge institutes and businesses, the so-called Triple Helix, are working together at the HTCE (Ming, 2011).

From this paragraph it can be proposed that the HTCE really tries to create an open innovation ecosystem. A lot of benefits that are offered by the Campus overlap with the theoretical benefits of open innovation and networks. For BSOs the Campus can be an attractive place to situate, because it offers a knowledge-based business ecosystem with closely located high tech firms that can help them with technical problems, share knowledge and lead to new partnerships. Collaboration, what is priority for most of the starting spin-offs, seems to be very important on the Campus. Besides, BSOs might also profit from the reputation of the Campus, for example to build up a recognized brand name.

5.1.2 The power of the Campus

The High Tech Campus connects all industrial players in the supply chain for High Tech Systems & Materials (HTSM), with its core productions in the region Eindhoven, The Netherlands. The HTCE belongs to the top 17% biggest science parks worldwide, and the firms on the Campus are responsible for almost 50% of the patent applications in the Netherlands (High Tech Campus Eindhoven, 2013). Because of the large amount of Original Equipment Manufacturers (OEMs), like Philips, FEI Company and Océ, a complete ecosystem has arisen, consisting of suppliers, knowledge institutes and R&D centers. This ecosystem promotes shared research, exchange of knowledge and development of new products, services and technologies. This is reflected in the architecture, the Campus Sports Club and the shared seminars/conferences held at 'The Strip'. The Strip is the core of

the Campus and houses all the communal facilities, such as the Conference Center and several restaurants and shops (Brainport Industries, 2012).

The Campus focuses on high tech areas such as micro-system devices, embedded systems, signal processing and nanotechnology, offering opportunity for research through formal partnerships and consortiums.
The HTCE covers 103 hectare, and the Campus even comprises about 25 to 30 new buildings with a total surface area of more than 174.000 m². There are more than 8.000 researchers, developers and entrepreneurs who work closely together in more than 90 companies. The HTCE's management team planned to grow its campus to about 10.000 people within 5 years (Ming, 2011; van der Borgh et al., 2012; OECD, 2008).
The ecosystem includes a large variety of companies. They range from the famous OEMs like Philips, IBM and ASML, to startups and spin-offs like Cordian, Sapiens and Liquavista (Azeredo, 2006). The Campus is supported by several knowledge suppliers, such as the education- and training centers TU/e, Fontys and Avans, the knowledge centers TNO and ECN, and commercial players like Philips Innovation Services (PIS) and CCM. Besides, integral partners that give a boost to the cooperation at the HTCE are research centers and research programs like Holst center, Point One and DevLab (Brainport Industries, 2012). For an overview of the Campus, see appendix E.

Brainport Industries confirms the propositions made at the end of the former paragraph: The HTCE seems to be a good place for high tech BSOs to locate at, since the ecosystem focuses on collaboration in terms of shared R&D, knowledge and technologies between a large variety of actors.

5.1.3 Campus suited for small firms

High Tech Campus Eindhoven (2013) argues that the Campus has an attractive climate especially for starters among the small firms, that offers a great opportunity to survive and succeed. Basically, one of the prime objectives of the Campus is to create the right conditions for innovative young companies. Startups cannot have essential functions like legal services, accountancy, and patent registration in-house, but all of these are available on the Campus. Second, the object of the Campus is to generate opportunities for co-operation and joint ventures, creating valuable partnerships and turning ideas into business ventures. With a huge number of technical specialists near each other, Campus startups are able to focus on their core competences (Ming, 2011). The Campus' infrastructure provides an adequate setting for intensive cooperation between these small specialists. As a result, innovations are achieved more rapidly, more cost efficient and are of better quality (Brainport Industries, 2012). Therefore, a Campus where intensive collaboration is possible between startups can result in an increase of both individual and joint innovative ability of these firms. So, according to High Tech Campus (2013), the establishment of spin-off companies fits well into the ecosystem of the High Tech Campus. In opposite to this argumentation, van der Borgh (2007) argued that the current HTCE does not support the emergence of startup firms, but aims at the high-end of the market. That is why the smaller firms need to join their forces to cooperate and share their knowledge, (R&D) costs, common institutes for R&D, etc. In short, there is agreement about the fact that small firms need to cooperate , but there are contradictions about the role of the Campus. More of these contradictions are described in the next section.

In short, young BSOs most often miss the benefits of economies of scale and finances to survive without collaboration. So, it can be argued that an area in which proximity and collaboration of firms is high, is an attractive place for business spin-offs to establish. However, the question is whether the HTCE is such an attractive place or not. Due to the ongoing discussion about the suitability of the Campus to startups, it is unclear what value the Campus offers to BSOs in reality and what the role of open innovation is.

5.2 Added value of HTCE

Azeredo (2006), van der Borgh (2007), and van der Borgh et al. (2012) investigated the critical success factors of the HTCE ecosystem. Due to the fact that this ecosystem is supposed to run on an open innovation network, the influence of open innovation can, to some extent, also be seen from their research results. There is a large overlap between their explorative ecosystem investigations and my open innovation investigation. That is why these interview and survey results can already give me insight in the added value of open innovation to the HTCE firms in general.
To clarify, the following categories are based on the most important findings of the three studies. Several direct and indirect success factors are incorporated into these categories, which can be compared to the conceptual model eventually.

5.2.1 Proximity

The proximity of a large pool of resources and capabilities within the Campus, and a fast and convenient infrastructure make this knowledge-based business ecosystem a potentially efficient environment for its companies. The proximity of research institutes, service providers, and technology companies tends to support and reinforce the (intra-Campus) mobility of resources and knowledge. During the interviews of van der Borgh et al. (2012), 50% of the respondents explicitly mentioned the proximity and the ease of access to (potential) clients, resources or knowledge as their most important source of efficiency. Firms get more easily into contact with other parties at the Campus. For example, some employees from Philips work part-time for other Campus firms, and companies are more frequently approached by other firms, which eventually leads to new collaborations or customers (van der Borgh, 2007; van der Borgh et al., 2012).
Proximity of the firms seems to be helpful to BSOs and seems to stimulate the use of open innovation, since clients, external knowledge and resources are easier and more efficiently accessible.

5.2.2 Informal networks

Informal networks were identified at the Campus confirming that valuable knowledge is being shared between employees of different firms. This informal exchange of knowledge was observed to occur without explicit compensation. Informal networks became the way SMEs found to overcome high expenditures. Such costs may be related to shared services, such as download of papers from the Campus Library, or to consultancies with researchers and experts regarding problem solving issues. Among the origins of these informal networks could be the cultural environment of the Campus, the shared identity around Philips, the interaction of workers at shared facilities or informal meetings and social events. Formal factors, such as colloquiums and seminars, also sponsor these networks. However, new informal networks within the boundaries of the Campus appeared to be not stimulated by the single occurrence of aspects such as co-location, or the availability of shared facilities. Just by placing workers together at common facilities did not make them to interact, not even with support of social events. According to Bert-Jan Voertman (manager of The Strip), "*there is still not enough of a community. There are still too few people spontaneously engaging with one another. Co-workers tend to stick together in groups at lunchtime and rarely meet new people*". It seems that the 'gears' of open innovation, the researchers and knowledge workers, are not yet fully embedded with this new paradigm. Some firms even do not feel anything from the open innovation culture that should dominate the Campus. They argue that no shared vision, identity or common direction exists, and these firms do not feel they are part of the Campus. Besides, analyzed events evidenced no further reference to the existence of a shared identity of the HTCE (Azeredo, 2006).

Altogether, these findings are more or less in opposite to the research findings about close proximity. Open innovation seems to be used, but is (still) not noticeable throughout the whole Campus. Due to the fact that early phase BSOs are most often SMEs, informal networks at the

Campus appear to be very important for the existence of these firms, for example to avoid high expenditures. However, a spin-off should invest time and effort to build up an informal network at the Campus, because proximity of firms and shared facilities are not enough to create such a links.

5.2.3 Network externalities

Network externalities are likely to be present if the ecosystem's attractiveness increases with the number of (value adding) companies. For example, a research institute with a relevant knowledge portfolio will make the ecosystem more attractive for others. The opposite also holds: when several major firms leave the ecosystem, the latter will become less attractive for other firms considering entry (Katz and Shapiro, 1985). To counter such a vicious process, the creation of other network externalities is important. For example, developing informal networks and a strong community identity will tie firms to the ecosystem since this serves to raise switching costs. Second, the ecosystem's reputation depends on the relational embeddedness of all the companies: strong and repeated ties are expected to induce shared interests that invite future collaboration and information sharing. Firms adapt to each other's demands within a growing number of partnerships (Granovetter, 1992). This suggests that trust accumulates over time when companies increase the frequency of their interaction. Because knowledge-based ecosystems generally aim at long-term goals, trust in relationships is critical (van der Borgh et al., 2012).

So, to profit from the network externalities, BSOs should also contribute to the creation of a closely connected ecosystem. Therefore, they should have a high level of interaction with various actors to build up strong and trustful relationships at the HTCE.

5.2.4 Philips' influence

In general, the boundaries around Philips, the anchor firm of the Campus, were found to set the limits of informal networks on the Campus. While investigating informal networks between other firms of the Campus, it was noticeable that they were highly dependable on current or former employees of Philips. It seems to be that being part of Philips's network gives a firm more profits from being located at the Campus.

The informal networks, necessary for SMEs to transfer and acquire knowledge, were noticed to be controlled in great part by Philips. Even on knowledge flows external to Philips, a strong dependence on the anchor firm exists. It does so, by restricting or enhancing, the access to 'coffee places' and 'open doors' environments, and some formal meetings are restricted to Philips Research only. Even so, Campus residents can use the 'Library' for free in case they belong to Philips Research. Otherwise, they have to face fees and additional costs to borrow books, articles or magazines.

The control also comes from Philips' policy towards knowledge sharing and the consequent impact on its employee's behavior. Evidently, the processes of exchanging knowledge and resources between a particular set of companies need time to develop (e.g. in terms of trust), and once developed, these are difficult to imitate. On the other hand, this also creates barriers for new entrants to the ecosystem who would like to tap into these existing networks immediately after entering the ecosystem. The complexity of the ecosystem increases the amount of tacit knowledge in the system, but creates problems in terms of transfer of knowledge and access to information (van der Borgh et al., 2012). For the ones with a Philips background or several years of experience on the HTCE the problems of visibility and access to information are not so profound. The informal network with employees of the anchor firm is very helpful to acquire useful knowledge, mainly for the ones spinning-out of Philips. For companies who are new and unfamiliar, the situation is very different. They have many problems with finding out where to be and whom to contact, and without a Philips connection it is rather difficult to get access to personal networks (van der Borgh, 2007; van der Borgh et al., 2012). Workers with no previous experience at Philips had to count with knowledge brokers to gain access to the

available networks of the Campus. The informal network and the efficiency of knowledge brokers evidence how a similar background and trust feeling exiting at relationships is fundamental to the development of effective knowledge flows (Azeredo, 2006).
As a startup/SME on the Campus, it seems to be inevitable to survive without belonging to Philips, and so, it appears to be easier for spin-offs from Philips to achieve a business network than for non-spin-offs. A good connection to the parent firm can make it easier to survive and succeed: facilities are cheaper, the informal network can be used more intensive, knowledge can be acquired faster and more easily, etc. In turn, this stimulates the use of open innovation. Also, from chapter 2 it was concluded that tacit knowledge is especially important for the startup of spin-offs in general. Therefore, the Campus might be interesting to BSOs since it stimulates the exchange of tacit knowledge in particular.

Furthermore, creating a campus around Philips, stimulates the existence of a homogenous background, a disadvantage for innovation. It influences the way firms share knowledge, exploit the available common knowledge and background. The anchor firm policies on IP and financial compensations directly affect the creation of new informal contacts, especially to residents that do not belong to Philips. Diversity of knowledge should be available to get more innovative output. Besides, IP should exist to preserve the value of the knowledge, but it must not restrict the knowledge sharing in the 'open' innovation network. It appears that higher independence of the Campus from the anchor firm is a positive step being taken towards open innovation (Azeredo, 2006).

5.2.5 Transparency

The transparency of information about the open innovation network of the Campus has not been optimal to certain members. No successful deployment of open innovation occurred to several researchers at the Campus, at least outside Philips Research. Researchers not involved in the anchor firm, spinoffs or shared facilities and services of the Campus, were frequently not aware of the new policies towards open innovation. Some researchers argue that there is a lack of transparency regarding the implementation of open innovation. If they knew the possibilities and advantages of this open innovation policy they could perhaps profit more from it. The management of the Campus did not involve these researchers into new plans and they were not honest with the marketing presented. By providing improved information and higher availability for (potential) members, search and bargaining costs can be reduced, for example by providing a one-stop service point for new technology-based firms. The risk of opportunistic behavior is reduced by providing transparent information to all participants (Azeredo, 2006; van der Borgh et al., 2012).
So, another advantage of BSOs, that are still connected to their parent firm Philips, is that they get better insight in the use of open innovation on the HTCE. It may also stimulate them to make use of.

5.2.6 Knowledge flow

The study of Azeredo (2006) found that several aspects influence the distinct phases of deciding to seek, searching for and transferring knowledge in different ways. In general, the phases of deciding to seek and searching for knowledge are the ones that profit most from the available characteristics of the Campus: physical proximity, collocation and shared facilities were found to play an important role on these phases. While for these two stages face-to-face contact was a major sponsor, at the phase of transferring knowledge it was also found that the information- and communication technologies (ICT) of the Campus have great importance. Nevertheless, when the knowledge to be transferred is under more contextual and tacit levels, face-to-face meetings were found to be indispensable. The knowledge flow could be increased by stimulating a shared identity and enhancing network level knowledge sharing among Campus firms.
It seems to be important for BSOs on the Campus to have face-to-face contact with their partners, since this type of contact is most important to find new information and to exchange tacit knowledge.

Furthermore, the Campus creates lock-in. Compared with single businesses, ecosystems source knowledge more globally. Especially small firms that have entered the ecosystem will, over time, become increasingly dependent on access to this large pool of knowledge (van der Borgh et al., 2012). BSOs rely on external partners in the early phase, and so, they should be aware of the possibility to be locked into the ecosystem of the HTCE in long term. This does not directly mean it is negative for the firm's existence, but it perhaps reduces the independence of the BSO when it starts to grow larger. Further, it is clear that tension between openness and protection exists on the intersection of open innovation and IP. This tension is not new and, as a consequence, not easily solved. As a result, IP is observed to create barriers to the implementation of open innovation at the Campus.

5.2.7 Reputation

The ecosystem's reputation was an important reason for many firms entering the HTCE, and subsequently, these new firms also directly appropriate from the ecosystem's reputation. People associate the HTCE with Philips, resulting in marketing gains for the residents, since Philips stands for 'high tech' and 'leading edge research' (van der Borgh, 2007). About 60% of the respondents of research from van der Borgh et al. (2012), acknowledge that the mix of companies, technological and social facilities, and the pleasant working environment attracts third parties like companies, talented personnel, and governmental support. Especially smaller companies, such as high tech startups, benefit from their residency at the HTCE. For the small companies it is beneficial, because they can sell that they have access to high tech facilities. The firm is seen as more reliable by potential customers, partners and investors. Such perception corresponds to literature arguing that the advantages available to firms joining ecosystems are, in great part, originated from the prestigious environment created at these enterprises (Jonsson 2002). The HTCE provides firms a positive image to the outside world and an identity that facilitates useful contacts (Azeredo, 2006), and therefore, the reputation of the Campus appears to support the success of the business spin-offs too.

5.2.8 Costs

There is a high standard of facilities at the Campus, but only available for a high price. For startups the HTCE is very expensive; there is no differentiated offering as far as this is concerned. Startups themselves cannot afford high accommodation costs. This price premium creates a major entry barrier or may even motivate incumbent firms to leave the ecosystem. Moreover, companies who want to locate on the HTCE, but cannot afford this, will base their decision on the financial balance, which then will tilt to a location nearby, with accommodation expenses 2 or 3 times cheaper (van der Borgh, 2007; van der Borgh et al., 2012). For example, an interviewee from a small firm at the Campus reflected: "*I am currently dependent on the ICT-network, mainly for access to the outside world. The 1500 euro a year per connection is excessively high. Furthermore, the service charges are somewhat high, but the cost/benefit analysis has been done and the conclusions were to the advantage of the HTCE. At the end of each contractual term with the HTCE, a new analysis will be done to determine whether we stay here*" (van der Borgh et al., 2012).

The high costs of establishment on the Campus seem to be the biggest obstacle to BSOs. They usually suffer from a lack of resources and capital and that decreases the option to situate at the HTCE. However, for BSOs that are located at the Campus it might be extra motivational to apply an open innovation strategy to share resources and lower the costs.

5.3 Conclusion

This chapter has mainly tested the importance of the indirect external success factors from the conceptual model. The factor 'being part of a high tech ecosystem', reported in that model, was the point of focus. Based on this study some success factors described in the previous chapters can be

confirmed, like the importance of informal networks and trustful relationships, and the usefulness of a high reputation. Therefore, overlap exists between the conceptual model and the findings from this chapter. On the other side, the study shows there are differences between theory and the reality. It can be argued that establishment on the HTCE is not enough in itself to reap the benefits from. The context from this high tech area is more complicated than theory suggests. This chapter showed that several requirements have to be taken into account to take advantage of the Campus. If a BSO can meet these requirements, the HTCE can be very beneficial in the startup phase of the firm. The benefits, and corresponding requirements, for BSOs located at the Campus are summed up below:

First of all, physical proximity, collocation and shared facilities are important for the exchange of knowledge and perceived access to clients and resources.
Second, informal network contacts are important to share technological knowledge and resources, lower the costs and get help from experienced people in problem solving. These findings overlap with two of the indirect factors provided in the conceptual model. However, informal networks within the boundaries of the Campus have to be intensively worked on and are not created by the single occurrence of aspects such as proximity or co-location. This is a new empirical point that should be add to the existing factors identified in the model.
Third, BSOs should build up a strong and trustful network to benefit from network externalities, what confirms one of the indirect external success factors.
Fourth, firms adapt to each other's demands within a growing number of partnerships, what confirms the direct success factor 'ability to synthesize activities with partners'.
Fifth, established firms with a high reputation make the ecosystem more attractive for others, and the Campus' reputation can help to build up a recognized brand name in turn. This was not covered before by the conceptual model.
Sixth, with a good connection to Philips, facilities are cheaper, the informal network can be used more intensive and knowledge can be acquired faster and more easily. It is one of the most surprising findings from this chapter, because it indicates how the system of the HTCE works in practice. Lastly, the amount of tacit knowledge is high at the HTCE, and face-to-face contact is most important for the exchange of this kind of knowledge, and the Campus' ICT network is important for the transfer of explicit knowledge in particular. The conceptual model already covered the factors tacit and explicit knowledge, but it did not make clear in what way they were exchanged.

Although the benefits stimulate the use of open innovation, the three studies makes clear that there is still not a real community feeling on the Campus. When there would be more of an open innovation atmosphere, it would probably stimulate the share of knowledge via informal networks. Informal networks are helpful, but Philips determines more or less whether firms can use them or not. As a small starting BSO it seems to be inevitable to survive without a connection to Philips in some way. Moreover, some startups that are not connected to Philips, have more difficulties with the transparency of regarding the implementation of open innovation on the Campus. It takes a long time for these residents to identify the 'rules of the game'. By involving not only Philips related firms, such as Philips' spin-offs, the open innovation atmosphere of the HTCE could probably be improved. Even though access to knowledge is above level at the Campus, it appears that higher independence from Philips, and higher diversity of available knowledge stimulate the use of open innovation. Another challenge is that young BSOs might have become dependent on the pool of knowledge at the HTCE, what locks them into that location. Also, IP protection creates barriers for the use of open innovation. Finally, the high price that has to be paid to locate at the HTCE is a big disadvantage. For many startups the high quality of the facilities cannot offset the accommodation costs.

In short, on the one hand, the HTCE is seen as an attractive area due to the mix of companies, high quality facilities and a pleasant working environment. On the other hand, the concept of the Campus seems to be less positive to SMEs than is actually described by Brainport Industries (2012) and High Tech Campus Eindhoven (2013) themselves (section 6.1.3). It is not a place that fits to every single firm, and it is also not the perfect example of how an open innovation network should look like. The power of Philips, the focus on the high end of the market and the resulting high prices are seen as problematic to startups like new non spin-offs. However, for BSOs with origins in Philips, the HTCE seems to be a good place to locate. For them, a strong network, startup resources and exchange of knowledge might be powerful enough to compensate for the high establishment costs though.

6. Collective case study: Analysis of BSOs

In this chapter the empirical data of my own research are analyzed. First of all, the five cases are described in detail to get a complete overview of the companies and a better understanding of their business strategies. Since this study is about the use of open innovation by early stage BSOs (located at the Campus), Cordian is chosen as the bench-mark in this analysis. It is the youngest spin-off, with Philips as parent firm and located at the HTCE. Besides, most information was available about the business of this BSO: former interviews, newspaper articles and other publications could be used. Therefore, the descriptions of the other cases are mainly compared to Cordian. In the second part of this chapter the main differences and similarities between the 5 cases are compared to come up with general results. Finally, the chapter ends with a conclusion. Complemented with conclusions from chapter 6, the third sub-question, '*To what extent have the critical factors and determinants of open innovation been important for BSOs (on the High Tech Campus Eindhoven)?'*, is answered.

To start with, a short overview of information about the BSOs is provided in table 2.

Company	Parent firm	Age	Startup location	Current location	Number of employees	Industry	Business
Cordian	Philips	0,5	HTCE	HTCE	15	High Tech Industry	Alarm system for care business
Dimenco	Philips	2,5	HTCE	Industrial area of Veldhoven	10	High tech industry	3D displays and 3D software
Phenom-World	FEI	3,5	Industrial area of Eindhoven	Industrial area of Eindhoven	19	High tech industry	Table top microscopes
Mutracx	Océ	3,5	HTCE	Industrial area of Helmond	15	High tech industry	Digital inner layer printers
Civolution	Philips	5	HTCE	HTCE	245 (35 at HTCE)	High tech industry	Digital watermark and fingerprint applications

Table 2. Overview of details from the interviewed business spin-offs.

To clarify, during the interviews no direct reference was made to the different success factors covered by the conceptual model, to prevent any bias to occur regarding these topics. The interviewees were asked question about general themes, such as their parent firm, their network, their knowledge share, etc. That explains the categories chosen for the case studies below. Success factors are described within these categories, which can be compared to the conceptual model eventually.

6.1 Cordian Care

Cordian Care, better known as Cordian, is a company that strives to improve care solutions using radical innovative technology, and improve working processes for nursing staff in a challenging health care system. Therefore, Cordian introduced the BedLeave System (BLS) to the market. The BLS is a highly accurate and reliable alarm system that alerts nursing staff when clients leave the bed for too long (Cordian Care, 2012). Dirk Harteveld (Sales and Marketing at Cordian) argues that the BLS is just an extra help for nurses to keep them calm and confident (Edelman, 2012).

6.1.1 Origin

The initial concept of Cordian's technology has its origin in 2003 as part of a European cardiovascular research project led by Philips Research, part of Royal Philips Electronics. Philips searched for a way to take care of patients with cardiovascular problems. During the following next 10 years the concept of the BLS was extensively researched, developed, patented and tested in care facilities. These processes were led by Jan Nesvadba, currently director of Cordian. Next to the

technical aspects of the innovation, a lot of work was spend on marketing. Could a new market be created? Which customers did they have to focus on? Which companies did they have to motivate to cooperate? Etc. Both the technical and the managerial aspects took place within an ecosystem created by Philips.

The initiative of Dr. Peter Nesvadba (founder and CEO of Cordian) and Dr. Jan Nesvadba (son and technical director at Cordian), to startup an own business is a consequence of the impossibility to further develop the BedLeave System in name of Royal Philips. The production scale was simply too small for Philips: Philips was focused on the healthcare in hospitals, and the demand for the system was way too low. It could not be afforded to create a new product market, because this would take too much time and investments. So, it was too risky to introduce the innovation. *"Philips' decision is completely understandable, but it keeps a shame that, by far not all of the successes emanating from R&D are introduced to the market. Consequently, a lot of opportunities are wasted. That is why Cordian spun off from Philips in December 2012"*, explains Jan Nesvadba (van Erp, 2013). Cordian was able to introduce the product on a smaller scale and shifted its market from hospitals to nursing homes (Schell & Schellekens, 2013). The high tech spin-off situated at the High Tech Campus Eindhoven, with the idea in mind to use the synergies, capabilities and know-how of the high tech companies established on the Campus (Cordian Care, 2012).

6.1.2 Parent firm

There is a high level of open innovation between the parent firm and its spin-off company. The main reason Cordian receives so much external knowledge from Philips is that they both benefit. Within Philips it was not possible to introduce the BLS to the market, but this did not mean the system was irrelevant for the parent firm anymore. Instead, there is shared interest of Philips and Cordian in the survival and success of the spin-off company. Cordian bought the technology that Philips put a lot of money and effort in. Therefore, Philips uses a payback model to recoup the investments, and it is shareholder of Cordian (Schell & Schellekens, 2013). Cordian receives the necessary knowledge and start-up capital to develop and grow, and Philips makes profit of this growth too. *"Philips still helps a lot to get the product launched successfully into the market. It provides technical, administrative and commercial resources. Besides, the reputation of Philips helps a lot: Philips is seen as a trustworthy firm and that strengthens Cordian's reputation in turn"*, according to Freek Smit (IP Manager at Cordian). This quote shows that Philips is intensively involved into the spin-off company.
Philips keeps in close contact to Cordian. In case the BLS will be a big success, it can be a potential branch growth for Philips when the product is repurchased. If the BLS fails, Philips can cut off the investments to minimize losses. So, basically the spin-off reduces the risks for Philips.

Philips has a lot of influence on Cordian, because the two are so closely related. First of all, a lot of Philip's culture is taken over. The fact that most employees have a background at Philips is determining for the overlapping culture of both firms. Second, basically everything Cordian possesses comes from Philips Innovation Services. In January 2013, Cordian neither had an own R&D unit, nor had personnel with specialized knowledge of the product. This means that the absorptive capacity of the spin-off company was very low. In contrast, the parent firm has many R&D facilities, can developed and produce at lower costs and employs specialized workers. Cordian tries to do more internal, but some things are just not possible to do on its own. The following quote adds reason for Cordian to keep the relationship close with Philips. "*Cordian can always fall back on Philips. This has also been a very important reason for the establishment of Cordian on the Campus. If the startup has to travel to Philips for all the little problems and questions, it takes a lot of precious time. Every single meter further away to reach a company increases the threshold to take that step. Being located at the Campus keeps the threshold low to approach others"*, argues Martijn Schellekens (Senior Scientist at

Cordian). Third, for Philips the possibility is much larger to take over Cordian than for other firms. *"Every company is allowed to buy Cordian's product, however Philips has much more insight information and a better view of what goes on in the business of Cordian. This increases the interest and opportunity of Philips to take over the spin-off company once, compared to other companies with weaker connections to Cordian",* according to Freek Smit.

Dependency

When a starting spin-off grows and becomes more successful, the less dependent it is on its parent firm. Also, the firm creates an own reputation, not related to the parent firm anymore. This means that the 'distance' gets bigger between the two parties. As the distance gets bigger, it is also less necessary to be located at the Campus. However, right after the startup the strong tie with the parent firm and contacts on the Campus seem to be crucial for the survival. From analysis of Cordian it can be confirmed that the starting spin-off really needs its parent firm and the Campus. Cordian is such a young spin-off (7 months old at time of the interview) that it is still strongly connected to Philips. From Cordian's viewpoint the parent firm is seen as an important complementor: in case Philips falls out of Cordian's network it will be difficult to survive, but it is still possible. The replacement resources are available on the market, but have to be searched for. Cordian argues that it is not dependent on its parent firm, but if one looks at all the support it receives from Philips, the truth seems to be different. Due to Cordian's age it cannot be confirmed that a firm gets more independent during its evolution. However, the spin-off argues it will be less reliant on Philips in the course of time. For example, Cordian has made plans to cross the borders and become a bigger market player within a few years, which demonstrates that the Campus seems to be less interesting or necessary to survive within a few years (Smit & Schellekens, 2013). To draw clear conclusions, older successful BSOs have to be analyzed whether they are less reliant on their parent firm and the Campus or not.

6.1.3 Network

Since the spin out, Cordian has remained in close contact with Philips and can use a large part of its network. Dr. Jan Nesvadba, and some other employees that came over from Philips, have kept good connections within the parent firm. Jan could easily continue to work with these people in his own firm. In formal terms, Cordian is not part of Philips anymore, but informally Cordian uses a big piece of Philips' network (Schell & Schellekens, 2013).

Since Cordian is separated from Philips and it cannot be totally dependent on Philips anymore, it has also started to create its own network. Thus, Cordian is both active in Philips' ecosystem and in its own network. The next quote shows that Cordian prevents to be dependent on a single firm.*"For a (small) firm it is important to be not totally dependent on one firm, but it should have more contacts spanning a variety of markets. For example, ASML grows very fast and has a lot of dependent suppliers in its network. However, the first thing ASML will do when the profits are going down is to repel certain suppliers and integrate these parts of the supply chain in the own company. In short, if ASML collapses, all of the dependent firms collapse too",* argued Freek Smit. A firm should have many contacts spanning a variety of markets. This is exactly what Cordian tries to do. It keeps searching for new applications of the BedLeave System and does not have a single customer. Instead, Cordian builds on a network of many customers, and thereby it stimulates the use of open innovation.

Cordian consists of 15 persons nowadays, and together they are responsible for the development and sales; the production is outsourced to Neways. Cordian cooperates a lot with SMEs close to Eindhoven, most of them situated at the HTCE. This means that Cordian has many partners of equal level, which leads to symmetric relationships. Besides, the spin-off uses a lot of partners worldwide in its own network, like firms in Taiwan that produce the displays for the BedLeave System. Furthermore, Cordian is subsidized by the Dutch government, and the startup receives support

from Brainport Development, High Tech Campus Eindhoven, and Holland High Tech. The latter brings companies into contact with each other. This increases the possibilities on future collaborations with other parties, and thus, it stimulates the use of open innovation (Cordian Care, 2012; Schell & Schellekens, 2013; Smit & Schellekens, 2013).

Cordian is such a promising firm that many suppliers are willing to think along with Cordian to make the business grow. For example, suppliers deliver components on a smaller scale than normally, but do not make it relatively more expensive to Cordian. Martijn Schellekens explains that Cordian is seen as a very attractive firm to invest in: *"A firm like Cordian attracts a lot of attention from large players in the high tech sector. Investors also recognize that Cordian could be successful in the future; investing in an innovating firm that handles aging is an attractive option. If a new firm can create a lot of money, large players can also profit from the startup company if they invest. So, most firms approached by Cordian were willing to cooperate".*

Cordian is uniquely positioned to partner with the care community. It is connected to several nursing homes. These customers try to develop a product in cooperation with Cordian to lower their costs in long term. This is a form of open innovation, because the actors share experiences, knowledge and other information, to support, to make the firm grow, and to profit from it eventually (Schell & Schellekens, 2013; Smit & Schellekens, 2013). Also, in the future it might be possible to introduce the BedLeave System to the GGZ (Dutch mental health care institution) and home care, and even prisons already show interest (Edelman, 2012).

Campus

Cordian has consciously decided to establish on the Campus instead of somewhere outside. It is more expensive to be located at the Campus, but it also gives a company a lot of benefits. The Campus has a high quality ICT network and offers a social network. It also makes collaboration more time-efficient. *"Basically, the Campus makes it really easy to drink a cup of coffee with one of the network partners. If a company establishes somewhere else this contact will be more difficult. In that case it takes much more time when partners want to discuss something. Making an appointment normally takes three weeks to plan, a person has to travel for the conversation, and the conversation itself may only take 20 minutes"*, according to Martijn Schellekens. One of the main benefits for Cordian is that the largest part of the network partners is located at the Campus, so this keeps the threshold low to approach others, and reduces the planning and traveling time. Cordian can just ask its partners to come along. At the Campus Cordian's employees also meet new contacts (accidentally), or they meet old colleagues who might have some valuable information to share. Eventually, this leads to a higher share of valuable information.
In short, on the Campus one can meet important new partners or speak with existing partners more often than outside the Campus.

The Campus contains two buildings of Brainport Development, that are not property of the Campus. In these two buildings many startups (with a maximum of 25 employees permitted) are settled down, because the rents are somewhat lower. However, the costs per m^2 are still much higher than outside the Campus. So, a starting spin-off should have very good reasons to locate at the Campus and to stay there (Smit & Schellekens, 2013).

Trust

Cordian's relationship with Philips is especially based on trust, the same background and the same interests. Trust makes it unnecessary to regulate every part of the cooperation with contracts. Cordian can be more open to Philips, compared to firms in Thailand for example. Perhaps, not all partnerships work the same as the one between Cordian and Philips. Firms without the same history

and with a longer distance between the offices, and thus with weaker contact, use contracts more often. So, firms with weaker ties need to collaborate at higher levels of formality. It shows that trust is an influential factors for the flexibility and strength of relationships, and partly determines the openess of a firm towards its partners (Smit & Schellekens, 2013).

6.1.4 Knowledge share

Cordian's core activity is to focus on internal R&D and initial sales. Cordian has fully absorbed Philips' technology and holds the IP of the BedLeave System. It has an own R&D department that allows development of new applications, working closely together with the care sector (van Erp, 2013). Even though the spin-off focuses on internal R&D, most knowledge still comes from elsewhere, especially from Philips.

There are different levels of formality in field of knowledge exchange. Some people have to be paid for to get knowledge from, others just want a cup of coffee to let them tell important new information. At the Campus especially the latter kind of formality prevails. That is an important advantage, especially for the smaller firms. Martijn Schellekens explains this with the following sentences: *"As a startup it is impossible to pay for every piece of information or provide all kinds of services to others to receive information in return, so informal knowledge exchange is crucial then. Outside the Campus the situation is quite different when firms meet each other for knowledge exchange. The higher level of formality is mostly used: hourly invoice, in Dutch called 'uurtje factuurtje', is the standard practice. On the Campus the exchange is more like a kind turn. The share of knowledge is higher and easier. However, this also depends on the kind of firm. It differs whether a startup asks for information or a large firm. If ASML approaches another Campus firm it has to pay for the information. For startups it is less difficult to get information for free. That is why the 'get-together' at the coffee machine is so important"*.

One of the main values of the High Tech Campus for Cordian is that its employees can just walk into most companies and try to get some interesting knowledge. According to Ron Schell (Cordian's area sales manager) the Campus is 'one big family'. Knowledge is exchanged informally, and shared for free or to reduced prices via formal ways with Cordian. So, the lower level of formality at the Campus is an important factor for survival of the young company. From these benefits it can be concluded that the combination of a close ecosystem and the use of open innovation are the main reasons why Cordian is situated at the Campus.
A disadvantage could be that many firms established on the Campus are startups or young firms and are still developing their (innovative) product. The fact that most of these products are still not a definite market success can cause shudder among the firms to use each other's knowledge.

Freek Smit: *"Back in the days only explicit IP was shared among firms, but before a firm could use this new knowledge, some years passed to find out how it exactly worked. The know-how, or tacit knowledge, was always missing. Nowadays, this know-how is shared to get products ready within a few months*". This knowledge is especially important in times of fast changing market demands where the product life cycles are very short. For Cordian the informal contacts at the coffee machines help a lot to receive tacit knowledge. This tacit knowledge is most important to the spin-off company, because it already possesses the explicit knowledge. With the right know-how Cordian can get the BLS to the market quickly. Support of the R&D unit with know-how from partners like Philips is a success factor for the spin-off. The larger the pressure to get something to the market quickly, the more important this know-how support (Smit & Schellekens, 2013).

Protection of knowledge

A firm cannot only receive information, but also has to offer something in return. A win-win situation has to be created between two parties. Partners should have an equivalent role in their partnership. Nevertheless, many business managements try to only receive information and avoid sharing information with others.

On the one hand, Cordian is a small company what makes it easier to get information cheaply, compared to larger Campus firms. On the other hand, for Cordian it is more difficult to be an open innovator due to its size. The startup firm really wants to be an open innovator, but cannot just share IP for free. Cordian receives relatively more knowledge than it gives away. In contrast, for large companies it can be easier to decide about what they grant to others and what they keep secret. However, if a company would open its business to everyone, meaning that the crowd could get any generated knowledge for free, it would not survive. There would be no secret knowledge, no patents, and no profit could be made. In reality such a phenomenon will never happen, because innovating is not interesting at all then. Although the Campus is characterized by a lower level of formality, business managers strictly monitor what formal information is shared with other firms, especially with large players. This seems to be in contrast with the perfect picture of the open innovation ecosystem, but it is impossible to be completely open to each other on the Campus of course. Therefore, agreements are made in practice about the use of open innovation. If firms team up, some clear agreements have to be made. In reality open innovation has quite much contractual agreements, because firms still want to see things on paper to be sure. This makes open innovation more formal than theory suggests. An example is the case of Holst Centre. Holst Centre has two big partners: IMEC and TNO. If Holst Centre invents something new, it is immediately decided which company gets the IP and which one patents the product.

For Cordian the informal use of open innovation is much more important on the Campus. Compared to the formal way of open innovation, it is more open, more flexible and less pragmatic, because it is impossible to put things on paper. In that case, IP can be used more openly.

When a firm grows and possesses more knowledge, it has to be more careful about which large partners to work with and what kind of information to give away. For Cordian this is (still) not a problem, since its only large partner is Philips at the moment. Also, Cordian's system is so unique, it even does not have any competitors yet, and thus, competition does still not hinder the openness of the firm. When the BLS becomes successful, perhaps there will be competition in this market segment. So, during the evolution of the spin-off company it probably has to be more careful about its use of open innovation. From older participating BSOs it has to be analyzed whether they have become more closed innovators in the course of time (Schell & Schellekens, 2013).

Size of the company

Freek Smit tells the following about the influence of the firm size: *"Many large innovating players always try to put as much as possible on paper and get most of the rights when they cooperate with smaller players. Therefore, small firms marginally benefit from the cooperation. A good example is the 'cooperation' of a spring manufacturer with ASML. ASML immediately took all the patents about the specific spring when the firms started to cooperate. Because of that, ASML is the only one that has the rights to that kind of spring. However, the spring manufacturer could also supply its springs to a lot of other companies, in case it kept the patents in private. As a small company it is a difficult process to keep the IP itself, since large companies have a lot of power. On the one hand, ASML has a lot of power to nail down such private spring manufacturers. On the other hand, the spring manufacturer wants a big charge to produce, so working for a large company can still be attractive"*. Despite of the attractiveness of producing for a large company, the openness of innovation

is blocked. For open innovation it should not be stimulated that suppliers only produce for one company. With open innovation the spring manufacturer should produce for many companies and use the spring not in a single way but find new applications of the product. This would enlarge the field of use and would have a higher effect on the innovative outcome (Smit & Schellekens, 2013).

6.1.5 Barriers

Cordian is in such an early phase, since it is a business for only half a year, that it is really difficult to make clear what the problems are per phase of the firm's life cycle. After one year, with a real product on the market, it is better describable what the pitfalls and/or challenges are for Cordian. In spite of that, some difficulties can already be mentioned.

The first problem for Cordian was formed during the spin out. The problem was how it could be possible to make responsible agreements, meaning that Cordian received the opportunity to startup as an independent business and that it did not have to ask Philips' permission for every single trifle. To get this freedom the agreement had to be financially attractive, meaning that the parent firm could profit from the spin-off too.

The biggest obstacle for Cordian was to receive enough startup capital. Luckily to Jan and Peter Nesvadba their followers invested the necessary amount of capital to start the business and gave them the opportunity to build up an installed base (van Erp, 2013). According to Freek Smit a big advantage for Cordian is that the BLS was already developed, tested and almost market ready when the spin-off started. "*This situation made it possible for Cordian to come up with a concrete product very quickly. Therefore, the spin-off became attractive to investors. In many cases startups need 2 to 3 years before they have developed a product for the market. Every year these startups need to receive investments from partners, even without making profits. The investors have to be kept interested in the concept. In gen-technology this is even more difficult. Every year millions of euro's have to be collected for R&D and many firms need 5 to 6 years for the development of a conceptual product.*

A future difficulty can be the step to scale up the business. Cordian wants to expand, but this is done carefully, step by step. The following quote explains why this has to be done so careful. *"As a small firm it is not wise to do everything at the same time; it is better to progressively build up the business. Controlling the growth process is important, because in every phase new problems arise"*, argues Martijn Schellekens.

At last, Freek Smit describes two barrier for firms situated at the Campus: *"If a Campus firm wants to increase its storage capacity, and wants more facilities when the business grows, the Campus might become too expensive. Locating somewhere else in Eindhoven would probably be a better option then. This will perhaps be a problem to Cordian in the future. Besides, it is impossible to set up a production unit on the Campus, because that is not allowed by certain environmental laws and settlements. That is why almost all of the companies focus on innovative R&D. In addition, this is not problematic for Cordian, since its production is outsourced"*.

6.2 Dimenco

Dimenco offers end-to-end 3D auto-stereoscopic solutions that include autostereoscopic 3D displays, components, software, content conversion and consultancy services for professional and consumer applications. Dimenco strives to become the leading 3D technology company in the world.

6.2.1 Origin

In 2009 Philips closed its incubator, called 3D Solutions, that developed a technique to experience 3D without glasses. In the end of 2010 Dimenco was founded to restart the incubator. The 4 founders: Tobias, van der Horst, de Jong and Böggemann, have all worked together at the former

venture of Philips that focused on 3D technology. After discontinuation of this venture they have taken the step to bundle their specific knowledge and start their own business spin-off. Dimenco started at the High Tech Campus 2,5 years ago, and is nowadays established on the industrial area of Veldhoven, very close to Eindhoven (Dimenco, 2013; Tobias, 2013).
Dimenco kept a close collaboration with Philips. In turn, Philips kept active in the technology development and created a patent portfolio for the 3D technologies. Dimenco supports Philips and also develops own technologies and products for the 3D market (Dimenco, 2013).

6.2.2 Parent firm

The relationship between Dimenco and Philips is more or less the same as between Cordian and Philips. Dimenco has enjoyed an excellent relationship with Philips and there exists a win-win situation between the two companies. Namely, Dimenco acquired a full 3D technology license from Philips, the spin-off has the certainty of a revenue guarantee, and it has access to a large network of customers and suppliers from Philips. In turn, the startup company develops technologies for the parent firm and keeps Philips' technological development up-to-date in the 3D market (Dimenco, 2013; Tobias, 2013).

Like the relationship between Cordian and Philips, Dimenco has a strong connection to Philips. This can be seen from the resources Dimenco gets and the openness of the firms to each other. Formerly, Philips was just a big customer of Dimenco, but that role has shifted towards a strategic partnership more and more, and today, Philips is the most important partner. The degree of openness between both firms is quiet high. Dimenco received knowledge from Philips in form of a license. Furthermore, Dimenco is supported with technologies, capital and access to a network of partners (Dimenco, 2013; Tobias, 2013). According to Maarten Tobias (one of the founders and CEO at Dimenco): *"It is a big advantage to start as a spin-off from Philips, compared to startups without a parent firm, or without a parent firm with such a recognized name".* Thus, both the support and reputation of the parent firm are of advantage to the spin-off company, which confirms Freek Smit's quote about it (section 8.1.2).

Dependency

Dimenco is still a very young company of only 2,5 years old, but compared to Cordian this firm is already much more independent of Philips. For example, Dimenco still obtains a lot of information from Philips, but it is not depending on the parent firm, because the core technology is produced in-house. It also tries to achieve its sales volume and financial goals more independent of Philips, so it is less reliant on financial support from the parent company (Tobias, 2013). Maarten Tobias argues: *"Dimenco is less dependent on Philips nowadays and this will even decrease. This should always be the case for a startup firm. It has to stay on its own feet when it grows older".*
Subsequently, he strengthens his argumentation about the indecency of Dimenco with the following words: *"The chance Philips will take over Dimenco is very small. Philips' interest is very low to do this, even while Dimenco's technology fits seamlessly and the collaboration works fine".*

6.2.3 Network

In case of Dimenco it was no problem at all to find the right partners due to the founders' background at Philips. Because of their background they could take over many partners and customers and they could build on that existing network. Also, being visible in the market helps a lot, such as making business trips and participation in events and shows (Tobias, 2013).

If a startup has created a recognized brand name it gets much easier to find new partners. The firm gets more credibility in the market and more people trust the company. This can also work the

other way around. When the reputation is bad, it can be more and more difficult to find new partners or customers (Tobias, 2013).

From day one, Dimenco has operated worldwide. The Dutch sales volume is only a very small percentage of the total sales volume of Dimenco. The firm is focused on the product sales in the Asian countries. In Asia it has implemented an high-volume manufacturing line to supply high-volume products and components to customers. The largest customers are MMD, ASML and TP Vision. Dimenco collaborates intensively on shared ambitions with a number of partners. Dimenco is always open to collaborate with capable companies that share the same vision: Companies with which it can (jointly) bring products and services to market with the highest conceivable quality. The most important partners are Philips, IP&S and Dolby 3D (Dimenco, 2013).
The core of the network did almost not change. Most customers are still in the network too. Besides, the network has been expanded since the start. There have only been some changes in the edges of the network, for example when customers or suppliers changed their plans and chose another direction (Tobias, 2013).

Having big players in the business network has advantages and disadvantages. According to Tobias (2013) the advantage is that the spin-off is seen as more credible with a better quality. The disadvantage is that large firms have a strong bargaining position.

Campus

At the point in time Dimenco started at the Campus, the few contacts it had were informal in particular. Conversations were started to help each other, and these sometimes transformed into full collaborations. At that moment the links changed into formal ties. Nowadays, Dimenco has remained two Campus partners (Tobias, 2013).

Dimenco was established on Campus due to the facilities it provides. Some of the available facilities were exactly needed at that moment. The main reason the startup located outside the Campus was caused by the high rental costs. Some other reasons for leaving the Campus were: 1) The high quality ICT network of the Campus was not crucial for Dimenco anymore, so it was no reason to stay there. 2) In opposite to Cordian, Dimenco perceives no difference in the way of communication between Campus and non-Campus firms. So, this was also no reason to stay at the Campus (Tobias, 2013).

Many technological companies in and around Eindhoven collaborate. They often develop new technologies together. Actually, it is one big open innovation region. The Campus is only a single part of it. Maarten Tobias understands the Campus wants to be positioned as the open innovation area, but if one looks at the large amount of high tech firms that are located outside the Campus, it is obvious that the Campus is not the only place open innovation is applied. Dimenco has a certain network in Eindhoven and they closely collaborate, but this is not the result of their establishment on the Campus.

The Campus does not have an open innovation atmosphere at all. Dimenco did almost not feel anything from it. Dimenco did not get into contact with other Campus firms easily. It was located in the Bèta-building, which is positioned as the building for startups. However, Dimenco had contact with only one firm in the Bèta-building. On the one hand, Dimenco did not take much initiative to get into contact and it did not just approach the neighbor startups for help. On the other hand, it was hardly approached by other startups. Moreover, Maarten experienced that the people on the Campus create open innovation, not the firms. The employees share knowledge and help each other, but this is less noticeable at the firm level (Tobias, 2013).

Trust

Trust is essential to a firm. Unfortunately, the core knowledge has to be secured in contracts, even when partners trust each other very well. In that case trust is just not enough; it gives a firm no guarantee, but contracts do so. In opposite, informal agreements and aspects outside the core business can be based on trust (Tobias, 2013).

6.2.4 Knowledge share

Dimenco applies open innovation itself, because it develops technologies in collaboration with other firms. If one works together in the high-tech industry, it might be possible that insights and knowledge are obtained from totally different fields that can be used for a firm's own technology development. Furthermore, Dimenco shares knowledge via informal ways, and also via licenses for example.

Especially knowhow flows in. When people start talking with each other for the first time knowledge is often shared for free. People call each other for example to get solutions to small problems. If this happens more often and it seems to be interesting to both parties to share more knowledge an collaboration may arise. This causes a shift from an informal relationship to a stronger, but formal relationship. In that case contracts get more important. So, next to the fact that open innovation leads to new knowledge, it also helps Dimenco to improve the networking process.

Dimenco works closely with Philips and uses several patents in field of 3D technologies from the parent firm. Dimenco obtains a lot of information from Philips, but it is not depending on the parent firm, because the core technology is produced in-house. Since it has all the necessary mastering and replication tools in-house, it can produce quickly, make adjustments and achieve an optimal end-result rapidly (Dimenco, 2013). The ratio internal/external obtained ideas is 80/20.

Protection of knowledge

On the one hand, Dimenco's business sells products, but it also develops technologies. Therefore, it publishes enough so people can see how intelligent the firm is and think they can use the knowledge Dimenco gives away, but Dimenco just publishes not enough so people still need the company and cannot develop technologies on their own.

One of the challenges for Dimenco is which knowledge to share with others and which not. The startup wants to prevent that people use its knowledge in market segments Dimenco is an active player in itself. That is why open innovation is especially important to firms that operate in a separated field but can use each other's technologies to grow. However, it keeps a big challenge what to share with every single partner. For example, Dimenco is much more careful in what to share with its Asian partner firms, compared to the Dutch partners. It is difficult to monitor what is done with the knowledge at the other side of the world; it is more difficult to trust that knowledge is not abused by the Asian firms. Dutch companies are easier to monitor and to control, and are often better known (Tobias, 2013). Due to the fact that Dimenco operates at a larger scale than Cordian it is a bit more closed. So, Dimenco uses open innovation, but it is really careful about whom to share what kind of knowledge with.

If a firm exists for a longer time, it starts to make better choices about collaborations. In the beginning Dimenco was more free and easier in forming new relationships, but today it has to consider much better which partners to work with and which ones not. Dimenco has also become more careful in what kind of knowledge and innovative ideas to share with others. The added value of sharing much knowledge is not as high anymore as it was in the first year. This actually means that the firm has become a bit more closed than before (Tobias, 2013).

Dimenco has a small patent portfolio for the core business. These patents are very important to the firm, because the firm is dependent on them (Tobias, 2013). However, Dimenco has an extensive licensing program that provides access to its peripheral know-how, patents and trademarks. In that way it shares knowledge with others formally. For example, some software is given away via Dimenco's website. The software is only a small piece of Dimenco's business, that is why they do not keep it secret. The free software makes the firm look like a pleasant firm that does not keep everything secret. Dimenco further has several Joint Development Programs (JDPs) with consumer electronics companies to build on extensive know-how.

Open innovation is important to search for innovations in the edge of the technology development which can be applicable to the core technology of the firm. So, in the core of the technology development, Dimenco does not use open innovation, only in the applied technologies. Maarten Tobias makes clear that firms should be very careful about the share of core technology: *"In case collaboration results in a better market position for both firms, open innovation can be a very attractive option, but firms have to be very cautious about sharing their core technology"*.

Size of the company

Maarten Tobias explains that it is very helpful to be a small firm when external knowledge has to flow in: *"Small firms are helped more easily than large firms. Firms often try to utilize and exploit larger firms, and this is less possible with smaller firms. For small firms it is quiet easy to get knowledge via an informal way. People often help startups with some extra knowledge or resources, like a kind turn".*

6.2.5 Barriers

First, making the right choices about investments is difficult. A firm has to decide where to put money and effort in, even when it does not know the outcome of it. Second, the quality of the product was a problem in the beginning. Especially when a firm works with new products and developments, and tries to put a certain quality level in the market. The quality of Dimenco's products was much lower in the beginning. Third, the organization of the firm itself gets harder when it starts to grow. Dimenco started with four people and had a simple overview of the business. When more people are employed, there will also be more organizational problems.

In short, the larger the firm grows, the more problems/challenges it gets. For Dimenco this was particularly caused by the quality of its products and the organizational aspect.

6.3 Phenom-World

Phenom-World, or Phenom, is a leading global supplier of desktop scanning electron microscopes and imaging solutions for submicron scale applications. Its SEM-based systems are used in a broad range of markets and applications.

6.3.1 Origin

The table top microscope is created within Philips Natlab on the Campus in 2002. This was commissioned by FEI Company. FEI used the technology of the microscope to turn it into a real product between 2002 and 2005. The first Phenom product hardware was presented to a small group at the Philips Research Centre at the High Tech Campus in Eindhoven in January 2005.
Together with many partners led by the NTS-group and Sioux, under the guidance of FEI product management and technical architects, the Phenom column concept was transformed into a market-focused product. With customer input as a guide, the result was the Phenom product launch in the Netherlands in October 2006. In the following three years FEI put much effort and time in the

development of a concept to a real product, but the company could not make it profitable unfortunately. That made FEI stop the project at the end of 2009. In that way Sioux and NTS lost their investments, and that made them decide to buy the technology from FEI and created Phenom. However, FEI kept a certain share in the spin-off.
Phenom started at the industrial Area of Eindhoven and has stayed there to this day. In 2010 a new strategic plan was created, including extra investments from the new owners. Since 2011, the business has become profitable. In that year Phenom made a profit of 4 million euro's. In 2012, this profit increased to 12 million euro's, and Emile Asselbergs (CEO at Phenom-World) expects that the profit will be 50 million euro's within a few years. Phenom's profits are partly reinvested in the development of the product. In that way better versions are developed to be sold by the distributors worldwide, especially in Asia (Asselbergs, 2013; Phenom-World, 2013).

6.3.2 Parent firm

The relationship between Phenom-World and its parent firms FEI Company, NTS Group and Sioux is of a different kind than Cordian's case, and is not optimal. The big question that always arises is who is going to pay for what and who is receiving what amount of money from the profits. The relationship with FEI is weaker than with the other owners, because FEI is a closed innovator and does every collaboration on basis of contracts. Nevertheless, the firms really need each other, and so, they keep close contact (Asselbergs, 2013.

Since two years, Phenom has left the first phase behind in which many startups fail. This is partly achieved through to the fact that Phenom was allowed to underpay its owners, otherwise the spin-off could not make it to succeed. Also, FEI kept a certain share in the spin-off (Asselbergs, 2013).

Phenom is almost completely independent of the parent firms nowadays, because it develops the core technology in-house and only receives the necessary peripheral knowledge, technologies and other resources from the parent firms. The independence will even increase during the time.

Theoretical it is possible FEI, NTS or Sioux takes over Phenom-World in the future. The decision whether or not and when is preserved to the shareholders. However, the chance this will be done is low.

6.3.3 Network

First of all, Emile Asselbergs clarifies the importance of networks to firms and links it to the use of open innovation. *"A successful idea is never devised in one single company, but is always arisen from the network of firms. Many firms want to take credits of the invention, but they actually invented altogether. If they had to find out something on their own they would not have made it"*. Emile couples the adage 'Success has many fathers' to this phenomenon. *"Networks are very important; ideas pop up much faster in an open innovation network compared to firms that keep their doors closed. That is the reason why the pizza-meetings are so important to our company"* (Asselbergs, 2013). This example already shows that open innovation is closely related to networks.

The network of partners has been very constant and stable during the time. Since the spin-off of Phenom not much changed in the network. The three owners have established the firm and are still the main partners.

Like the informal network of Cordian at the Campus, informal contacts helped Phenom-World to create a network. For example, Phenom has some good informal and non-contractual relationships with American suppliers. Furthermore, worth-of-mouth helps most in Phenom's case to find customers to buy the microscopes. Also, the brand is strengthened, for example by sponsoring the RoboCup in Eindhoven, to create more credibility and a better reputation in the market.

Phenom does not believe in contracts and other kinds of formal agreements. That takes a lot of time and money, which can be better invested in other occasions. In case of Phenom, maintaining the relationships with the distributors are the central activity, since selling products happens one on one with customers. Without the good relationships with the distributors worldwide, Phenom could have never been so successful.

Campus

Phenom has no contact with firms on the HTCE, only with some people working there (e.g. ex-colleagues). The spin-off innovates itself, has an own knowledge network, and has its product market in Asia. These are the reasons it has not many Dutch partners, and no partners located at the Campus. Although Phenom has never been established on the Campus, the firm agrees about the fact that physical proximity of partners is helpful. NTS is located in the same building, Sioux is located in the neighbor of Phenom, and some other small partners are situated in the neighbor or same building as Phenom. The relationship with FEI is weaker than with the other owners, because FEI is located further away, so contact with that firm does not take place regularly, and even diminishes (Asselbergs, 2013).

The environment Phenom established, is commercially not a good place to locate. However, it is cheap and easily accessible. Phenom has installed a fiber network that is of equal quality as the ICT-network on the HTCE. This cost 6000 euro's, but it was worth it, because the investment is paid back very quickly compared to the rent of a Campus building.

Emile Asselbergs would like to be established on the Campus, but it is too expensive and trucks are not allowed to get there. These are restrictions that make it impossible to locate at the HTCE. However, if Phenom receives guests they sometimes visit the Strip, because it provides more quality than the environment of Phenom's office. In the neighborhood of Phenom it is totally not attractive to have a diner with a client or a partner. The industrial environment is not representative, the Campus is. In this respect, the Campus has a great advantage.

Trust

Phenom does not cooperate with people it does not trust, because without trust collaboration is not possible. There has to be a certain click with the partners in particular, since they are spread all over the world.

Sometimes people collaborate out of necessity, even though there is not a good relationship between them. If these kind of 'partners' get into conflict about the business it will be very difficult to find a solution. Most often these conflicts end up in a lawsuit. Also, if firms cooperate out of necessity, one of the firms has less benefits than the other one. The former never stimulates the collaboration then. This blocks the progress of the collaboration and also the progress of a company itself.

Today, the spin-off does only work with partners with the same interest, nothing is necessity driven. Perhaps this will change in the future though, since the firm is growing fast and needs to deal more and more with its competitors (Asselbergs, 2013).

6.3.4 Knowledge share

Phenom is more like Cordian in the use of open innovation. Because of its size Phenom needs to be open towards other firms to get valuable knowledge in return. With open innovation firms share some knowledge, it is for free and it makes the companies faster innovators in the market. Phenom tries to be as open as possible to the network partners. The parent firms also have insight in its core business. *"As partners it should be able to walk into each other's buildings without an appointment. Open doors, flexible groups and business units, and the use of each other's knowledge without the need to ask permission, are belonging to open innovation. In an open innovation strategy a firm*

shares knowledge, so fear for others is absent", argues Emile Asselbergs. Phenom definitely is supporter of the open innovation strategy and clarifies it with the following example: *"If our parent company FEI would have been an open innovator, it definitely would have undercut its competitors. However, FEI is a closed innovator, and therefore, the competitors are still in the running".*

Phenom is more open than Dimenco and uses more knowledge from external parties. Because of that, the ratio internal/external obtained knowledge is 50/50 with a margin of 10%. Sometimes more internal knowledge is given away, sometimes more external knowledge is received (Asselbergs, 2013).

Phenom is helped by other players, but it also helps a young startup itself. Phenom shared experiences, technologies and ideas with the startup located in Delft, The Netherlands. In that way firms help each other growing. Phenom does not directly get something back from the startup, like profits, but it delivers new partnerships and a possible market for the future.

Protection of knowledge

When a firm gets successful and starts to grow, it is attacked with lawsuits by other competing firms. In opposite, a small firm is not seen as a threat and is more often helped by others. Phenom is growing fast and that is recognized by the competition in Japan. The increased competition will make it less possible for Phenom to use open innovation in the future, and it will have to protect its IP even better. Emile actually does not like the closed innovation strategy, but he also knows Phenom cannot stay as open as it is nowadays. Everything will be more formal and the doors will be more closed then. The position of the spin-off has to be protected more and more in the future, so staying completely open is not an option anymore (Asselbergs, 2013).

Phenom-World possesses one patent. It only needs to defend that IP and can focus on open innovation. In opposite, large firms have to protect their knowledge much better than small firms. That makes a portfolio of patents important to them; they can trade with it. For large firms it is more difficult to afford using open innovation. Phenom is too small to patent every piece of knowledge it creates or receives, so the startup firm is forced to apply an open innovation strategy (Asselbergs, 2013).

Size of the company

For small firms or startups it is more important to use open innovation. As a small firm it is simply not possible to pay partners for every hour they invest and share knowledge. Small firms more often receive information for free. In opposite, large, successful firms need to pay much more often if they want to get external knowledge. Even though Phenom invests a lot in internal R&D, it frequently receives new product insights at a reduced rate or even for free, because it only has a small group of people that develop internal knowledge and new products, and Phenom is not a threat to other firms. Not everything is invented by Phenom itself: It gets insights and free solutions to problems from suppliers, it hires people from outside the company and it exchanges information with external parties. At Phenom they also have 'pizza-meetings'; partners innovate together and help each other, even without directly benefiting from it. The startup company mentions it uses both tacit and explicit knowledge from external parties.

6.3.5 Barriers

On the one hand, a startup fails when no capital is available. On the other hand, in case a firm becomes successful it can fail due to the high production costs. Banks do not innovate that much, so a firm needs to find other ways to get its business funded. Phenom succeeded, but many startups do not receive the fund from any investor.

Another reason many startups fail is because of their technical background. Most technical persons

starting a business do not know how to sell a product. They may invent a great product, but if they cannot bring it to the market and sell it, it is a failure too. Emile Asselbergs status the following: *"About 80% of the Dutch SMEs operates in the Netherlands, but this reduces their chances enormously to succeed. These companies miss the world economy. Besides, many SMEs miss a good marketing and sales unit".* Phenom's market is located in Japan and China in particular. It develops and produces the products in Eindhoven, and sells them in Asia. If Phenom did not have the market over there, the firm would only have been 1/3 of its current size. This shows how important it is to have a world economy. Many small firms just need the guts to cross the Dutch borders. According to Emile, this is also a big problem with the small firms at the HTCE.

Problems differ per life stage of the company. In the early phase the main problem is a lack of startup capital. Later on, the problem is caused by the grow of the company. Grow leads to more business units and hierarchical levels within a firm (Asselbergs, 2013).

If a firm grows even bigger it becomes a threat to others, and they will attack the firm with lawsuits. That is the main problem of a growing, successful firm.

A weak part of a firm, like many Campus firms have, is that the R&D unit is far removed from the production unit. According to Emile, if R&D is not closely located to the production, a firm will not be successful. So, many firms on the Campus provide services, because production is not allowed. Phenom is successful, due to the fact that the production is done in the same building. Philips Natlab is demolished, because it was too far removed from its production, and production is something else than inventing. That is why Natlab has not been getting successful in long term; as a firm you should stay connected to your production. Philips learned a lesson from and has located its R&D partly in Asia nowadays, because the most of the production is done in that continent too.

6.4 Mutracx

Mutracx produces the first fully digital inner layer printer based on inkjet technology, called Lunaris. Lunaris is a truly disruptive technology, because contemporary methods of inner layer production have not changed significantly in over forty years. Mutracx has completely digitalized this process, and so, it replaces the lithography technology. Mutracx' primary focus is to revolutionize and dominate the Printed Circuit Board (PCB) market.

6.4.1 Origin

Mutracx spun out of Océ in December 2009, the first such spin-off from Océ's Inkjet Application Centre (IAC) in Eindhoven.

Mutracx is created because of two reasons. First, it is focused on a different market than its parent firm. If Mutracx would have been placed in a business unit, it would not have survived. Without the spin-off the technological development would have taken four times longer and perhaps it would have never been developed as far as it is nowadays. Second, an independent firm is much faster in decision making. In a large firm there are more than 100 people who can reject an idea. Decisions have to be assented by so many people that every decision takes a month to be made. In opposite, if Mutracx has to make a certain decision it can already be done in a few minutes.

Whilst it operates as a totally independent business, it has a strong and important relationship with Océ. Mutracx once started at the HTCE, but already left the places after 9 months to locate at the industrial area of Helmond, the Netherlands (Mutracx, 2013; Zwiers, 2013).

6.4.2 Parent firm

Compared to Cordian, Mutracx has another kind of relationship with its parent firm. Mutracx is focused on a different market than its parent firm. It only received a bridging finance from Océ that

was enough for 9 months since the start, but everything else is financed by third parties afterwards. Today, Mutracx has become a customer of Océ's products, but the parent firm treads the spin-off like it is a single department of the company. Océ becomes less influential and gets more into the supplier role. From the beginning it is meant that the parent firm develops a part of the technology for Mutracx, but Océ does not want to face the spin-off as an independent firm nowadays. This causes tension between both parties, and it puts pressure on their relationship (Zwiers, 2013).

Compared to Cordian, the amount and intensity of knowledge exchange is lower and more formal between Mutracx and Civolution and its parent firm. There is a lower degree of openness between them. However, all of these BSOs received financial support, and of course, they took over the technology that formed the fundament of their venture.

Océ manufactures the basic technology Mutracx uses. Mutracx could have never developed that technology for the PCB market without Océ's help. It depends on a project Océ invested 150 million euro's in. It is important to Océ that Mutracx runs well, because Mutracx is the supplier of applications based on technology developed by the parent firm. Also, Océ is shareholder in the spin-off company (Zwiers, 2013). Thus, a win-win situation exists between these firms.

It can be noticed that the relationship between the firms is not as the close as the one between Cordian and Philips. Henk Jan Zwiers (one of the founders and Managing Director at Mutracx), supports this view: *"In theory, it is always possible for Océ to repurchase the spin-off. In practice, Océ will not be more than a strategic partner in the PCB business"*.

Dependency

Mutracx develops the core technology in-house, and so, it is less dependent on the parent firm than Cordian is. Mutracx is customer of Océ's technologies and therefore dependent on the parent firm's product, but that is of a much lower level compared to the dependency of Cordian on Philips.

6.4.3 Network

Mutracx confirms Cordian's thoughts about the importance of the founders' background . The network is mainly based on contacts Mutracx already had from the past. Mutracx' founders all come from Océ, and Océ had a large supply base back in the days. Mutracx still knows this network of suppliers very well. The spin-off could immediately start using the network. Océ allows Mutracx to work with the same partners, because the two firms operate in another context (Zwiers, 2013). So, for Mutracx the fact that it started from Océ was not the biggest advantage, but the partners it already knew helped most for a successful startup.

Mutracx uses informal contacts to find the right people. Via different persons the necessary partners are found, and from then on, the knowledge exchange goes via formal ways. The most important development partners, some of them also active as co-investors, are Sioux, 3T, CCM, TMC, NTS Optel, Weideven and Dedinsco. The scope of Mutracx is changed during the time, what can be seen as the main cause of some network changes out of the core.

A firm is more often approached by others when it gets into a later stadium. The growth and recognized brand name stimulate this phenomenon. However, being more often approached does not mean these firms are necessarily competent in what they offer.

Zwiers (2013) argues that it is unimportant to have big players in the network. What helps is collaboration and a click between people, regardless of their firm size. *"Het moet goed boteren, net als een huwelijk"*, argues Henk Jan Zwiers.

Campus

Mutracx has never had close contact with any of the Campus firms, because they were too expensive to collaborate with. The spin-off did neither collaborate with firms nor with people working

on the Campus. This means that a firm like Mutracx does not need to be located at the HTCE for the informal network contacts. Mutracx just searches for the firms it needs to work with. It does not matter whether these are established on the Campus or not.

Océ was located at the Campus, and thus, after the start, Mutracx was established there too. However, Mutracx already left the place after a period of 9 months, because it was way too expensive to the startup. Henk Jan Zwiers' has shifted his loyalty away from the Campus: *"If a firm has enough money to spend, the Campus is an attractive place to locate, but not as a spin-off".* Furthermore, Mutracx can buy or rent the same facilities as the ones provided at the HTCE. So, the availability of a wide range of facilities was not a reason for Mutracx to stay at the Campus. Henk Jan Zwiers states: *"The Campus is an appropriate place for a good lunch, but that is it"*. Some other reasons for Mutracx to leave the Campus are: 1) the culture of the HTCE does not differ from the culture at other industrial areas. 2) The reputation of the Campus is great, but it does not directly help a firm to get successful. Producing a high quality product is much more important than counting on the Campus' reputation (Zwiers, 2013).

Henk Jan Zwiers confesses the words of Maarten Tobias. At the Campus open innovation is not more used than somewhere else in the region. Open innovation is about relationships between people, and these do not differ between Campus and non-Campus firms. If open innovation would really be as important to the Campus as it suggests, startups like Mutracx would have been offered a place on the Campus for free to become successful. Instead, the spin-off has to pay the full prize for an office.

Like Cordian and Phenom, Mutracx confirms that proximity of partners is important to a firm. The current location is chosen due to the fact that Mutracx had to locate close to NMA. NMA is the PCB manufacturer. Besides, Mutracx works with NCA and QPI, which are located nearby.

Trust

Trust is the most important aspect for the cooperation of parties. Investors, partners and customers have to trust the firm, otherwise it will not survive and succeed. If firms collaborate on a contractual base, but they do not trust each other, it will not work eventually. Henk Jan Zwiers clarifies this as follows: *"When Mutracx hits a bad run, partners still need to trust and support the firm"*.

6.4.4 Knowledge share

Compared to Cordian, Mutracx is less focused on the use of open innovation, because the company has had difficulties with ownership of the IP when products are invented and developed via open innovation. *"Open innovation is difficult when it comes to arguing about ownership of the ideas. Thus, if a product is created via open innovation, who will be the owner of the IP afterwards? Who has the right to apply the new technology when it is developed together with other parties? Open innovation is useful, but the main question is who pays for what. It takes effort to find solutions to these difficulties of open innovation"*, according to Henk Jan Zwiers.

Even though Mutracx is more closed to the outside world than the other described BSOs, open innovation brings benefits to the firm. According to Zwiers (2013) open innovation is cheaper than closed innovation in principle, what confirms the ideas of Cordian about open innovation and cost reduction. Due to intensive collaboration with partners Mutracx gets a better sense of low cost prices.

Mutracx often uses specific knowledge of external parties. Some knowledge is tremendously specialized, Mutracx even does not want to produce it internally. There is simply not enough work for such a very specific kind of knowledge. It would lead to higher costs, when someone was positioned to develop that knowledge internally. Also, specialized firms know much better what they are talking

about. Next to the inflow of this explicit knowledge, Mutracx also uses tacit knowledge from external parties.

Protection of knowledge

Mutracx does not share any core knowledge with others, also not with the parent firm. It only use open innovation in the applied technologies. Henk Jan states: *"Everything I pay for is my property".* Mutracx uses open innovation, but what the firm, investors and shareholders pay for in the development process, is property of the spin-off.
Formally, Mutracx almost never exchanges knowledge without any payment from one of the parties. In contrast, Mutracx sometimes shares knowledge via informal ways for free. For example, starting spin-offs visit Mutracx to ask questions about possible pitfalls a startup might encounter, or what strategies to take. Answers are given for free, in case the spin-off operates in a completely different market.

The core business of Mutracx is not outsourced, only the peripheral technologies. Henk Jan explains why some peripheral technology or knowledge just has to be outsourced: *"If a firm is unable to produce a certain technology, or if the technology is produced very cheap somewhere else, the firm should just buy it".*

Size of the company

Zwiers (2013) confirms that the accessibility of knowledge is an advantage to small firms. Although Mutracx always sealed of its (core) knowledge from the market domain, it has developed almost everything with external parties. The spin-off only started with four persons, so it was heavily reliant on other firms.

6.4.5 Barriers

Mutracx is still a non-revenue generating firm, and so, it needs large investments. It is difficult to find new investors repeatedly. Besides, it is hard to keep them optimistic about the future when Mutracx has to overcome some rebuffs. Mutracx enters the phase it cannot only survive with startup capital anymore; growth financing has become a necessity (Zwiers, 2013). Mutracx has been lucky investors keep interested in the startup. Due to the economic crisis, Henk Jan Zwiers thinks not many small firms can afford to innovate in the future anymore.

Another challenge is caused by the conservativeness of the PCB market. In the PCB market it is difficult to introduce new solutions. It is hard to get customers replace their machines by Mutracx' Lunaris. A firm like Mutracx really needs to show what quality and improvements it offers. Testimonials are needed to achieve that.

6.5 Civolution

Civolution is the world's leading provider of technology and solutions to help media content owners, right holders and distributors to better protect, manage and monetize their assets. Securing media content and setting innovative management systems has become paramount for all the players in the media eco-system. Therefore, Civolution uses two technologies: digital watermarking and fingerprinting. Both focus on two media types: audio and video, and so, there are four quadrants within Civolution. The products are services and software, no hardware is sold (van der Veen, 2012).

6.5.1 Origin

The origin of Civolution is in the former group Content Identification of Philips Research (hence the 'ci' in the name), that generated IP in field of watermarking since mid 1990s. The first watermarking activities that would be the basis for Civolution started within the Philips Research labs, and in the year 2000 the first commercialization activities took place. However, in the beginning of

this century, Philips decided, after repel of its professional audio- and video-activities, watermarking could not be a core activity anymore and would be better situated in Philips Technology Incubator. The research team received the opportunity to give it a try to set up a watermarking business. In 2006, Alex Terpstra (founder, owner and CEO at Civolution), quickly concluded a spin-off would be the best option to expand this technology; Philips had to be totally left aside.
In August 2008 and July 2009 Terpstra took over two other software companies. The takeover of the two other firms took some time and effort, but since the start of 2011 the company is very stable, with six establishments all over the world. The head office from Civolution is located at the HTCE since the start of the spin-off company. In Eindhoven, 35 employees are working on the fingerprinting and service platforms. In Rennes, France, all of the watermarking activities are concentrated and about 60 employees work on that technology. Furthermore, sales- and support-offices are located in London, New York, Los Angeles and Hong Kong with in total 150 employees (Civolution, 2013; Terpstra, 2013; van der Veen, 2012).

6.5.2 Parent firm

There is no way a big company like Philips can keep up with the rag-tag pirates on the internet, which might explain why the company has spun off its content watermarking business as Civolution. As a new and independent company, Civolution is well positioned to anticipate and respond to the needs of the dynamic market of the digital content industry. The spin-out allows Civolution the flexibility to take new strategic directions beyond the current scope of Philips and to focus fully on meeting market demands as they evolve (Maassen, 2008).

In opposite to the very close relationship between Philips and Cordian, Civolution has the weakest connection with its parent firm nowadays. Civolution received the opportunity to startup an own business, independent of Philips, but the connection between them would be completely broken then. There was little direct interest from Philips, because it took another market direction a few decades ago. That is the basis for the step Civolution took to spin out of Philips. Philips' activity is almost not noticeable in the market Civolution operates in. The relationship with Philips is only financial, and so, the parent firm does not support the BSO with knowledge, technologies or some other resources (Terpstra, 2013). Alex Terpstra reinforces the feeling of disconnection between the firms as follows: *"It is never excluded that Philips takes over our firm in the future. Years later parent companies perhaps change their strategy in direction of the venture. However, in Philips' case, the chance is very low, or even zero, this will ever happen"*.

In Civolution's case there was only financial help since the start of the spin-off. At moment of time Civolution became a spin-off, all formal connections with Philips were stopped and everything had to be done by the firm itself. In case Philips is not interested in the new venture, it permits the entrepreneurs to make some preparations for the moment the business spins out, but nothing more than that. So, there were no direct operational connections with Philips anymore from one day to another (Terpstra, 2013). Nowadays, Philips continues to support the venture through its partner position in a funding firm, called Prime Technology Ventures (PTV). Philips is only interested due to the efficiency of this venture capital fund (Maassen, 2008). Furthermore, Civolution and Philips sometimes meet, just because Philips is a customer of Civolution's products (Terpstra, 2013).

Dependency

Civolution is completely independent of its parent firm. This is mainly caused by the origin of the firm and partly by the fact that the firm is already such a large player in its industry. *"The first and most difficult obstacle for Civolution was to set up a complete own firm, including personnel, a financial system, working conditions, housing, etc. This had to be arranged quickly, before the startup could be an independent market operator. It is the toughest part of the startup phase"*, suggested Alex

Terpstra. Even though most of the interviewed firms are more or less independent of their parent firms, they still receive investments of them. Civolution is the most developed company and compared to the others, it is the only one that already speaks about independence of financial help. Terpstra wants to be independent of PTV's fund within a few years and wants Civolution to stand on its own feet then (Terpstra, 2013; van der Veen, 2012).

6.5.3 Network

Civolution took over some important partners from Philips legally when it spun off. Besides, it has some employees that formerly worked for Philips and sometimes speak with ex-colleagues. These informal ties might open doors to new markets. Unfortunately, this informal contact is decreased in the course of time (Terpstra, 2013).

Civolution has passed the startup phase of a spin-off, and nowadays it has a lot of partners and customers due to its interesting technology and recognized brand name. Civolution collaborates with firms that watermark content for film studios in Hollywood. Encoding partners are for example Rhozet and Digital Rappids. Civolution's clients are all over the world. Among Philips, some other big names are the European Commission, United Nations, Disney, Sony Picture Entertainment and Warner Bros. Compared to the other BSOs, Civolution has developed the most recognized brand name. This confirms that Civolution has made the furthest strides in the development of the interviewed firms.

For Civolution it is important to stay in a neutral position, because it delivers blocks in solutions and no end products. In every corner of its market Civolution has multiple partners and clients. It tries to prevent being too close with a certain actor, because that can hinder the cooperation with similar actors. A so called 'Switzerland-position' is strived for.

To be linked to large partners can both have advantages and disadvantages. Alex Terpstra explains this with the following words: *"As a startup it can be difficult to create a link with large players. Luckily, Civolution started as a small venture within Philips and that helped a lot in the development of the firm. If a venture can show off with a business card from Philips it is welcome to every company around the world"*. So first, Civolution tried to collaborate with the big players in the field, and after, the smaller ones were connected with.
Later on, Civolution profited from the fact that it was not covered by Philips anymore. *"Sometimes a small player, like this spin-off can be seen as a more attractive partner in opposite to a larger player, since the latter can also be threatening to others. Philips is seen as a large, powerful player and this is not always an advantage for the networking process in later phases of the spin-off's life cycle"*. Just like Cordian's network, most of Civolution's partners are SMEs. Since Civolution is still a SME itself, the company acts on the same level with its partners. The large companies are most often customers instead of partners (Terpstra, 2013). Due to the fact that these firms operate on the same level, and have equal power more or less, it is easier to apply an open innovation strategy.

Campus

For Civolution there are no differences between Campus and non-Campus firms. The firms on the Campus do not add value to Civolution's business, but the people on the Campus do so. People with different backgrounds and experience meet each other informally, easily and with a low threshold on the HTCE. That makes it enormous helpful when a firm has partners located at the Campus who operate in the same industry. Also, the openness of the Campus influences the workers and that is the power of the HTCE. The openness stimulates a certain way of thinking and working, even if the company has not much to do with other Campus firms.
Partnerships are important to most Campus-firms. Unfortunately, Civolution is operating in a completely different industry that has no other companies located at the HTCE, except Philips as one

of its customers (Civolution, 2013; Terpstra, 2013).
Civolution benefits from the pool of highly educated workers at the Campus, especially in the software development. Traditionally, there are many people working on the Campus (ex-Philips employees) who have a lot of knowledge in field of Civolution's business. One can meet people with the same mindset/opinions, or people that are mind opening. This pool of talent is interesting to Civolution. Besides, the Campus provides a high quality ICT network, good infrastructure, good facilities, sport activities, cultural aspects, etc. Besides, the Campus provides a high quality ICT network, good infrastructure, good facilities, sport activities, cultural aspects, etc. Together they are the basis of innovation on the Campus. However, qua firm contacts, the Campus does not offer any advantages to the spin-off (Terpstra, 2013). This confesses that the people on the Campus add value to the established firms, but not the firms themselves.

Trust

A large part of the network partners meet at marketing events. These events probably are the most important fundament of the network Civolution is taking part of. Almost every partner participate in the events. During an event a firm meets many customers and suppliers. It shared experiences, knowledge and information. In that way the industry feeds itself and stays innovative. The events lead to new partnerships, customer deals, new employees (for the future). Trust is important on such a days, because building on new contacts is mostly resulting from mutual trust.

6.5.4 Knowledge share

Civolution is 4,5 years older than Cordian, is already much bigger and operates on a larger scale, but it shares some similar thoughts about the usability of open innovation. Like Cordian, it consults and collaborates with partners earlier and more often in the development process of a certain product. Much more knowledge is shared among partners nowadays, compared to several decades before. This is also the result of the increased innovation speed firms need nowadays to survive in the market. The innovation cycle is faster and if a firm cannot be fast enough it will fail. The old model of closed innovation does not fit to the present innovation cycle at all. Openness is just necessary to create the speed to respond to market demands (Terpstra, 2013).

Sometimes, the firm shares (peripheral) knowledge via informal ways, for example by publishing an article or an interview, or by speaking on an event. In the last case, much knowledge is shared with researchers from the same industry. There is a lot of interaction on such an event. New external knowledge flows into the company, and some internal knowledge is given away for free then. This is done to stay closely connected to the network partners.

Qua knowledge acquisition Civolution looks the same as Mutracx. The firm develops most of the knowledge itself, since it has an own R&D unit. The firm invests a large amount of its revenues in R&D. Civolution is a development company at heart: The spin-off company had an R&D unit right from the start, and nothing had to be outsourced. The BSO has this capacity in house what stimulates the grow of the company, according to Terpstra (2013).
Civolution explicitly mentions it uses both tacit and explicit knowledge from external parties. Civolution is a software company which means that a lot of expertise is needed to develop qualitative software. Actually, that is the kind of knowledge a firm wants to anchor in the own organization, because it is needed every day, and so it is turned into internal knowledge by intensive use.
In case certain technological knowledge is only needed for a single time, the specific knowledge is brought in once and does not have to be anchored.

Protection of knowledge

Civolution is the largest and most developed business spin-off that is interviewed, and that can also be measured from Tobias' interview asnwers. The fact that Civolution is market leader makes the firm even more alert on competitors. As a result, the BSO is the closest innovator and does not directly share knowledge with others. Moreover, Civolution does not share any core knowledge with others, also not with the parent firm. It only uses open innovation in the applied technologies.

Civolution is a worldwide market leader and therefore it has to be extra careful about its IP portfolio. Formally, the firm does not directly share knowledge with other firms, only in the products it provides. Everything is captured into contracts. So, it does not give away licenses on IP without a product (Terpstra, 2013).

6.5.5 Barriers

The transition from Philips Research to Civolution was the biggest challenge for Alex in two ways. The first obstacle was to set up a complete own firm, including personnel, a financial system, working conditions, housing, etc. This had to be arranged quickly, before the startup could be an independent market operator. The second obstacle was that the spin-off suddenly was not part of the brand Philips anymore. It had to build up a recognized brand name and a good reputation itself. This activity is always underestimated. Civolution started with the creation of a recognized brand name since the first day of the spin-off, called corporate marketing. It prioritized a clear vision and business strategy. To get a high reputation and a recognized brand takes a lot of money, time and effort, and it even does not directly pay off. Corporate marketing pays back in long-term. Civolution invested hundreds of thousands per year to create a brand. After 2 to 3 years the marketing started to pay off: firms started to recognize Civolution and associate the spin-off with watermarks. So, branding is very important to a (new) firm. It results in a certain market position and firms do not link Civolution anymore to a startup from the middle of nowhere.

Thus, next to the technical development, investing in marketing is of high importance. Many startups underestimate this activity, put too less effort in, and mostly start from a technical angle. They often have invented a high tech product, develop it, and then try to bring it to the market. At time the product is ready for the market the firm starts with some marketing activities, but this is way too late. It causes a lag from the beginning. Most startups that fail, get stuck on this part of the firm's life cycle. So, they should start creating a recognized brand directly from the start, even when the product is still not optimal.

Another organizational problem is to find highly educated workers, employees who have the necessary competencies. There are many jobs in the region around the Campus, which sometimes is a disadvantage for the smaller firms located there. Big firms like ASML employ a large amount of employees, and as a consequence, there are not much qualified employees left for Civolution. That is why the search for suitable employees goes far beyond the Campus, and even beyond the Dutch borders (Terpstra, 2013).

6.6 Intermediate results: Comparison of BSOs

This section provides a comparison of the five different cases. In the analysis, similarities, patterns, and interpretations are only considered if based on data from at least three of the interviews. Besides, only the most remarkable differences between the BSOs are mentioned.

6.*6.1 Parent firm*

The interviewed BSOs started all from the same idea: the parent firm developed a technology, but this could not be made profitable, and as a consequence, a venture firm spun out. However, there

are big differences between the relationships of the parent firms with their spin-off companies. The relationships actually depend on the origin of the BSOs and are very context dependent.
The relationship between Dimenco and Philips is more or less the same as between Cordian and Philips: there is a win-win situation between the parent firm and the BSO. The relationship between Phenom-World and its parent firms is of a different kind and is not optimal. The firms are dependent on each other, and therefore, they keep close contact. Mutracx also has another kind of relationship with its parent firm. Océ does not want to face that Mutracx is an independent firm and that causes tension between both parties. In opposite to the very close relationship between Philips and Cordian, Civolution has the weakest connection with its parent firm nowadays. Civolution received the opportunity to startup an own business, but the connection with Philips would be completely broken.

Apart from Cordian, the BSOs all argued the parent firm will never take over the business spin-off in reality. The interest is simply too low. This confirms that Philips is closest with Cordian: the spin-off has a high potential and is most interesting to be taken over once.

In short, the differences in the origins of the BSOs are determinant for the kind of relationship with the parent firm. If the BSO goes in a completely different market direction, uninteresting to the parent firm, the spin-off cannot count on much help. In that case, the relationship is weaker with the parent firm, and open innovation is applied to a lesser extent between both firms. Since Philips is most interested and involved in Cordian's business, the relationship between them is the strongest and most open one of the five interviewed firms.

Support of parent firm

All parent firms are shareholder in their BSO, even if the startup company is irrelevant for their own business, or if the relationship between both firm is weak. However, it can be noticed that the better the relationship with the parent firm, the more support the BSO can count on and the more open both firms are to each other.

There is a high level of open innovation between Philips and its spin-off company Cordian. Next to the share of knowledge and capital, Philips supplies technology, and provides commercial and administrative resources. Besides, its reputation strengthens Cordian's brand. So, for Cordian it is really helpful to be a spin-off from Philips. Like the relationship between Cordian and Philips, Dimenco has a strong connection to Philips. This can be seen from the resources Dimenco gets. Further, the support and reputation of the parent firm are of advantage to the spin-off company, confirming the case of Cordian. Unless the weaker relationship of Phenom with NTS, Sioux and FEI, the firm is quiet open to them. As a result, it received the needed technologies, knowledge and financial support. Compared to Cordian, the amount and intensity of knowledge exchange is lower and more formal between Mutracx and Civolution and their parent firms. There is a lower degree of openness between them. Both of these BSOs received financial support though, and of course, they took over the technology that formed the fundament of their venture.

For the BSOs from Philips, a pattern can be considered. In case Philips is not interested in the new venture, it permits the entrepreneurs to make some preparations for the moment the business spins out, but nothing more. This is in contrast to the great support Cordian receives from Philips, and so, it can be seen from the amount of help that the parent firm is most interested in Cordian's business.

Independence of parent firm

Cordian argues it will be more independent of its parent firm when it gets older. From the other interviewed BSOs it can be assumed that the startup company will be less reliant on its parent firm when it starts to grow and become successful. The biggest difference between Cordian and the

other BSOs is that Cordian still receives core knowledge from its parent firm, the others already develop that kind of knowledge on their own.

Dimenco, Phenom and Mutracx are still very young companies, but compared to Cordian they are already much more independent of their parent firm. These spin-offs develop the core technology in-house and only receive the necessary peripheral knowledge, technologies and other resources from their parent firm. The oldest interviewed BSO, Civolution, is completely independent of its parent firm. This is mainly caused by the origin of the firm and partly by the fact that the firm is already such a large player in its industry. Even though most of the interviewed firms are more or less independent of their parent firms, they still receive investments of them. Civolution is the only one that already speaks about independence of financial help.

From these findings a red line can be recognized in the evolution of the BSOs. When the startup company grows and gets more successful, the external knowledge acquisition from the parent firm is reduced, because the BSO will increase its level of internal R&D. This can have two different consequences for the use of open innovation between both firms. On the one hand, when the BSO is less dependent on external knowledge, open innovation between the parent firm and its spin-off company will decrease. On the other hand, a higher level of internal R&D increases the absorptive capacity, and from theory it can be seen that this stimulates the use of open innovation. For the interviewed BSOs the first consequence counts, because their parent firm contact decreased. Later on in the life cycle, the BSO will not only be less dependent on the parent firm's knowledge, it will also be less reliant on investments done by the parent firm in all probability.

6.6.2 Network

For Cordian it was not difficult to build up a large network. Since the spin out, Cordian has remained in close contact with Philips and can use a large part of the formal network. Cordian's employees have kept good informal relationships within the parent firm. Also, the high reputation of Philips indirectly helped to find partners, the spin-off company was attractive for new partners in itself and the informal Campus contacts were very useful. Some of these aspects also helped the other interviewed BSOs to build up a business network.

Like the informal network of Cordian at the Campus, informal contacts helped all of the other interviewed BSOs to create a network. Unless some of the other BSOs could (hardly) not use their parent firm's network anymore in a formal way, the informal contacts within the parent firm have been important to all of them. So, all firms agree that their background and collaboration with the parent firm are very important for the startup of the BSO. The parent firm can directly provide potential network partners, and the parent firm's reputation helps to be attractive to others. Further, the BSOs confirm that the startup's own reputation, or recognized brand name, makes it much easier to find new partners. The firm gets more credibility in the market and more people trust the company. Compared to the other BSOs, Civolution has developed the most recognized brand name.

Also, the interviewees of the BSOs agree about the importance of trust. Trust is an influential factor for the flexibility and strength of relationships, and partly determine the openess of a firm towards its partners. Trust can be seen as a prerequisite to be open to each other.

Cordian has build on a large network of partners, most of them SMEs. The young spin-off company is very careful about collaborating with big players. It only has Philips as a large partner. From interviews with the other BSOs it can be stated that having big players in the business network has one advantage and many disadvantages.

The advantage is that the spin-off is seen as more credible with a better quality. The disadvantage is that large firms have a strong bargaining position. They have a lot of power and can put pressure on

smaller firms to achieve what they want. Therefore, BSOs should be cautious when they start to collaborate with large market players. Also, cooperation with larger players can be demotivating for BSOs to use open innovation. Sometimes a small player, like this spin-off can be seen as a more attractive partner in opposite to a larger player. Just like Cordian's network, the other interviewed BSOs mainly have SMEs as partners. Due to the fact that these firms operate on the same level, it is easier to apply an open innovation strategy.

In short, large companies can contribute to the reputation of a BSO, but they can also limit the openness of the BSO's business. From the interviewed spin-offs it can be measured that collaboration (with equal SMEs) is more important than a recognized brand name eventually.

6.6.3 Campus

Freek Smit argued Cordian will be less reliant on the Campus when the firm gets older and more successful. Since the other interviewed BSOs are older, larger and have less or even no formal partners on the HTCE, it can be noticed that they are independent of the Campus. Nevertheless, the informal contacts at the Campus appear to be important for these firms, except for Mutracx.

The business spin-offs agree about the fact that physical proximity of partners is useful; it is absolutely helpful when a Campus firm has partners located at the Campus who operate in the same industry. It stimulates partners to be more open to each other. Nevertheless, compared to Cordian, the other interviewed BSOs are much more critical about the open innovation atmosphere that should represent the Campus. There is agreement about the fact that the Campus firms do not add value to the interviewed BSOs, in case they are no partners. Qua firm contact there is no difference between Campus and non-Campus firms. At the Campus open innovation is not more used than somewhere else in the region. Many technological companies in and around Eindhoven collaborate. The Campus is only a single part of it. However, the people on the Campus make the difference. On the Campus the possibility is much higher that employees of different firms meet (accidentally) and exchange some valuable knowledge, and the threshold is low to approach other people with different backgrounds and experience for an informal meeting.
So, in a formal way, the Campus firms do not share significant more knowledge compared to firms outside the Campus. The informal use of open innovation is most important on the Campus. This means that the people working on the HTCE stimulate the use of open innovation in the ecosystem, not the situated firms.

Even though the Campus is very expensive, the Campus is important for the startup and survival of Cordian. The combination of a close network and the (informal) use of open innovation are the main reasons why Cordian is situated at the Campus. The spin-off meets new partners, and speaks with existing partners more often than outside the Campus. Nowadays it is beneficial to Cordian to be located at the HTCE, but this may change in the future. When the startup company wants to grow, the Campus might be too expensive.
The other BSOs all agree with the statement that establishment on the Campus is much more expensive than outside, and so, Dimenco, Phenom and Mutracx could not afford to situate/stay there. Some other reasons for leaving the Campus were: 1) the high quality ICT network and wide range of facilities were not crucial (anymore) to situate/stay at the Campus, 2) in opposite to Cordian, the other BSOs perceived no difference in the culture and the way of communication between Campus and non-Campus firms, 3) trucks and production are not allowed on the HTCE, and 4) the reputation of the Campus is great, but it does not directly help a firm to get successful.
For Civolution it was still beneficial enough to locate at the HTCE, because 1) the firm benefits from the pool of highly educated workers at the Campus, and 2) the Campus provides more quality than many other industrial areas (e.g. high quality ICT network, good infrastructure, good facilities and

sport activities). However, qua firm contacts, the Campus does not offer any advantages to the spin-off, what confesses the findings of the previous paragraph. Only the people on the Campus add value to each other's firms.

6.6.4 Knowledge share

The open innovation strategy is beneficial to Cordian, because the firm can use a variety of people, knowledge and resources from outside the company, what eventually reduces the costs. Cordian also shares some internal knowledge with partners. All other interviewed firms use open innovation too. One has a higher degree of openness than another, but all BSOs perceive some important advantages of the strategy.

Next to the fact that open innovation leads to new insights and knowledge, it also helps to improve a firm's networking process. Further, open innovation is cheaper than closed innovation in principle, what confirms the ideas of Cordian about open innovation and cost reduction. Open innovation makes a firm consult and collaborate with partners (and customers) earlier in the development process of a product, what makes the product fit better to the market demands. Finally, the old model of closed innovation does not fit to the fast innovation cycle of today. Openness is just necessary to create the speed to respond to market demands.

In reality open innovation has quite much contractual agreements. However, that is the case when firms start a formal collaboration. According to Cordian, the informal use of open innovation is more suitable. The lower level of formality at the Campus is an important factor for survival of this young company. The other BSOs most often apply open innovation at the lower level of formality too. Formally, the BSOs almost never exchange knowledge without any payment from one of the parties. Cordian and Phenom are really open to other firms and prefer to collaborate, but they do hardly give away any core knowledge. They only share their core business with the parent firms, because these firms still produces a lot of their knowledge. Dimenco, Mutracx and Civolution do not share any core knowledge with others, even not with their parent firm. They only use open innovation in the applied technologies.

So, the most important knowledge exchange goes via formal ways and is captured into contracts or licenses, but the firms also share some peripheral knowledge via informal ways. In contrast, this knowledge is most often shared for free. Open innovation is especially important to firms that operate in a separated field but can use each other's technologies to grow. If one works together in the high-tech industry, it might be possible that insights and knowledge are obtained from totally different fields that can be used for a firm's own technology development. In such a situation there is no competition, what makes it easier to use open innovation.

<u>Knowledge protection</u>

All of the interviewees acknowledge it keeps a big challenge what to share with every single partner. In the beginning a BSO can be free in forming new relationships, but when the firm starts to grow it has to consider much better which partners to work with and which ones not. The BSO also needs to become more careful in what kind of knowledge and innovative ideas to share with others, and so, it will probably become a bit more closed than before.

Due to the fact that Dimenco operates at a larger scale than Cordian it is a bit more closed. Dimenco uses open innovation, but it is really careful about whom to share what kind of knowledge with. Phenom is more like Cordian in the use of open innovation. Because of its size Phenom needs to be open towards other firms to get valuable knowledge in return. Phenom is more open than Dimenco, Mutracx and Civolution, and uses more knowledge from external parties. Even though Mutracx and Civolution are more closed to the outside world than the other BSOs, open innovation brings benefits that make the strategy an attractive option for both firms to make use of.

Cordian needs to protect one patent only, and so, it can use open innovation for the rest of its business. However, that single patent forms the core of the business, so it is highly important to protect. The other BSOS confirm the importance of IP protection.
Dimenco, and especially Phenom, are more or less the same in their way of thinking about IP protection in combination with open innovation. Both firms have a small patent portfolio for the core business. They only needs to defend a few patents and can focus on open innovation. In opposite, larger firms like Civolution have to protect more knowledge than small firms. That makes a portfolio of patents important to them, because they can trade with. For large firms it is more difficult to afford using open innovation, and so, Civolution has to be extra careful about its IP portfolio. Formally, the firm does not directly share knowledge with other firms, only in the products it provides.

Competition does still not hinder the openness of Cordian. When the starting spin-off becomes more successful, competition will probably increase. So, during the evolution of the spin-off company it has to be more careful about its use of open innovation. Also, when Cordian grows and possesses more knowledge, it has to be more careful about which partners to work with and what kind of information to give away. The other business spin-offs confirm this phenomenon.
When a firm gets successful and starts to grow, it is attacked with lawsuits by competing firms. In opposite, a small firm is not seen as a threat and is more often helped by others. The increased competition will make it difficult to keep on using open innovation on an equal level. Also, the firm will have to protect its IP even better. Everything will be more formal and the doors will be more closed. Civolution is the largest and most developed business spin-off that is interviewed, and that can also be measured from the interview asnwers. The fact that Civolution is market leader makes the firm even more alert on competitors. As a result, this interviewed BSO is the less-opened innovator.

Knowledge acquisition

Cordian focuses on internal R&D, but most knowledge still comes from elsewhere, especially from Philips. Dimenco and Phenom obtain a lot of information from their parent firms, but the spin-off companies are not depending on them, because the core technology is produced in-house. Mutracx looks more like Civolution: More knowledge is produced in-house, compared to Dimenco and Phenom. Both firms have a larger R&D unit, and so they are less reliant on external knowledge.

For Cordian it is less difficult to get information for free, compared to larger firms. Therefore, it is easier for the small spin-off company to get external information than to give internal knowledge away. Although the other firms are much more driven by internal R&D, they confirm that it is less difficult for startups to have access to external information for free. For small firms or startups it is more important to use open innovation. As a small firm it is simply not possible to pay partners for every hour they invest and share knowledge. In opposite, large, successful firms need to pay much more often if they want to get external knowledge.

For Cordian and Dimenco obtainment of tacit knowledge is most important, because they already possess the necessary explicit knowledge. Phenom, Mutracx and Civolution explicitly mention they use both tacit and explicit knowledge from external parties, and so, it cannot be concluded from the interviews that one of the two kinds of knowledge obtainment is more important for the startup and survival of BSOs.

6.6.5 Barriers

Even though the problems and challenges BSOs encounter differ widely, some of them seem to count for every business spin-off in a certain life stage.
First, in the earliest phase of the firm financial funding is the most difficult aspect. In this phase most firms fail. Luckily to all the interviewed firms they could raise enough fund to survive. One of the

reasons startups fail is caused by an absence of capital.
Second, the larger the firm grows, the more challenges it gets. One of the challenges that seems to count for all BSOs, except Cordian, is the organizational aspect of the firm. The organization of the firm itself gets harder when it starts to grow and when more employees are needed. When the BSO grows, there will be more business units and hierarchical levels within a firm, otherwise the overview of the firm will probably be lost. Another organizational problem is to find highly educated workers.
A third reason for the failure of many startups, not mentioned by Smit & Schellekens (2013), is the fact that many starting high tech BSOs are only focused on developing a good product. They do not know how to deal with marketing. Besides the technical development, investing in marketing is of high importance too. If this does not happen, startups mostly cannot capture a market piece. At the moment the product is ready for the market many BSOs start their marketing activities, but this is way too late. They should start creating a recognized brand directly from the start, even when the product is still not optimal. Therefore, branding is very important to a new BSOs.

6.7 Conclusion

This chapter tested every part of the conceptual model: it was analyzed how important the indirect success factors are and how they are related to each other (part 1), what the direct success factors are (part 2), and which factors the use of open innovation influence (part 3). Open innovation was the core of this analysis. It was tried to find the link between the use of open innovation and the other parts of the conceptual model. This provides an answer to the third sub-question of my study.

- *To what extent have the critical factors and determinants of open innovation been important for BSOs (on the High Tech Campus Eindhoven)?*

There are big differences between the relationships of the parent firms with their spin-off companies. The differences in the origins of the BSOs determine the kind of relationship with the parent firm. If the BSO goes in a different market direction, uninteresting to the parent firm, the spin-off cannot count on much help. In that case, the relationship is weaker with the parent, and open innovation is applied to a lesser extent between them. In opposite, the better the relationship with the parent firm, the more support the BSO can count on and the more open both firms are to each other. This finding confirm the propositions made in the literature background.
The BSOs argue generation of startup capital is the most difficult aspect of the startup phase. Financial funding by the parent firm and by third parties is necessary for every BSO. The parent firms also share knowledge, technology, and commercial and administrative resources with some of them. Besides, the good reputation of the parent firm strengthens the spin-off's market position, confirming the conceptual model.
For the BSOs from Philips, a pattern can be considered. In case Philips is not interested in the new venture, it permits the entrepreneurs to make some preparations for the moment the business spins out, but nothing more. This is in contrast to the great support Cordian receives from Philips, and so, it can be seen from the amount of help that the parent firm is most interested in Cordian's business. A high level of support increases the survival chances of course, but it is not directly decisive for the startup and survival of the BSO. Civolution proved it is possible to become a market leader with only a marginal amount of help from the parent firm.

When BSOs grow the relative inflow of external knowledge decreases relatively, because they will increase their level of internal R&D. The external knowledge acquisition from the parent firm is reduced, and as a consequence, the startup will be less reliant on its parent when it starts to grow and becomes successful. In turn, open innovation between the parent firm and its spin-off will decrease. This is a new empirical point, since it could not be proven from the literature background whether an

increase in internal R&D would strengthen or loosen the relationship between the BSO and the parent firm. Furthermore, when a BSO grows even bigger it will also be less reliant on the parent firm's investments in all probability. This findings was not covered by the literature yet.

The background at the parent firms, the collaboration with them, and the informal contacts, helped all of the interviewed BSOs to create a network. The parent firm can directly provide potential network partners, and its reputation helps the young companies to be attractive to others. These findings confirm the literature background of this study. Further, the BSOs confirm that the startup's own reputation makes it much easier to find new partners. The firm gets more credibility in the market and more people trust the company. Trust is important to the firms, because it can be seen as prerequisite for the use of open innovation. To achieve this, marketing (branding) is of high importance too. The factors 'own reputation' and 'branding' are new empirical points and should be added to the existing factors of the conceptual model.
Large companies can contribute to the reputation of a BSO, but they can also limit the openness of the BSO's business. As young BSOs need to work on their reputation and need to be open to others, collaboration with big firms has advantages and disadvantages. Eventually, the interviewed spin-offs attach more importance to collaboration (with equal sized SMEs) than to a recognized brand name. The latter is a surprising result and means that the conceptual model should be revised, since it suggests that big partners should be included in the own business network.

In general, when a Campus-located BSO starts to grow, it will be less reliant on the Campus. This confirms the propositions made in the literature background about the relevance of an ecosystem to growing BSOs. Nevertheless, the informal contacts at the Campus appear to be important for most BSOs at the Campus or in the neighbor of. Formally, the Campus firms do not share significant more knowledge compared to firms outside the Campus, but the informal use of open innovation is most important on the Campus. This finding is not covered by the conceptual model. People working on the HTCE stimulate the use of open innovation in the ecosystem. Further, physical proximity of partners is beneficial: It leads to higher efficiency and stimulates partners to be more open to each other, confessing the findings of chapter 6.
Meanwhile, the BSOs all agree with the statement that establishment on the Campus is much more expensive than outside. As starting BSOs most often face a scarcity of startup capital, it creates a barrier to locate there.

Open innovation can be beneficial to BSOs for the following reasons: 1) a firm can use a variety of people, knowledge and resources from outside the company, 2) it helps to improve a firm's networking process, 3) it is cheaper than closed innovation in principle, 4) open innovation can make a product fit better to the market, and 5) openness makes a firm faster to respond to market demands. The factors 1,2 and 3 confirm the conceptual mode, factors 4 and 5 are new and should be added.

The BSOs most often apply open innovation at the lower level of formality. So, open innovation is used via informal ways in particular. Further, the spin-off companies only use open innovation in the applied technologies. No core knowledge is shared with others (except the parent firm). These empirical findings were uncovered before in the model, and so, they should be added to the list of existing factors that influence the use of open innovation.
Open innovation is most useful with firms that operate in a separated field and use each other's technologies to grow. In such a situation there is no competition, what makes it easier to make use of the open innovation strategy. A higher level of competition makes it difficult to keep on using open innovation to the same extent. The factor 'competition' was already taken into account in the conceptual model, and is confessed by this empirical evidence.

During the evolution, the spin-off company has to be more careful about the use of open innovation. In the beginning a BSO can be free in forming new relationships, but when the firm starts to grow it has to consider much better which partners to work with and which ones not. The BSO also needs to become more careful in what kind of knowledge and innovative ideas to share with others, and so, it will be more closed than before. This statement was already made in the literature background of open innovation; the empirical findings confirm it.

Further, the BSOs confirm the importance of IP protection. IP is important to every firm, whether it is a small or a large one. The difference is that small firms, like young BSOs only need to defend one or a few patents and can focus on open innovation. Larger BSOs like Civolution need to protect more patents and have to keep the doors more closed. These empirical findings mostly overlap with the existing factors of the conceptual model: protection of IP is important, but it can also hinder the openness between firms. Furthermore, it is less difficult for startups to have access to external information for free, and so, it is especially important for small BSOs, such as Cordian, to use open innovation. This is an interesting outcome, as theory could not make clear whether small firms should apply the open innovation strategy or not.

It cannot be concluded from the interviews that the inflow of tacit knowledge is more important than explicit knowledge for the startup and survival of BSOs., what contradicts the theoretical suggestions.

Finally, the organization of the firm itself is not a big challenge in the early phase of a BSO. This will be more difficult when the firm starts to grow and expand, and more employees are needed. More units will be created within the BSO, what diminishes the transparency of the firm. Eventually, this can make the management decide to limit the use of open innovation. This is a new empirical point and should be added to the conceptual model.

Conclusion

Chapter 7. Summary & conclusions

7. Summary & conclusions

This concluding chapter consists of four sections. In the first section the main research question, '*How important is the use of open innovation (in terms of knowledge exchange), for the survival and success of business spin-offs in the high tech industry?*', is answered, and the main conclusions are formulated. In the second section, the implications of this research are discussed. In the third section the reflections on rigor and relevance and the limitations of the research are discussed. The final section provides several suggestions for future research.

7.1 Answers to the research question

The aim of this study was to find out what the critical factors are for BSOs to survive and succeed (on the HTCE), and what specific role open innovation plays. Therefore, four sub-questions were defined in section 1.2. Three of them are already answered in the previous chapters. To be able to answer the general research question, the fourth sub-question should be answered first:

- *What kind of conclusions can be drawn for survival strategies of BSOs, including the use of open innovation, based on this study?*

The answer to this sub-question is divided into three parts. First, the critical factors important for the survival of BSOs are mentioned. Second, the benefits and pitfalls of open innovation are discussed. Third, it is explained how the critical factors are related to the use of open innovation.

7.1.1 Critical factors for high tech BSOs

Whether a business spin-off uses the open innovation strategy or not, the startup firm always needs some critical factors to survive. The factors that influence the survival and success of BSOs can actually be split up into two groups: indirect and direct success factors. Without the indirect factors most of the direct factors are not obtainable.
Also, some critical factors, found in the literature background, are mentioned in this section, even though they are not explicitly mentioned by the interviewees. This is only done when researchers already pointed out that these factors are indispensable for the startup of a BSO in general.

Based on the theoretical and empirical analysis, the most important direct success factors are: skills and experience (via background at parent firm), a high reputation, absorptive capacity, adaptation to partners' demands, internal R&D, exchange and protection of IP, access to technologies, access to external tacit and explicit knowledge, startup capital, human capital and marketing channels.

A point of information should be made about three of these direct factors. First, the startup's own recognized brand name makes it much easier to find new partners. With a high reputation, the firm gets more credibility in the market and more people trust the company. To achieve a high reputation, the firm needs to invest time and effort in marketing, branding in particular. Second, from the empirical analysis it is argued that firms adapt to each other's demands within a growing number of partnerships. This is more or less the same as 'ability to synthesize activities with partners', what was already incorporated into the conceptual model. Third, it cannot be concluded from the interviews that the inflow of tacit knowledge is more important than explicit knowledge for the startup and survival of BSOs. This rejects the findings from the theoretical background.

The most important indirect success factors are: use of open innovation, parent firm's support and collaboration, and the way in which it is related to the BSO, use of the parent firm's network, an own business network and establishment on a high tech ecosystem.

To clarify, the parent firm and its network are most important in the early phase of the BSO, since the startup company still needs to widen its personal network. The parent firm does not only

support the spin-off with capital and knowledge, its reputation strengthens the BSO's brand too. Theory could not prove so far whether the importance of the parent firm and its network changes during the evolution of the BSO. The case studies showed that the parent firm and its network get less important during the evolution of the BSO. The spin-off company is able to stand on its own feet and can rely on an own business network over time. The own network should be based on trustful relationships with many different partners, including investors.

From the interviews it can be noticed that large players are not needed to survive. They can contribute to the reputation of a BSO, but they can also limit the openness. Instead, collaboration with firms of equal size (SMEs) is more important to BSOs. This contradicts the theory in which it was suggested that large players are needed to survive. Equal sized partners are just more suitable to work with. Informal networks are important for the existence of BSOs, mainly to avoid high expenditures. A spin-off should invest time and effort to build up an informal network, because proximity of firms, collocation and shared facilities are not enough to create such a links. So, there should be a high level of social interaction. Moreover, informal contacts are important to build up a formal business network. During the startup phase, informal network ties are more important than formal network ties, because informal ties lead to a higher degree of trustworthiness among firms. Strong and repeated ties are expected to induce shared interests that invite future collaboration and information sharing. Trust should be captured into these relationships to benefit from the network externalities.

Further, as young BSOs miss the benefits of economies of scale and finances to survive without collaboration., it can be argued that an area in which proximity and collaboration of firms is high, is an attractive place for business spin-offs to establish. However, base on the the case studies it can be concluded that the importance of establishment on an ecosystem decreases over time. When the BSO grows, it gets less dependent on the facilities, resources and network contacts an ecosystem offers. So, the value of local ties decreases when the firm scales up the business.

Only for BSOs at the HTCE

Establishment on the HTCE is not enough in itself to reap the benefits from this hotspot. So, 'being part of a high tech ecosystem', written down in the conceptual model, was way too simple. Several additions should be made. Some of them are not generelizable for every BSO, but they only count for BSOs located at the HTCE. For example, a good connection to Philips is highly important, because facilities are cheaper, knowledge can be acquired faster and more easily, and the network of the HTCE can be used more intensive. Without a connection to Philips it is rather difficult to get access to personal networks. The informal network and the efficiency of knowledge brokers evidence how a similar background and trust feeling exiting at relationships is fundamental to the development of effective knowledge flows at the Campus. A generality could be that BSOs, established in ecosystems, should always be connected to the anchor firm of that hotspot. However, only the Campus is used in my research, so this cannot be proven.

Due to the specific focus on the HTCE, some more factors cannot be generalized, and are only valid for BSOs situated in that area. It is important for BSOs on the Campus to have face-to-face contact with their partners, since this type of contact is most important to seek and search for knowledge and transfer tacit knowledge. The ICT network should be used to transfer explicit knowledge.

Also, the Campus' reputation was an important reason for many firms entering the HTCE, and in turn, these new residents also appropriated from the ecosystem's reputation. This is especially beneficial for small companies, because they can sell that they have access to high tech facilities. The firm is seen as more reliable by potential customers, partners and investors.

7.1.2 Benefits and pitfalls of open innovation to high tech BSOs

Based on the theoretical background of business spin-offs, open innovation is much more beneficial to them than closed innovation, at least in the beginning. Open innovation is cheaper than closed innovation, since costs can be divided between collaborating parties. The amount of internally created ideas is marginal among BSOs, and therefore, use of external knowledge can be extra helpful. Open innovation leads to the inflow of knowledge, technologies and IP, mainly in the peripheral activities of the spin-off firm. Moreover, the interviewees made clear that not only technological knowledge is obtained from external parties, managerial knowledge is also absorped for example. Openness also helps to improve a firm's networking process. Further, a BSO can use open innovation to rescue false negatives, share risks and uncertainties with some partners, and stay specialized in their specific business. Furthermore, open innovation can speed the development and market launch of new products, improve the success rate of new products, and fill in gaps within the BSO's own road map. One of the reasons, not incorporated into the conceptual model, is that open innovation makes a spin-off company consult and collaborate with partners (and customers) earlier in the development process of a product, what makes the product fit better to the market demands. Also, BSOs from the high tech industry often come up with radical innovations, and so, it appears to be more interesting to them to apply the open innovation strategy.

Openness can cause difficulties to the ownership of IP. With open innovation the use of others' IP is less difficult, but a pitfall can be that IP should be shared more often with use of this strategy. For BSOs it appears to be more difficult to share IP themselves, since they most often have a single/few patent(s) only. So, open innovation can be benefical to BSOs for the flow-in of IP, but it can also be more disadvantageous than closed innovation when the startup firm needs to share knowledge itself. With use of open innovation, there might be the risk that BSOs too heavily rely on external partners. This can be seen as another pitfall of open innovation. So, BSOs should develop internal knowledge to be not totally dependent on external sources. The spin-off companies also need to be careful whom to collaborate with, to reduce knowledge leakages and improve their reputation. In addition, spillover effects occur broadly across industries, but they are accelerated within close geographical locations, especially in combination with open innovation. On the one hand, this helps BSOs located in an ecosystem to receive external knowledge more easily. On the other hand, it should make them aware of a greater risk on knowledge leakages.

Finally, open innovation influences a great part of the direct factors. One could argue that even more factors are stimulated by open innovation, like employment of qualified mancraft and obtainment of startup capital. However, these factors are indirectly influenced by the use of open innovation. To clarify, openness makes it easier for a BSO to build up a business network, and as a consequence, the probability to find qualified people and startup capital increases.

7.1.3 Relationship between critical factors and open innovation

At first, it has to be mentioned that no direct relation exists between stimulance/hindrance of open innovation and the succes rate of the firm; every BSO has its own optimal degree of openness.

The external indirect success factors stimulate the use of open innovation, what confirms the findings of the theoretical part of this study. Support of the parent firm, use of the parent firm's network, an own business network and establishment on a knowledge-based business ecosystem stimulate a spin-off firm to be more open.

Differences in the origins of the BSOs are determinant for the kind of relationship with the parent firm, and therefore, they indirectly determine the openness between both firms. If the BSO is uninteresting to the parent firm, the spin-off cannot count on much help. In that case, the relationship is weaker with the parent firm, and open innovation is applied to a lesser extent between both firms.

The startup company will be less reliant on its parent firm when it starts to grow and become successful. The external knowledge acquisition from the parent firm is reduced, because the BSO will increase its level of internal R&D. As a consequence, open innovation between the parent firm and spin-off will be reduced more and more.
Also, the firm's own network is very influential for the openness of the BSO. A business spin-off will be more open to partners when the level of trust is high. Trust is important for spin-off companies to be open and is best attainable via intense interaction with local partners. Therefore, physical proximity, collocation and shared facilities can also be considered as stimulators of the open innovation strategy.

Some direct success factors also influence the use of open innovation. The ones that stimulate openness of the BSO are: absorptive capacity and adaptation to partners' demands.
Usually, the absorptive capacity positively affects a spin-off's ability to exploit the opportunities presented in external relations. However, information exchange is hindered when the parties have differential levels of absorptive capacity. This can hinder the co-operation between firms. So, absorptive capacity does not always directly stimulate the use of open innovation.

The direct success factors that hinder BSOs to be open are: internal R&D and protection of IP. When BSOs grow the level of internal R&D increases. This increases the absorptive capacity, and thus, it can indirectly stimulate the use of open innovation. It can also limit the use of open innovation directly, because the inflow of external knowledge is no priority anymore. From the empirical findings it can be stated that internal R&D limits the openness of the BSO.
From the literature background it could be read that a bilateral relation exists between open innovation and IP share. The two are engaged with advantages and disadvantages. The case studies showed that the tension between openness and protection exists on the intersection of open innovation and IP. IP should exist to preserve the value of the knowledge, but it must not restrict the knowledge sharing in the 'open' innovation network. Even though IP is shared to a larger extent with the open innovation strategy, it can be concluded that IP protection still blocks the use of open innovation for BSOs.

Besides, some other factors influence the openness of the firms. The ones that stimulate business spin-offs to be open are: high (R&D) costs, lack of a track record, transparency of the firm and partners' businesses, short innovation and product life cycles, uncertain market demands, scarcity of resources (startup capital in particular) and technological complexity.
The high R&D costs form the most important reason, but not the only one, that makes a firm use the open innovation strategy. As example, the high rent at the Campus can also make a BSO decide to collaborate with others to share some costs at other fronts.
When the BSO grows, the organization of the firm gets more complex. There will probably be more business units within the BSO, what diminishes the transparency of the firm. Eventually, this can make the management decide to limit the use of open innovation. So, the higher the transparency within the firm, the more open the firm can be.

The factors that block the firms to be open are: knowledge gap, knowledge leakage, value of shared knowledge, size and power of the BSO, competition, big partners and the level of formality. Important for the openness of the firm, is the value of the knowledge shared with others. Core knowledge is almost never given away. Open innovation is not important to such kind of exchanges. In case peripheral knowledge is shared, open innovation is much more important, especially when the exchange goes via informal ways.
Furthermore, the size of the BSO is of influence on the openness of other firms towards the company and it influences the openness of the company itself. To clarify, it is less difficult for startups to have access to external information for free. Second, for small firms or startups it is more important to use open innovation. Small firms, like young BSOs, only need to defend one or a few patents and can

focus on open innovation. Larger BSOs need to protect more patents and have to keep the doors more closed.
When the firm starts to grow it has to consider much better which partners to work with and which ones not. The BSO also needs to become more careful in what kind of knowledge and innovative ideas to share with others, and so, it will probably become more closed than before. Competition plays a large role in the openness of a BSO. Open innovation is especially important to firms that operate in a separated field but can use each other's technologies to grow. In such a situation there is no competition, what makes it easier to use open innovation. A higher level of competition makes it difficult to keep on using open innovation to the same extent.
The size and power of the partner determine the openness of the business spin-off to some extent. Large companies can contribute to the reputation of a BSO, but they can also limit the openness of the BSO's business. Collaboration with equal sized partners, thus SMEs, is regarded as more comfortable to apply the open innovation strategy to.
Informal network contacts are most important during the early phase of BSOs and therefore the informal use of open innovation is more suitable than the formal way. So, the higher the level of formality between partners, the more closed the firms are.

Only for BSOs at the HTCE

First, the high costs of establishment on the Campus seem to be the biggest obstacle for BSOs to locate there. However, for BSOs that are located at the Campus it might be extra motivational to apply an open innovation strategy to share resources and lower the costs.
Second, IP is observed to create barriers to the implementation of open innovation at the Campus, confessing the general conclusions drawn from this paragraph.
Third, a shared vision, identity or common direction would be in favor of the open innovation atmosphere at the Campus. In addition, higher independence of the Campus from Philips is a positive step being taken towards open innovation.
Further, people working on the HTCE stimulate the use of open innovation in the ecosystem, mainly by informal interaction. Physical proximity of the spin-off company and Campus partners is beneficial, because it leads to higher efficiency and stimulates the firms to be more open to each other, confirming the general findings about physical proximity.
Lastly, there is a high level of interrelatedness between Philips, the HTCE and open innovation. On the one hand, a good connection to Philips is necessary to make better use of the informal network at the Campus. Via the informal network knowledge can be acquired faster and more easily. This means that Philips helps firms to receive new knowledge. On the other hand, Philips determines to some extent whether firms can use the informal network or not. At the Campus, open innovation is mostly used via informal network contacts, and so, the Campus would be more open if it was less dependent on Philips. It can be concluded that, these days a BSO should still be connected to Philips to make better use of open innovation on the High Tech Campus Eindhoven.

7.1.4 Answer to the general research question

- *'How important is the use of open innovation (in terms of knowledge exchange), for the survival and success of business spin-offs in the high tech industry?*

Based on the empirical part of this study it can be stated that open innovation is really helpful to BSOs, but the strategy has some more pitfalls and difficulties than theory actually described. The strategy is restricted to more rules and agreements than one would think of.
Nevertheless, it is a very useful strategy for starting spin-off companies, especially in their early years with scarcity of startup capital, knowledge and other resources. Open innovation offers some advantages, and most of them overlap with the theoretical success factors. Besides, some remarkable contradictions and some patterns not covered by previous literature have been found too (see previous paragraphs).

To confirm the theoretical proposal, open innovation is a factor that can definitely add value to BSOs on a wide front, but it is not the most important success factor, given that its use depends on availability of the indirect external success factors. Without them open innovation would not make sense. From the empirical analysis it can be concluded that parent firm's support and building up an own network are the most important indirect success factors for a starting BSO. The network is the fundament of the open innovation method. Further, being part of a high tech ecosystem can be helpful in the beginning, especially in combination with the use of open innovation.

The use of open innovation also works the other way around. When the BSO is more open, it seems less difficult to build up good relationships and get the right technology, explicit and tacit knowledge, and other resources via the parent firm and the network. This shows that the interrelation is high between open innovation and the other indirect success factors.
As these factors are strongly related to open innovation, the method is especially important in the startup period of the firm. If the firm starts to grow some factors will become more important than others. As a consequence, the relation with reference to the usability of open innovation will also change. To clarify, the parent firm and the ecosystem get less important and the personal network grows. The usefulness of informal ties decreases, and formal ties get more important. Also, competition increases, even as the protection of knowledge and IP. These important changes during the evolution of the business spin-off, make the firm become more closed than before. It further shows that the application of open innovation is a very dynamic process.
Altogether, the role of open innovation will change over time and the importance of this strategy to BSOs will decrease (to some extent), in all probability.

<u>Only for BSOs at the HTCE</u>

From theory it could not be made clear how important the HTCE is for BSOs during their evolution process. The empirical analysis showed that, in a formal way, the Campus firms do not share significant more knowledge compared to firms outside the Campus. However, the HTCE stimulates the amount of informal relationships of business spin-offs with other companies. The informal use of open innovation is most important on the Campus. This means that the people working on the HTCE stimulate the use of open innovation in the ecosystem, not the situated firms.
In short, spin-offs located at the High Tech Campus might even more often use and benefit from open innovation than BSOs outside this area, but only via informal ways.

7.2 Implications for high tech BSOs

My research findings have a twofold role: they fill in the existing theoretical gap, and they can help improve the strategies of business spin-offs by means of a managerial policy.

7.2.1 Theoretical implications

In short, the research findings are used to extend and adjust existing literature on topic of business spin-offs in combination with open innovation. To clarify, literature is extended, because new critical factors can be added to the conceptual model (e.g. the level of formality), and new insights are added to our knowledge about BSOs and open innovation (e.g. open innovation is used to a lower extend when the BSO grows). Literature is adjusted, because some empirical outcomes contradicted the existing literature (e.g. SMEs are more important than big partners for the survival of the BSO), or were slightly different (e.g. tacit knowledge is not more important than explicit knowledge in the early life stage).

The graduation study taught us more about strategies of business spin-offs to survive and succeed in the high tech sector and gave us deeper insight in the value of open innovation. Very little was known about the role of open innovation and networking in the strategies that high tech BSOs apply in the early life stage (e.g. open innovation supports the development of a business network). It is made clear how important open innovation can be to starting BSOs and how this method is related to other critical factors needed to survive (e.g. the interrelatedness is high between open innovation and the other indirect success factors). Also, the research has build on our knowledge about the value of the HTCE (e.g. shared facilities and physical proximity are very helpful), and the usefulness of open innovation in that area (e.g. informally, open innovation is used to a higher extent than outside). Further, this study can be seen as a first step in research about the combination of the two concepts. Section 8.4 shows that some follow-up studies can be thought of both to deepen and to extent our knowledge about this specific topic.

7.2.2 Policy implications

In short, the findings function as a starting point for further development and improvement of management and strategy of young BSOs, in particular with regard to open innovation issues.

Although the number of Dutch spin-off firms started each year is low, the failing rate among these startups with potential is still too high for several reasons. This could also be noticed from the BSOs searched for in the empirical part of this study. Appendix A shows that three BSOs were already bankrupt after a few years on the market. In order to help the firms overcoming their problems, business managers should use this research findings to improve the strategies applied in the early life stage (e.g. how to deal with the parent firm, competition, and IP). However, the report does not exactly show what to do in every situation, because the findings are context dependent and rely on a good interpretation of the managers themselves. To clarify, open innovation is very important during the startup phase of a BSO to increase the survival chances, but later on, the firm should get more closed. Nevertheless, when it is profitable for a growing BSO to stay as open as in the early life stage, for whatever reason, this should be done of course. So, except for the outcomes only concerning the HTCE, the conclusions and suggestions should be seen as a guideline for the Dutch BSOs. In addition, it would have been best when entrepreneurs read this report before they spun out their business. Then they could use the suggestions to strengthen their BSO, especially when they start to operate at the HTCE. For example, they would have known that it is unnecessary to collaborate with large companies, that investments in marketing should be done right from the start, that they should begin with the creation of an informal network, and in case they situate at the Campus they should be connected to Philips. For young BSOs in the Dutch HTSM sector this report could make clear that

they need someone with network capabilities who should be responsible for the open innovation activities of the firm.
From another viewpoint, this report could be used by the parent firms. In case they have a good relationship with their spin-off company, they could use the findings to better support the startup firm. When a parent firm actively helps to increase the success rate of his BSOs, it can also increase its reputation. A win-win situation will be the result.
The research outcomes should also be implicated by Dutch policy makers, such as the Campus managers. Since open innovation is very helpful for startups, they should write policy to promote and stimulate the use of this method among these kind of firms. For example, initiatives should be taken by policy makers to bring BSOs together (at the Campus) and let them share their ideas and collaborate, just to increase their chances to survive and succeed in the high tech industry.

Hence, a contribution of this report is to emphasize the problems and solutions, specifically focused on the use of open innovation, that have to be taken into account by the BSO, parent firm or even other policy makers considering the ambitions in the HTSM sector. So, this report could guide them in better supporting Dutch high tech business spin-offs.

7.3 Limitations

The method that was used has some clear shortcomings, which are dealt with as far as possible. Some problems could not have been prevented though. These are described below.

At first, limitation is caused by the fact that studies are typically static in nature and focus upon the link at a single point in time. Different phases of a venture's development may be characterized by different distinctive resources, institutional links and business models. In other words, the study was not longitudinal, which prevents uncovering changes in the situation. I could only ask them how open innovation created value in a sustained way during the time. It would have been better to follow a BSO for a while and observe how open innovation creates value from the startup till maturity for example. Due to time restrictions it was not possible.
This limitation was partially overcome by gaining new information from the data sources, and by reconsidering the findings, after a short period of time, regarding a selected number of events and routines.

The second limitation is related to the generalization of the research outcomes. For the scientific value of this study and the strength of the managerial implications it is important that this study can provide some general findings. However, the research was conducted in a single business ecosystem, with a small population of BSOs that met the selection criteria for this study. It decreases the generalizability, or external validity, of the outcomes and conclusions for other high tech ecosystems. For this instance the generalization is limited, because less cases were studied so that the implementation of the outcomes cannot be easily applied in other ecosystems. For a more general conclusion, it would be useful to study other (Dutch) business ecosystems, which will also increase the sample size of BSOs. In turn, a larger sample size will increase the generalization of the findings in the study. In addition, to increase the external validity the results of this research should be used in managerial practice and then compared with findings from other comparable studies.
The use of a protocol, shown in appendix D, should make it possible to repeat the exact same research in a similar or different context and get mainly the same results. Therefore, it is argued that the qualitative reliability of this study is quite good.
Readers of this case study research can judge whether or not the analysis presented sounds convincing, based upon what they know of similar situations and circumstances. If the findings can 'ring through' in other settings, the generalization of my study is strengthened.

Third, as a startup/SME on the Campus, it seems to be inevitable to survive without belonging to Philips, and so, it appears to be easier for spin-offs from Philips to achieve a business network than for non-spin-offs. The limitation is that no BSOs with another parent firm at the Campus were able to join the research. So, I only got evidence from the two Campus-firms that have Philips as parent firm. My conclusions would have been more powerful and reliable if the data set included findings from a BSO at the Campus with another parent firm.

Fourth, considering the qualitative validity the most important problem is the bias that the research may have brought to this study; all the findings are based on the interpretation of the researcher. The findings are not based on exact facts, but on relative interpretations of the interviews and documents. Some findings are, therefore, more trustworthy than other findings.
Moreover, there might be some bias in the information the interviewees provided me due to their backgrounds. The empirical results are mainly based on the truth as know by the interviewees. For example, the interviewees' opinions about the HTCE could clearly be related to their own experience with that area. One was very negative about the Campus, because the place had been too expensive in the past, the other was very positive because he dreamed of being established there. Altogether, this shows that the case studies are interpretation sensitive.
In order to make the project more formal, and at the same time improve the qualitative validity, it was required that formal methods were included, such as logical models. A literature review, a conceptual model and case studies were used in this research, which indicated the level of formalization is high.

Finally, another challenge with use of case studies, that could have led to a bias, is that there is too much data for easy analysis. When case studies are successful in revealing some of the complexities of social or educational situations, there is often a problem of representation. In other words, the complexity examined is difficult to represent simply. It was difficult to present accessible and realistic pictures of that complexity in writing.

7.4 Future research

First of all, more BSOs should be tested on the factors that I found to increase the internal validity. To increase the external validity the results of this research should be compared with findings from other comparable studies. This means that copies of this study should be executed with different BSOs in different ecosystems.

Due to the construction of a revised model (see appendix F), a follow-up study can be done, in which the factors that I already considered as critical can be tested more specified and with more depth. The factors do not have to be explored anymore, and so, the focus of the study can be on the relationship between the factors, including the use of open innovation. It can be seen as a shift from the exploratory research that I did, to an explanatory study.
Also, to come up with some hard data about this topic, a quantitative study could be executed. This study could show how important the success factors and the different determinants of open innovation are to the spin-off's performance and/or growth rate. To date, no study has linked these categories and performances. Hence, a new challenge for future research is to build a taxonomy able to highlight the differences in the performances of BSOs with diverse characteristics and strategies.

Further, this report focused explicitly on the early phase of BSOs. A follow-up study could be interesting to find out more about the importance of open innovation in the later life stages of a firm.

Finally, as could be seen from this study, the most difficult aspect concerning the use of open innovation is how to deal with the intellectual property rights. There is always the challenge of what knowledge to give away and what to keep secret. Teece (1989) adds that the effectiveness of

protective property rights strongly contributes to the value creation potential of innovations. So, how open should a firm be to achieve maximum profitability? The implicit discussion of protection vs. knowledge leakage becomes an even more challenging topic. It would be really interesting to learn more about this specific field of open innovation research.

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Appendix A: List of BSOs and parent firms (suitable firms are green)

Company name	Since	Location	Parent firm	Suitable	Participation
Cordian	2012	HTCE	Philips	Yes	Yes
Civolution	2008	HTCE	Philips	Yes	Yes
BICHEM	2010	HTCE	BIOeCON	Yes	No, lack of time
Sapiens	2011	HTCE	Philips	Yes	No, secret information and lack of time
Intrinsic-ID	2008	HTCE	Philips	Yes	No, not interested
Priv-ID	2008	HTCE	Philips	Yes	No, not interested
ASML	1984	HTCE	Philips	No, too old and too large	No, unsuitable
Silicon Hive	2003	HTCE	Philips	No, too old and too large	No, unsuitable
IRex Technologies	2006	HTCE	Philips	No, too old and bankrupt	No, unsuitable
Polymer Vision	2005	HTCE	Philips	No, too old and bankrupt	No, unsuitable
Miortech	2006	HTCE	Liquavista	No, too old	No, unsuitable
Dimenco	2010	Veldhoven	Philips	Yes	Yes
Phenom-World	2009	Eindhoven	FEI Company	Yes	Yes
Mutracx	2009	Helmond	Océ	Yes	Yes
Liquavista	2006	Eindhoven	Philips	No, too old	No, unsuitable
Shapeways	2007	Eindhoven	Philips	No, too old	No, unsuitable
Serious Toys	2008	Den Bosch	Philips	No, bankrupt	No, unsuitable

Company name	Location	Number of employees	Suitable
Philips	HTCE	> 100.000	Yes
Océ	Den Bosch	> 10.000	Yes
FEI Company	Eindhoven	> 1000	Yes
Liquavista	Eindhoven	< 100	No
BIOeCON	Hoevelaken	< 100	No

Appendix B: List of participants' interview data

Company	Interviewee(s)	Function	Date	Duration	Conversation
cordian	Freek Smit (1) & Martijn Schellekens (2)	(1) IP Manager (2) Senior Scientist	16-07-2013	77 min. 34 sec.	Face-to-face
civolution	Alex Terpstra	Founder, owner and CEO	06-08-2013	52 min. 48 sec.	Face-to-face
PHENOMWORLD	Emile Asselbergs	CEO	09-08-2013	63 min. 39 sec.	Face-to-face
DIMENCO	Maarten Tobias	One of the founders and CEO	17-08-2013	49 min. 55 sec.	By phone
mutracx	Henk Jan Zwiers	Founder and Managing Director	25-09-2013	47 min. 14 sec.	Face-to-face

Appendix C: Interviewees' backgrounds

Cordian

Freek Smit has an IP background and worked as Patent Counsel at Philips from 1978 till 2006. He worked for the Vereenigde as a Patent Attorney from 2006 till 2011. He has also been working for the spin-off Polymer Vision for a while. Since October 2012, Freek is the IP manager at Cordian.

Martijn Schellekens has a research background at Philips Electronics. There he worked as a Senior Scientist from 2007 till January 2013. From then on he works as a Senior Scientist at Cordian. Together with a specialized R&D team he investigates and develops new product possibilities. For this investigation they use small research projects.

Civolution

Alex Terpstra led the creation of Civolution as a spin-out from Philips in 2008 and subsequently executed two acquisitions for Civolution: Teletrax in 2008 and Thomson STS in 2009. After initially working in the television content production industry, Terpstra built his professional career further at Philips. From the early 1990s Terpstra was involved in the digitalization of television broadcasting and held various managerial positions in project and product management, sales, marketing and business development. In 2003 he was appointed General Manager of Philips' conditional access business CryptoWorks. In January 2007 he was appointed CEO of the Philips Content Identification with the assignment to accelerate its growth, which led to the spin-out as a standalone company Civolution, in 2008. In his role as an industry thought-leader, Terpstra is a frequent speaker at key global events.

Phenom-World

Emile Asselbergs was Development Engineer at Philips in the period 1984-1992. After that, he was the Sales specialist UK at Philips from 1995 till1998. In 1998 he made the switch to FEI. He worked there as the Engineering Manager in Hillsboro till 2001, as R&D Manager TEM in Acht from 2001-2003, and as the Manager Advanced Products at FEI Electron Optics from 2003-2006. He ended his career at FEI in 2006 and started to work both at NTS Group and NTS Optel B.V. as the Managing Director till 2010. Furthermore, Emile became the Managing Director at NTS Systence in 2009-2010. Afterwards, he made a new shift from NTS to Phenom-World. Since 2011, he is Phenom-World's CEO. Moreover, Emile is not the owner of the firm, but he is a CEO employed by the Ltd.

Dimenco

Maarten Tobias, born in 1979, studied Strategic Management at the University of Tilburg. In 2006 he started his career at Philips Electronics and had different positions, under which Global Business Development and Sales manager at Philips 3D solutions and Senior Strategist at Philips TV. He was one of the founders of Dimenco and is CEO of the spin-off company.

Mutracx

Henk Jan Zwiers (Managing Director) joined the Lunaris project in 2008 after a long and successful career within Océ Technologies R&D department. He has extensive experience within the product innovation arena and has a long and proven record in new product development, including Océ's CrystalPoint Technology. A strong innovator and product architect, Henk Jan has over 25 years proven development and engineering record of which the last 10 years is inkjet related.

Appendix D: Interview [spin-off]: Open innovation

High-tech spin-offs are important companies, because they often capture a piece of market with progressive, innovative ideas, or even create new markets. It is unknown what exactly stimulates the growth of these spin-offs and what kind of barriers they encounter on the High Tech Campus Eindhoven. Since the Campus strives for open innovation, this seems to be an important aspect of the strategy firms use. This raised the following question: which advantages and/or disadvantages are delivered by the Campus' open innovation 'atmosphere' to the business spin-offs located there?

I would like to ask you several questions to get a better understanding of your company and to answer my research question eventually.
Do you mind if I record the interview so I can write out the answers and analyze them in detail? If certain answers are not allowed to be published in my thesis report please let me know. Furthermore, I will send you the transcription of this interview afterwards so you can check everything and decide whether to agree with the content or not.

Introduction

1. Can you shortly explain the origin of the organization?

Open innovation

2. What do you mean by open innovation? Does your company apply it?

My description of open innovation: Firms commercialize external (as well as internal) ideas by deploying outside (as well as in-house) pathways to the market.' In other words, a firm is looking to combine and commercializes both its own ideas (internal) as well as those of other firms (external) and look for opportunities to bring the innovations to the market.

3. What is the added value of open innovation to the startup and maintenance of [**spin-off]**, for example in field of marketing, startup capital, costs, knowledge exchange or IP support?

4. What can be improved to this added value?

5. To what extent is open innovation a benefit to small firms? And to what extent is open innovation a benefit to startups?

6. To what extent is [**spin-off]** depending on ideas from external actors? And from internal ideas?

7. What is the ratio internal/external obtained ideas?

Network

8. How did the networking process go from the start?

9. Who were your partners at the moment the spin-off was founded? And why these partners?

10. Did the network change since the start? If so, why, when and which partners?

11. Is it difficult to find the right partners in the beginning? Is this getting easier in a later stadium?

12. Is it important to be connected to big, famous companies?

Parent firm

13. Which role did [**parent firm]** have at the moment your firm spun out? And is this role changed (e.g. more or less influential)?

14. In which way does **[spin-off]** profit from **[parent firm]**? And the other way around?

15. Is it possible **[parent firm]** takes over your company in the future?

High Tech Campus (only for Campus spin-offs)

16. Are the partners located in the neighbour of your firms?

17. Do you think the Campus is a place dominated by open innovation?

Philips wanted to create a community where businesses and people could find each other, inspire each other and overcome technological challenges together. The label of 'open innovation' has been adopted to define its emerging strategy and preferred work approach.

18. Does Philips take the initiative to create the open innovation environment?

19. Does it help to be a spin-off from **[parent firm]** within the Campus? Is there a difference between spin-offs and startups without a parent firm?

20. If you have any problems, questions or the need for new information, is it possible to ring the neighbors for help?

21. Is it easy for **[spin-off]** to obtain new knowledge and resources on the Campus?

22. Do you have formal or informal contacts in particular on the Campus? And strongly or weakly tied connections?

23. Does the way of communication, knowledge exchange, etc. differ with firms outside the Campus? If so, does the open innovation culture play an important role in it?

Knowledge inflow

24. What kind of knowledge flows in?

25. In which way does this knowledge come in (e.g. in-licensing, free-riding, open source software)?

26. Are informal network connections more useful than formal ones qua knowledge exchange, cost reduction, access to resources, etc?

Knowledge outflow

27. Does **[spin-off]** have certain patents? How important are these to the firm?

28. To what extent do you share knowledge with your network partners? And what kind of knowledge is this in general (e.g. information, know-how)?

29. Is this knowledge given away for free or in another way (e.g. out-licensing)? What is the ratio free/paid knowledge outflow?

30. How important is trust for the exchange of knowledge?

Pitfalls

31. Which problems/pitfalls did **[spin-off]** encounter during the start and growth phase of the spin-off, especially in case of knowledge exchange?

32. Do the kind and quantity of problems differ per stadium (startup, growth, maturity)?

These were all the questions I wanted to ask you. Thanks a lot for participating in my study. I will send you my final thesis report as soon as I have finished it, in case you are interested.

Kind regards,

Daniël Timmermans

TU/e, Innovation Sciences.

Appendix E: Map of the HTCE (the two red circles indicate the buildings 9 and 27, in which the interviewed BSOs Civolution and Cordian are located, respectively)

Resident	House number
ABB	5
Accenture	69
ACTRA group	5, 9
AEC Systems BV	9
Algemeen Octrooi- en Merkenbureau	69
Analog Devices Nederland BV	41
Anderis B.V.	9
Anthony BV	9
ARTEMIS Industry Association	69
ASML	4
Atos Origin	52
Avanade	48
Axxerion	9
BiCHEM Technology B.V.	48
Biotech Systems Platform	9
Brainport Development	9
Business Development Office	The Strip 1e
Campus Site Management	The Strip 1e
Capgemini Nederland B.V.	83
Celadon Europe	9
Chematronics People	9
Civolution	9
CLTR	48
Cognizant	9
ColPac Collapsible Containers	9
Cordis Automation B.V.	9
CTMM	84
Cytocentrics	9
Deltaclip International B.V.	41
ECN	5, 11a, 29, 48
EIT ICT Labs	69
ESI-CIT Group	9
FME	84
Free Energy Consulting	9
Free IT	9
GenKey	9
Green Hills Software Inc.	9
HDTO Development & Training	48
Greentech Engineering	9
HEINMADE	9
High Tech Partners	9
Holland Innovative B.V.	9
Holst Centre	31
IBM	68
IDT	41
Indiprof	9
Intel	83
Intrinsic-ID	9
IPL Advies bv	9
Irdeto	84
iSense	41
ITEA 2	69
Kembit	41
KeyTec International B.V.	41
KIC InnoEnergy	69
KNP Praktijk	41
Ledzworld	41
Mahindra Satyam	9
Marketredesign	9
Maxon Motor Benelux BV	9
MEDION	5
Mikrocentrum	9
Miortech	9
Multimediabox	9
Nikinc Dental B.V.	9
NT-MDT	83
NXP	
NXP Semiconductors	4, 32, 37, 41, 46, 60
NXP Software	41
OM&T/Moser Baer Technologies Europe	29
OMT Solutions BV	9
One Red Netherlands BV	9
Outdoor sports facilities	8

Resident	House number
Parametric (PTC)	9
Philips	
Consumer Lifestyle	37
- Advanced Technology	37
Corporate Investments & NewVenture Integration	5
Corporate Research	5
Corporate Technologies	5
Design	33
Event and Visuals Support	34
Healthcare Incubator	5, 7, 29
Innovation Services	5, 7
- ElectroMagnetic Compatibility (EMC) Center	26
- Electronic/Photonic Instrumentation	7, 29, 37
- Electronics Systems Creation	37
- General Support & Services	29
- Industry Consulting	5
- Materials Analysis	7, 11
- Mechatronics	7
- Technology Labs	4, 7, 29
Intellectual Property & Standards	44
IT	42, 43, 45
IT Infrastructure	48
- Healthy Living	27
Lighting & Cleantech Incubator	5
- D-Light	27
Research	4, 5, 7, 11, 11a, 29, 34, 36, 37
Supply Management	42
Translation Services	5
Warehousing & Distribution EMEA	5
PNA Group	9
Point-One	69
Point-One Innovation Fund	69
Prime Ventures	9
Profit Consulting BV	69
Q-matrix	9
Randstad	69
Red Bluejay Foundation	48
Renesas Electronics	9
Richtek Europe B.V.	9
Saffir	9
Sapiens Steering Brain Stimulation BV	41
Segula Technologies Nederland B.V.	5
Sentech Sensor Technology	9
SIMAX Services	69
Solliance	5
SPIL GAMES B.V.	84
SRB Energy Nederland	9
ST-Ericsson	41
STMicroelectronics	41
SunCycle	69
Supercis Solar	9
Synopsys	41
T&M Solutions	9
Tecnotion	9
TE Connectivity	41
Teledyne DALSA	27, 29
Texas Instruments	9
Thomson Video Networks	9
TM Profs	9
TP Vision	37
Triple R IT B.V.	9
TULIPPS Solar Systems	9
Universiteit Utrecht	5, 11a
VDL Enabling Technologies Group	7
Veeren Electronic Design Solutions	9
Vereenigde	84
Virtual Proteins	9
Wafer Based Solutions	9
WieHaalt	48
Wingz	9
Wipro	41
Xtreme Technologies GmbH	9
Yacht	84

Appendix F: Revised conceptual model