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# Governance and Business Models at the HTCE: Disrupting Science Parks

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## Abstract

The aim of this Master of Science thesis is to develop a well founded understanding of the governance approach of the High Tech Campus Eindhoven. In particular, the question how governance can enhance the value creation and appropriation on the High Tech Campus is investigated. The resulting insights are drawn from literature on science parks and organizational theories and a case study. The proposed findings can be used as a starting point in the development of a governance structure that boosts the potent characteristics of the 'Open Innovation' mind setting that was initiated by Royal Philips during the late 1990's.

*- He who would learn to fly one day must first learn to stand and walk and run and climb and dance; one cannot fly into flying.-*

Friedrich Nietzsche


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# Management Summary

## The Aim of this Study

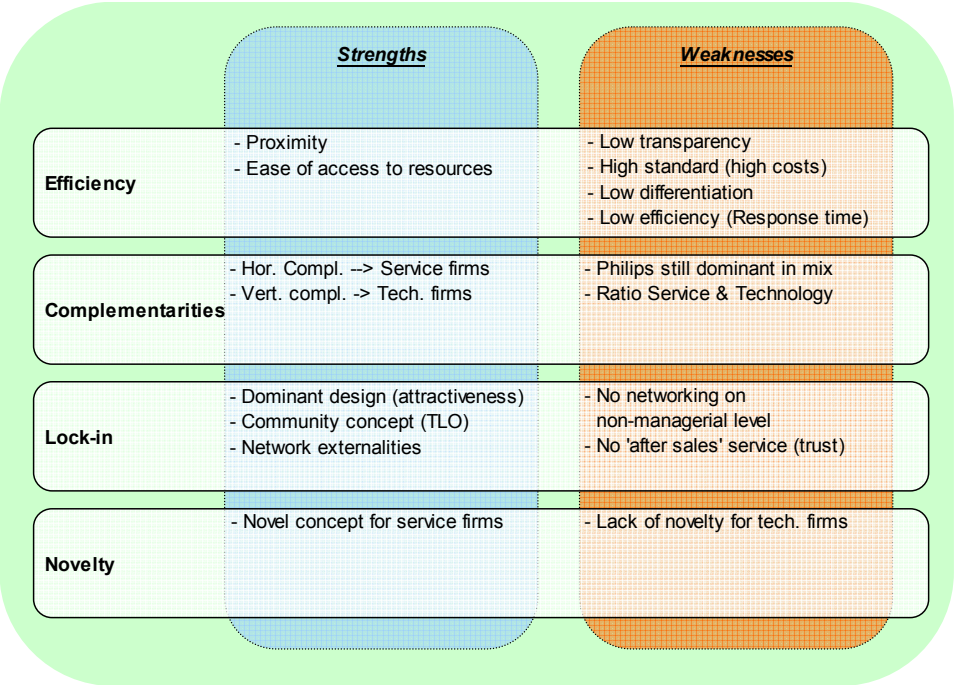
This study is part of a project carried out at the department of Technology Management of the Technical University Eindhoven. The High Tech Campus Eindhoven (HTCE) is a good example of a swiftly growing science park and was started by Royal Philips in the late 1990s. Based on the new 'paradigm' of Open Innovation the HTCE evolved into a technological center with a global reputation. A collaborative project was initiated between the Technical University Eindhoven, Philips and Brainport to uncover and codify the principles and mechanisms that constitute the (emerging) strategy of the HTCE, in relation to the critical success factors of the Eindhoven region.

In this study the current governance structure on the High Tech Campus Eindhoven was investigated. More specifically, the influences of the governance structure on the added value for the stakeholders were investigated. This in order to uncover the specific value sources of the current situation at the HTCE. The current situation was investigated by collecting data from current residents by means of a questionnaire and semi-structured interviews. The identified respondents were selected on decision making power regarding the location of their company. Besides this the selected sample represents the emerging strategy of the HTCE.

The conceptual framework is based on the Business Model since this perspective is consistent with the prevailing organizational theories. The Business Model is therefore the unit of analysis during the study and represents the so-called 'HTCE-concept'. By means of a literature study four value sources were identified that determine the potential value creation and value appropriation for the stakeholders, i.e. '*efficiency*', '*complementarities*', *'lock-in'*, and *'novelty'*. The analysis failed to identify a relationship between value creation and the value sources due to a low sample size. Nevertheless, by analyzing the value sources the strengths and weaknesses of the current HTCE-concept were identified.

## Strengths and Weaknesses of the Current HTCE-concept

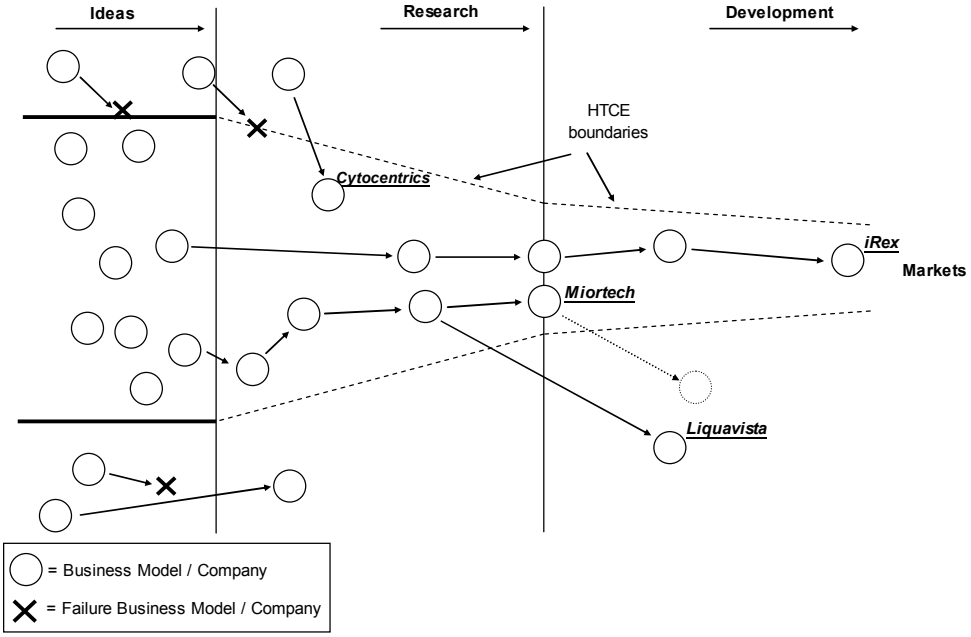
The analysis led to a 17 strong and weaker points of the current HTCE-concept. The figure below shows these items.



At this moment the attractiveness of the HTCE is the highest rated value source for the residents. Especially the benefits of positive association with the HTCE and attraction of new resources are the direct results of the good reputation of the HTCE. Also certain items of the value sources complementarities and efficiency are strong points of the current model. On the other hand there are also some weaknesses uncovered during the study. The main barrier for efficiency is the lack of transparency of the HTCE organization and its residents. At this moment it is very difficult to identify the current pool of resources that is available on the HTCE. Next to this, also the high price was identified as a weakness that results from the focus for a world-class high standard of facilities, thereby overshooting certain residents in their needs. Especially, the lack of differentiation in the offerings of rental spaces and facilities is something that could be improved according to the residents.

## The Current HTCE-concept

From the analysis it appeared that the current HTCE-concept aims at the high-end of the market. This implies that only undershot customers (residents) have an added value by being located on the HTCE. These companies are locked in due to benefits in terms of reputation, complementarities (e.g. MiPlaza), and economies of scale. These companies are willing to pay a price premium for the facilities and offerings on the HTCE. In contrast, companies that do not find an added value that exceeds the costs of being located on the HTCE will (re-)locate somewhere else. Start-up companies that look for a low-cost environment and which do not rely on the advantages offered by the HTCE (like MiPlaza) have no incentives to locate on the HTCE. In the current situation the idea generating phase is integrated in the (larger) residents like Philips, NXP, and the Holst Center. This implies that the current HTCE-concept in general does not support the emergence of start-ups. See the figure below for a schematic overview of the current situation.




From the analysis it became clear that under the current situation Campus Site Management (CSM) cannot serve the lower ends of the market due to barriers in both motivation and ability. Philips made large investments to turn the HTCE into a 'state-of-the-art' environment with accompanying world-class facilities, services, and work environment. Large fixed costs resulted in high rental prices (around €250,- per $m^2$) and a mark-up of €5000,- per FTE per year for usage of general facilities like parking lots, The Strip, and maintenance of the green area. This situation increases the incentives to grow quickly and reap premium benefits from the investments. This situation demands a deliberate strategy and won't tolerate emergent forces like small scale and cheap offerings in terms of rental space and facilities because this

would decrease the value of the surrounding landholdings. So, this situation forces the strategy of the HTCE towards a setting where premium prices must be demanded from the residents, thereby lowering the motivation to innovate towards low cost solutions. Selling the HTCE to an external investor would not solve the problem because also these investments have to be turned into profits. In this situation there even is the risk that the focus is on (short term) financial measures instead of long term R&D. A direct question that results from this is whether the market of undershot customers is large enough to let the HTCE mature (in terms of numbers of residents) within a reasonably short time-frame.

## Insights and Implications for the HTCE

The most important requirements for the stakeholders that are uncovered during the analysis are now summed up. First, the HTCE-concept should retain the current level of reputation or improve this level. The image and attractiveness of the HTCE is the most important value source for the residents. This attracts all kinds of companies and people, which is beneficial for the current and future residents.

Second, the residents' business models should have a fit with the strengths of HTCE-concept. In the current situation a specific market segment is served; the so-called undershot performers. In general this implies that the facilities and other offerings are of a high standard and therefore also more expensive. The basic premise underlying this model is that the model overshoots the demands of other market segments; consequently these companies do not find an added value on the HTCE which outweighs the premium prices. An important question that needs to be solved is whether the undershot market is large enough for the HTCE, in specific the time that it takes to 'fill' the HTCE.

Third, the HTCE should focus on 'vertical complementarities' that fit the needs of the technological companies. The analysis indicated that especially the technological oriented companies perceive the vertical complementarities as an added value. In contrast, the service oriented firms more rely on the horizontal complementarities since this augments their businesses. The focus should be on vertical complementarities since service oriented companies are attracted anyhow whereas technological oriented companies primarily are attracted by the vertical complementarities (besides the reputation). The number of service oriented companies should be kept at a minimum; just enough to serve the needs of the technological oriented companies.

Fourth, the CSM should increase the transparency of the HTCE organization and its residents. From the analysis it became apparent that the transparency is not very high. Information is difficult to acquire, therefore increasing the search costs for the residents. The transparency influences the trust on the HTCE, so the higher the transparency the higher the trust which influences the communication on several (functional) levels in at the HTCE. Especially the transparency of available resources (both human and technological) would be an added value. When CSM has more control over resources they can serve the current residents to a higher degree. Giving CSM more independency is a prerequisite to benefit maximally from the internal and external strengths that are present on the HTCE. By targeting weaknesses with the help of novel solutions, leveraging both internal and external strength, CSM can strengthen all four sources of value and consequently increasing the potential value creation and appropriation for both HTCE and the residents. At this moment the motivation and ability of CSM (and HTCE in general) are not bounded to optimize the situation for the residents. One could say that the HTCE is lacking market mechanism that controls the price and quality levels to a level that fits with the demand of the customers.

Finally, CSM should complement the HTCE-concept by collaborating with other regional institutions that serve lower tiers of the market. As argued before, the current model of the HTCE focuses on the high end of the market where undershot performers (mainly technological oriented companies) are served. When further investigation shows that this market is large enough, and proves that the current model is viable, the CSM can augment this model by collaborating with other organizations that serve different market segments. These market segments can be non-customers like startups, but also companies that need production facilities. By collaborating with organization that focus on these market segments CSM can scan the trends in the market (for example by screening startups) and provide an exit strategy for current residents which do not longer have a fit with the strengths of the HTCE.

# Preface

This Master of Science (MSc) thesis is the result of my graduation project which I have conducted at the High Tech Campus Eindhoven. The graduation project is the concluding part of the master program 'Industrial Engineering and Management Sciences' which I have followed at Eindhoven University of Technology (TU/e). This thesis investigates the current governance on the High Tech Campus Eindhoven and is part of a larger project which aims to uncover and codify the principles and mechanisms that constitute the emerging strategy of the High Tech Campus Eindhoven, in relation to the critical success factors of the Eindhoven region.

While I am writing this preface I remember the words of one of my teachers; '*Only due to laziness people innovate*'. At first a strange remark but when looking deeper into the meaning behind these words one can detect some sense of truth. When looking at my own life this laziness is a reoccurring subject about which I could write a complete discourse in this preface. However, to keep things short, the most important thing I learned during my years on the TU/e is that motivation is something that brings you far in achieving your goals, further than one ever could realize by means of laziness.

I've experienced the graduation project as a very exciting period in my life. Due to the new setup of the Master program I was already involved in the project one year before I started my final Master thesis. This gave me the advantage of connecting the course material of the second and third semester to the Master project. A disadvantage was that time during this period was sparse and the larger part of the work had to be conducted during the five months of the master thesis, making it significantly shorter than the 8.5 months that students of the old program could spent.

At the beginning of the project, I presumed that the project wouldn't be easy: both *governance* and *Science Park* are concepts which are difficult to grasp at first sight. Some people even devote a lifetime to a search for understanding these terms. Looking back at the project, I know that the governance of a science park *can* be determined and that it *does* play an important role in the evaluation of a science park.

I've could not have written this thesis without the support of various persons. First, I would like to thank my university supervisors, Prof. Dr. A.G.L. Romme and Dr. M.M.A.H. Cloodt, thank you for always pointing me in the right direction. Your enthusiasm, support, expertise and positive attitude have motivated me tremendously. In addition I would like to thank the other persons of the research project who have helped me with my research.

Next, I would like to thank all the people at Philips and the High Tech Campus who have made this research project possible. In particular, I want to express my gratitude to Cees Admiraal and Ferrie Aalders who have supervised my work. Cees and Ferrie, your ideas, optimism and sincere interest in my progress have been a great stimulus to the research. Also a special thanks goes to Marieke Giebelen who was always willing to take some time to provide me with all kinds of information.

I also want to show appreciation to all the interviewees from High Tech Campus residents. Without your input, I could not have gathered the essential empirical evidence. As well, I would like to show appreciation to all the students who have supported me and in particular, Christian Peeters, Chun Leung, Eddy Janssen, Jan Spruijt, Gaus Azeredo, and Linco Nieuwenhuyzen for their suggestions during the initial and final phase of my research.

I would like to thank my dear friends, family, brother and most of all, my beloved parents who have all supported me in their own way. Without your tremendous support, everything would have been impossible. I am especially grateful to my loving girlfriend Priscilla Hensens for her continuous support and understanding. She gave me the motivation needed during this exciting journey.

Michel van der Borgh
Eindhoven, July 2007

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# List of Abbreviations

| | |
|---|---|
| BM | Business Model |
| CTC | Campus Technology Liaison Club |
| CTO | Corporate Technology Officer |
| FTE | Full Time Equivalent |
| HEI | Higher Educational Institute |
| HSIP | Hsinchu Science-Based Industrial Park |
| HTCE | High Tech Campus Eindhoven |
| IASP | International Association of Science Parks |
| NTBF | New Technology Based Firm |
| OECD | Organization for Economic Co-operation and Development |
| OLS | Ordinary Least Squares |
| OT | Organization Theory |
| PBP | Perceived Business Performance |
| R&D | Research and Development |
| RBV | Resource Based View |
| SME | Small and Medium sized Firm |
| SWOT | Strengths, Weaknesses, Opportunities and Threats |
| TCE | Transaction Costs Economics |
| TLO | Technology Liaison Office |
| TSIP | Tainan Science-based Industrial Park |
| UKSPA | United Kingdom Science Park Association |
| ZSP | Zhonggunacun Science Park and |

# 1. Introduction

This chapter gives a short overview of the rationale behind this study. The chapter starts with the background and motives for the research. In the second part it presents the project definition, research model and the research questions. The end of the chapter provides a preview of the reminder of the report.

## 1.1. High Tech Campus: Background and Motives

Royal Philips Electronics is a global leader in healthcare, lifestyle and technology. The last two decades changes on various institutional levels have led to a more open world were country borders and company borders are fading and people become more and more interconnected. The 'closed innovation' process, where all processes are vertically integrated inside the company, is no longer tenable. As a reaction to the changing environment Royal Philips Electronics initiated the High Tech Campus Eindhoven (HTCE), an ecosystem in which companies can find one another. In light of the adopted 'Open Innovation' strategy, a situation where companies benefit from both external and internal ideas, the High Tech Campus Eindhoven evolved into a technology centre with a global reputation.

At this moment relatively little is known about how to organize and manage the ecosystem of a large high tech campus with a large number of residents. An ecosystome, or business ecosystem, are compared with biological ecosystems, in which companies succeed and fail as acollective whole. As with biological systems, the boundaries of a business ecosystem are fluid and sometimes difficult to define. As such, ecosystems traverse industries and encompass the full range of organizations that influencethe value of a product or service (Iansiti, 2005). Just as biological ecosystems establish themselves within a larger environment, so do business ecosystems (Moore, 1995). The surrounding environment of the High Tech Campus Eindhoven therefore also influences the formation of the ecosystem at the HTCE. At this moment little is known about the wider institutional and regional context (the Eindhoven area as well as the broader Eindhoven-Leuven-Aachen region). To gain more understanding of this phenomenon a collaborative project was initiated between the Technical University Eindhoven, Philips and Brainport to uncover and codify the principles and mechanisms that constitute the (emerging) strategy of the High Tech Campus Eindhoven, in relation to the critical success factors of the Eindhoven region.

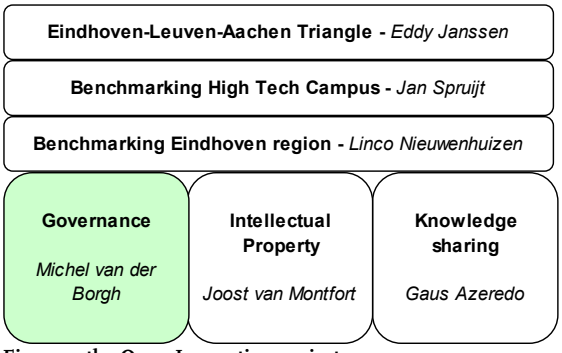


**Figure 1: the Open Innovation project**

The project is initially conducted by a team of six Master of Science students of the Innovation Management program and staff supervisors of the Technology Management department of the Technical University Eindhoven. See figure 1 for an overview of the topics that are addressed during the project. This study will address the governance on the High Tech Campus Eindhoven.

## 1.2. Literature Background

The academic literature has reached no consensus on why the science park performance shows such mixed results. Apart from the location and administrative support advantages, several authors even have questioned the value of science parks (Hansson et al. 2005; Chen and Choi, 2004). One

argument for the mixed results is the lack of a theoretical framework for assessing the performance of science parks and their management. Phan et al. (2005) argue that due to a lack of systematic data collection, constructing theories of science parks have remained at the level of an inventory of typologies, causations and outcomes. Hence, a gap can be identified between the current academic literature and the actual behavior of science park management. The influence of this gap is twofold due to the absence of a proper framework; scientists have problems with assessing the performance of science parks, while science park management has difficulty with installing a sound governance system that performs well.

The problems start with the definition of 'science parks' and other science and capacity building initiatives. There is simply no universally accepted definition of a science park (Hansson et al., 2005). Several institutions, like the OECD (1997), UKSPA, and IASP have adopted conflicting definitions for science and capacity building initiatives.

When looking at the management of a science park many comparisons can be made with the management role in other industries and companies (Chen et al. 2004). Therefore, corporate governance and network governance are an interesting starting point for analyzing the governance of science parks. To date, the literature shows no attempts for defining a science park governance framework. The sheer complexity of science parks, due to the numerous stakeholders and possible conflicting goals, does not simplify matters. One of the few attempts made to systemize the research on the management (and governance) of science parks is done by Bigliardi et al. (2006). Bigliardi et al. (2006) proposed a conceptual framework for science park performance, which is determined by the "real mission and strategy", which in turn is determined by the context, life cycle of the science park, its judicial form, the commitment of its stakeholders, and the availability of (or possibility to attain) the technical-scientific knowledge of university departments (or other research centers or professional structures) which actively collaborate with a park. The study, however, does not reveal governance principles or mechanisms. More research is required to determine how and which governance principles on science parks should be installed to leverage the opportunities of the science park. The important message here is that the science park literature should look more closely at governance mechanisms and principles.

In sum, science park governance is a field in the governance literature which has not received much attention. Yet, its investigation is important since sound governance principles and mechanisms help science park management to reach their goals.

## 1.3. Project Definition

This research focuses on the High Tech Campus Eindhoven as the general object of analysis. Based on preliminary meetings and interviews with senior managers from the HTCE management it became apparent that little is known about the real execution of the governance on the HTCE. Mainly this is caused by the complexity surrounding the governance itself. The total numbers of executives that influence the decision making process is large and have different interests. With the expansion of the HTCE this is growing even more. Another issue is that the responsibilities are scattered throughout different functional and independent organizations with no clear picture about who is responsible for what. Finally, with the increasingly number of residents and the rapidly changing relationships between these residents the organizational problems are also perceived to increase. The involved individuals tend to focus on the problems that might arise, thereby creating an attitude of resistance. A preliminary cause and effect diagram is developed on the information available (Van Aken et al., 2007). This diagram only shows the interpretation and opinion of a couple of interviewed persons and requires organizational validation during the first stages of the empirical analysis. The diagram is presented in figure 2.

The governance issues that surround a science park should first be placed into perspective before one can give recommendations for a proper governance structure and the assessment of its performance. The research should gain insight in the current use of governance at the HTCE to identify strong and weak point. Consequently, this asks for an analysis of the status of governance theory.

The project definition is formulated as follows:

*The aim for this research is to develop a normative framework for governance on the High Tech Campus Eindhoven by testing and uncovering construction principles and design rules that maximize output of the High Tech Campus in terms of technological innovations. The framework is based on organization theories, science park literature and results from an explanatory case-study at the High Tech Campus Eindhoven.*

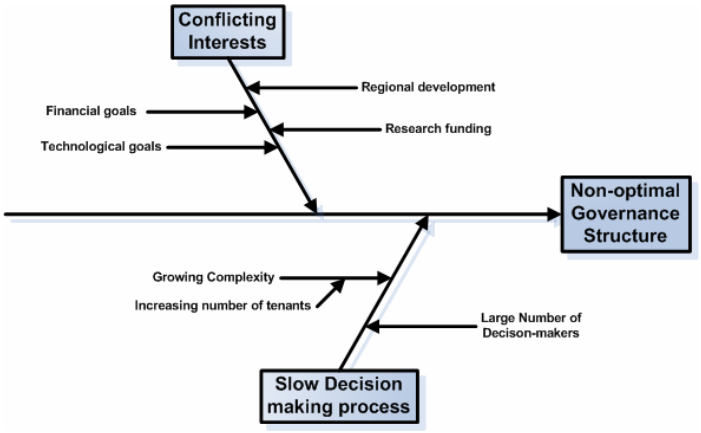


**Figure 2: Preliminary cause-and-effect diagram**

The above definition makes clear that the research is design-oriented; the result is a normative model for the governance on the High Tech Campus Eindhoven.

## 1.4. Research Model

During this research project the science-based design is adopted as the primary approach for investigating the characteristics of a science park. A science-based design is the entire body of intellectually thought, analytic, partly formal, and partly empirical knowledge for the design process (Simon, 1996). Romme and Endenburg (2006) identify five steps in the research and development cycle in organization design; 'Organization Science', 'Construction principles', 'Design rules', Organization design', and Implementation and experimentation' (see figure 3).

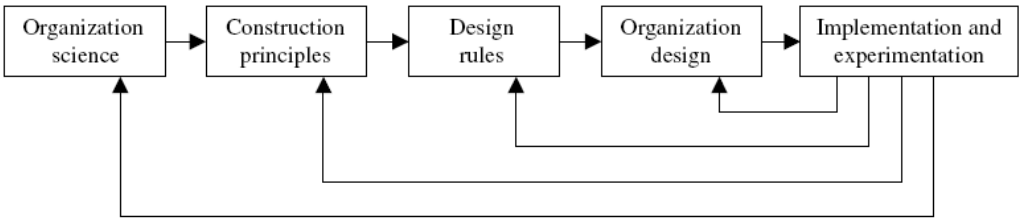


**Figure 3: Science-based design approach (Romme and Endenburg, 2006)**

Several research methods will be used in this research. These different methods are presented in a research model (see figure 4). The research model gives a global overview of the different steps that must be executed to reach the target of the research. The five elements at the left hand side of the research model represent the various sources for information. The information will be drawn from literature (top two fields) and from the case study (bottom three fields). Literature is used for developing a boundary object (Romme and Damen, 2007), in the form of a preliminary governance framework consisting of construction principles and design rules.
This framework can be seen as a conceptual benchmark for interpreting the current governance processes at the HTCE. The analysis copes with the comparison of the current governance process and the findings from literature and, where needed, indicates areas for re-design. Finally, this study

concludes with points for improvement in the form of a normative framework for governance on the HTCE.
The literature review will cover the 'organizational science', 'construction principles' and part of the 'design rules'. The empirical research investigates which construction principles and design rules are implemented in the field. The analysis of the project identifies the set of construction principles and design rules, drawn from theoretical and empirical evidence, which can be used as a normative framework for the deliberate design of the governance structure at the HTCE. As such, this study resembles the logic postulated by the so called alpha testing, where the goal is to develop an initial proposition (Van Aken, 2004).

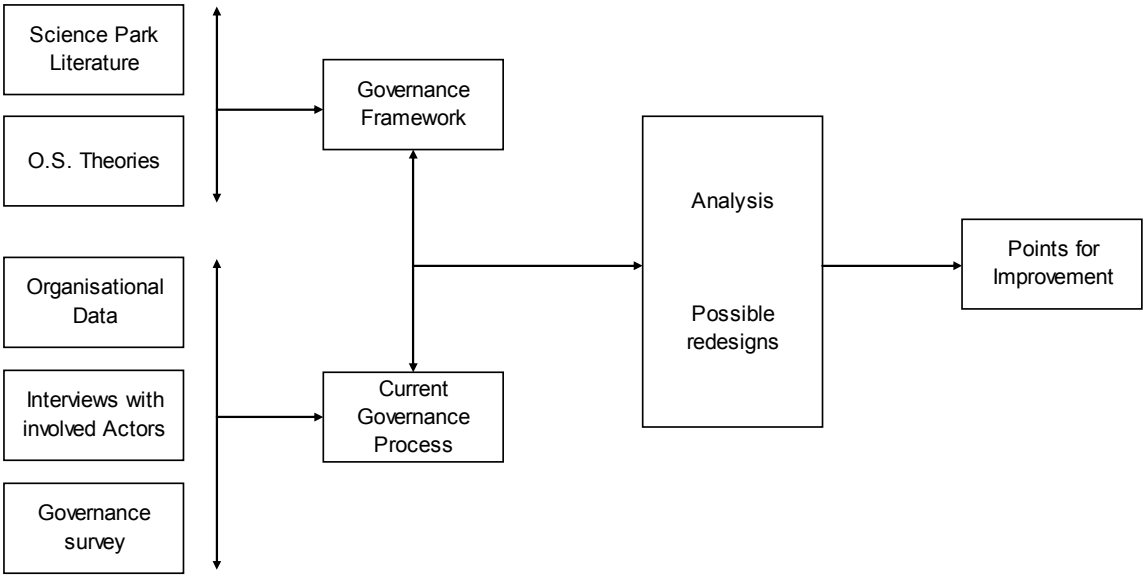


**Figure 4: The Research Model**

## 1.5. Research Question and Deliverables

Based on the project definition and the research model the following general research question can be formulated:

> *How can governance be structured at the High Tech Campus Eindhoven to benefit maximally from it, i.e. maximizing output in terms of technological innovations?*

In chapter 4 the definition of governance is discussed into more detail and linked to the context of this research. For this moment governance is defined as the act or activity of looking after and making decisions about something.
Based on the project definition, general research question and the research model, the expected results for this research project can be identified. This study aims to be threefold in terms of results. In the first part, the literature review, the characteristics of a science park, such as the HTCE, is analyzed by looking at the current literature on science parks and the prevailing 'Organizational Theories[1]'. Based on insights from the prevailing organizational theories the second part of this research deals with the analysis of the current governance structure of the HTCE. Finally, the third part will describe the propositions for improvement of the current situation of governance, which will lead to the answering of the research question.

[1] Organizational theories have three origins: Max Weber's original work on bureaucracies which came to define the theory for sociologists, a line of theory based in business schools that had as its focus, the improvement of management control over the work process, and the industrial organization literature in economics (Fligstein, 2001).

Hence, the following results are considered the deliverables of the research:

| | |
|---|---|
| *1* | *Better understanding of the key concepts of the governance of Science Parks* |
| *2* | *Analysis of the current governance policies at the HTCE* |
| *3* | *Propositions for improvement points* |

For each deliverable, a number of questions is defined that must be answered to achieve the assignment of the project. These questions are presented below:

*1* *Better understanding of the key concepts of governance of Science Parks*
   a. What is meant by a Science Park?
   b. Which governance principles are available in Organizational Theory literature?
   c. Which governance principles are available in Open Innovation literature?
   d. How should a Science Park be set up to benefit optimally from governance principles?

*2* *Analysis of the current way of governance at the HTCE*
   a. How can governance be analyzed?
   b. What are the strong and weak points of governance at the HTCE?
   c. Which principles are considered as important by the various stakeholders?
   d. What is the position of these governance principles in the complete analysis?

*3* *Prioritization for improvement points*
   a. What are the most important requirements for the (potential) stakeholders?
   b. Which actions have to be taken to comply with the needs of the various stakeholders?
   c. Which hindrances might stand in the way of successful implementation?
   d. What is the expected result of implementing the prioritized improvement points?

The first set of research questions is derived from the top-left hand side of the research model; it investigates the current literature on science parks, organizational theory and Open Innovation to come to a preliminary governance framework. The second set of research questions is based on the bottom left hand side of the research model; it investigates the current governance model on the HTCE. The third set of questions deals with the right hand side of the research model; it compares the theoretical part with the empirical results in order to come to a re-design of what constitutes a governance structure on the HTCE and, hence, leads to a set of improvement points. These improvement points are presented in the form of construction principles and design rules.

## 1.6. Report Structure

The report comprises four sections which are analogous to the phases conducted during the research: the orientation phase, the theoretical analysis, the empirical analysis, the result and evaluation phase (see figure 5).

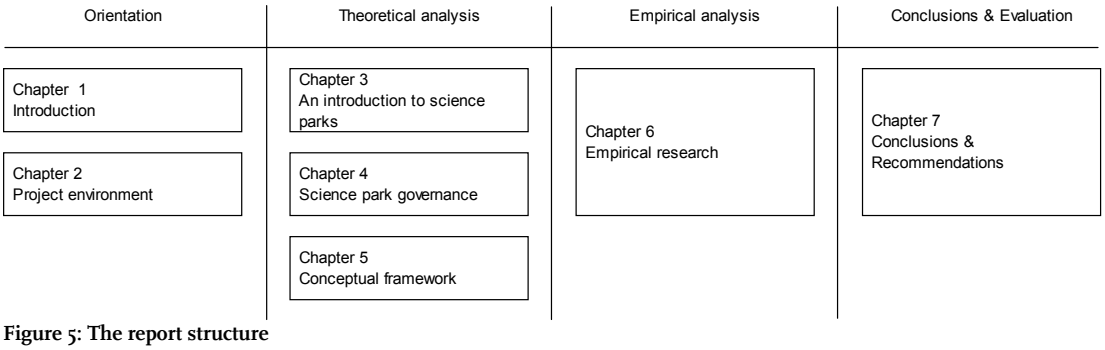


**Figure 5: The report structure**

The first two chapters discuss the orientation phase. So, the first chapter gives the project description and the second chapter describes the environment of the study. Subsequently, the theoretical analysis is covered by two chapters. In order to give the reader background information, chapter three elaborates on the concept 'science park', positioning the science park in the wider context of stakeholders, and discussing literature on performance of science parks and the current state of academic results. Chapter four elaborates on the governance of Science Park. With the knowledge gained by the organizational theories the characteristics of the science parks are explained.
Chapter five functions as the bridge between the theoretical analysis and the empirical analysis, because in this chapter the conceptual framework is developed. This chapter also discusses the empirical research variables, method and results. Chapter six discusses the empirical results of the study. The last chapter, chapter seven, presents the conclusions and recommendations. The conclusions answer each of the research questions posited in the previous paragraph.

# 2. Project Environment

This chapter describes the project environment. The High Tech Campus Eindhoven is part of Royal Philips Electronics. The first part therefore will describe the company Royal Philips Electronics. The second part focuses at the High Tech Campus Eindhoven. Also, its position within the larger company of Royal Philips Electronics will be described.

## 2.1. Royal Philips

Royal Philips Electronics of the Netherlands is becoming a global leader in healthcare, lifestyle and technology, delivering products, services and solutions through the brand promise of "sense and simplicity". With its headquarters in Amsterdam the four main businesses, Domestic Appliances and Personal Care (DAP), Lightning, Medical Systems and Consumer Electronics employ over 121,000 people in more than 60 countries (2006).

*Key figures*

The annual report of 2006 gives an overview of the financial figures of Royal Philips. Table 1 shows that sales increased by 4.7% in 2006. This increase in sales was partly influenced with the selling of 80.1% (September, 2006) of its Semiconductors business. With this sale Philips definitely changed its strategy, thereby focusing on the development of Healthcare, Lifestyle en Technology.

**Table 1: Financial Highlights Royal Philips[2]**

| *all amounts in millions of euros unless otherwise stated* | 2004 [1] | 2005 [1] | 2006 |
|---|---|---|---|
| **Sales** | 24,855 | 25,775 | 26,976 |
| **Earnings before interest and tax and amortization** [2] | 1,864 | 1,577 | 1,382 |
| as a % of sales | 7.5 | 6.1 | 5.1 |
| **Earnings before interest and tax** | 1,156 | 1,472 | 1,183 |
| as a % of sales | 4.7 | 5.7 | 4.4 |
| **Results relating to equity-accounted investees** | 1,464 | 1,754 | (157) |
| **Net income** | 2,836 | 2,868 | 5,383 |
| - basic (per common share in euros) | 2.22 | 2.29 | 4.58 |
| - diluted (per common share in euros) | 2.21 | 2.29 | 4.55 |
| **Dividend paid per common share in euros** | 0.36 | 0.40 | 0.44 |
| **Net operating capital** [2] | 4,524 | 5,679 | 8,724 |
| Cash flows before financing activities [2] | 2,757 | 2,828 | (2,469) |
| **Stockholders' equity** | 14,860 | 16,666 | 22,997 |
| per common share in euros | 11.60 | 13.87 | 20.78 |
| **Net debt : group equity ratio** [2] | 1:99 | (5):105 | (10):110 |
| **Employees at December 31** [3] | 161,586 | 159,226 | 121,732 |

[1] Restated to present the Semiconductors division as a discontinued operation
[2] For a reconciliation to the most directly comparable US GAAP measures, see the chapter Reconciliation of non-US GAAP information
[3] Includes discontinued operations 35,116 and 37,417 at December 31, 2004 and 2005 respectively

*Strategy*

Royal Philips Electronics has the ambition to become the leading solutions provider in the areas of healthcare, lifestyle and enabling technology. With their brand promise 'sense and simplicity' they want to deliver products and solutions that are advanced, easy to use, and designed to meet the needs of all the users of their products. Royal Phillips tries to achieve its mission through the following goals:

- increase profitability through re-allocation of capital towards opportunities offering more consistent and higher returns
- leverage the Philips brand and our core competencies in healthcare, lifestyle and technology to grow in selected categories and geographies
- build partnerships with key customers and suppliers, both in the business-to-business and business-to-consumer areas

[2] See for more details http://www.annualreport2006.philips.com/financials/highlights.asp

- continue to invest in maintaining world-class innovation and leverage its strong intellectual property position
- strengthen our leadership competencies
- drive productivity through business transformation and operational excellence

*Company structure*
Royal Philips is divided in four main business divisions and some other activities which comprises of 'Corporate Technology', 'Corporate Investments' and 'Design' and 'Consumer Healthcare Solutions'; a range of Philips' activities that business-wise do not fit in the current product divisions (see figure 6). 'Philips Research', 'Intellectual Property & Standards', 'Philips Applied Technologies' and the 'Healthcare, Lifestyle and Technology Incubators' are part of the 'Corporate Technology' activities.

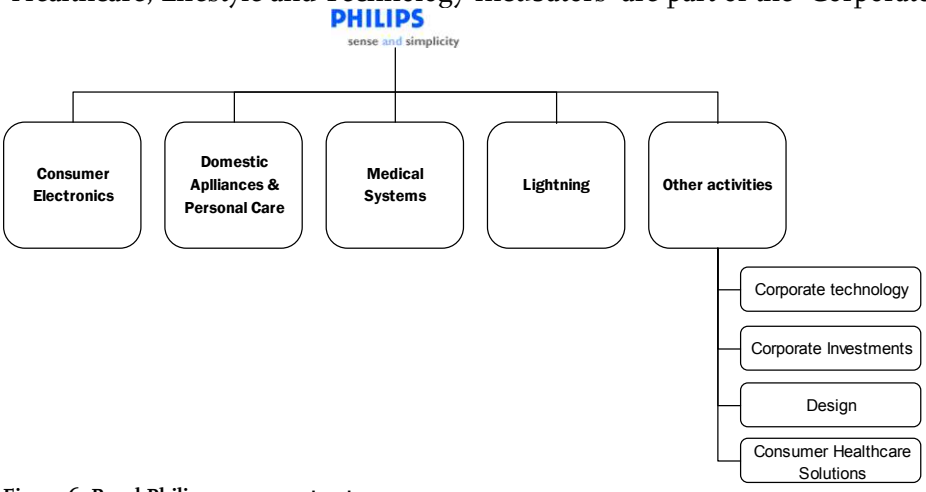


**Figure 6: Royal Philips company structure**

## 2.2. High Tech Campus

The setting for this research project is the High Tech Campus Eindhoven (HTCE)[3]. The HTCE is a good example of a fast growing science park and was started in the late 1990s by Royal Philips. The foundation stone for the campus was laid in July 1999. Originated from and situated on the very place of the former Philips Natlab, since 2002 non-Philips companies can also establish their businesses on the campus site and in 2006 the campus was opened up entirely. Governments, knowledge institutes and businesses (the so-called Triple Helix) are working together at the HTCE and the wider region to produce knowledge and innovation. Situated in the Eindhoven region, the HTCE is between the economic core regions of the Rhine/Ruhr area in Germany, the Amsterdam/Rotterdam area in the Netherlands, Antwerp/Brussels in Belgium and Northern France.

*Key figures*
The High Tech Campus Eindhoven covers 103 hectare. At this moment the campus comprises about 25 to 30 new buildings with a total surface area of more than 174,000 m². The following facilities are available, accessible for residents and partners:

- Over 8,000 m² clean rooms
- 50,000 m² lab space
- 100,000 m² office space
- 100,000 – 125,000 m² additional development space

Next to the facilities mentioned High Tech Campus Eindhoven offers more facilities like; high-quality commercial spaces, conference areas, parking facilities, shops, state-of-the-art ICT facilities,

[3] This overview draws heavily on the information found on the website of the HTCE: www.hightechcampus.nl

restaurants, child care facilities, sports facilities and a campus sports club. At this moment High Tech Campus Eindhoven has 6,000 residents in 2007 with about 50 nationalities. For an overview of the current list of residents see appendix A.

*High Tech Campus strategy*
The HTCE aims to act as the matchmaker between businesses and knowledge institutes. The focus of the HTCE is on five technology domains:
1. Microsystems
2. Life-tech
3. High Tech Systems
4. Infotainment
5. Embedded systems

*High Tech Campus organization*
The HTCE legally is directly placed under the authority of Philips Netherlands, just like the other Dutch offices fall under the jurisdiction of Philips Netherlands. Within the wider Philips organization, the HTCE reports directly to the Corporate Technology Officer (CTO) (see figure 7).

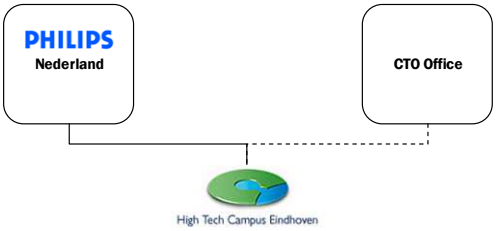


**Figure 7: Relation of HTCE within Royal Philips Electronics**

In reality the relationship between HTCE and Royal Philips Electronics is far more complicated than depicted in figure 7. Campus Site Management is the organization that deals with the operational management on the HTCE. Part of the CSM is the Technology Liaison Office (TLO) that is an important connection point for residents and visitors. The TLO is part of the Technology Liaison Eindhoven Region (TeLER) Foundation, which is established to promote High Tech Campus Eindhoven and the high-tech companies in the region Eindhoven. The TeLER strives to attract promising new businesses and knowledge workers. The TeLER Foundation comprises of representatives of the Province of Brabant, the Municipality of Eindhoven, SRE, Philips and several companies in the region. So, at this point in time CSM has to negotiate and justify their actions to numerous stakeholders.

# 3. An Introduction to Science Parks

Today, in an increasingly competitive landscape companies, institutions and governments seek different ways to drive economic wealth. These actors become increasingly aware of the importance of innovation and the dependence on global, high technology and research oriented organizations (Cabral and Dahab, 1993). The linkages between local and global movements tend to go beyond national borders whereas major economic actors are inclined to localize their most advanced resources on beneficial spots. A new organizational form has emerged as an engine for regional development: the science park (Lin, 1997). In this chapter, first, an overview is given what according to the prevailing literature constitutes a science park. The second section gives the positioning of the science park relative to the stakeholders involved. Finally, in the third section the performance measurement of science parks is discussed.

## 3.1. Defining Science Park

There is no universally accepted definition of a science park (Hansson et al., 2005). Science parks, incubators and technology centers belong to a set of political instruments that ideally provide for reindustrialization and regional development (Phillimore, 1999) and for the promotion and development of new high-tech business (Storey and Tether, 1998). Scholars and practitioners use many alternative names and forms for science and capacity building. Many of these institutional forms, designed to support knowledge and technology capacity building, are characterized by a specific physical location and co-operation between academia, industry and governmental institutes. As mentioned before, there is no consensus regarding what really constitutes a science park, technopole or knowledge centre and the terms are used in an unstructured way. These institutional forms can be large (e.g. Technopoles, clusters and innovation networks), park based (e.g. science parks, technology parks) or relatively small (incubators). In practice the three forms can be tangled in such a way that a clear-cut taxonomy is not easily defined. Appendix B gives an overview of the most common institutional forms.

This paper focuses on the park based institutional forms since the HTCE is a park based initiative. Therefore, Technopoles[4], clusters and innovation networks are not discussed in depth since these institutional forms are not necessarily confined to a park. Because an incubator can also be a park based initiative a better taxonomy between a science park and incubator is essential. The European Commission (2002) offers a useful typology to position the different incubator typologies and other SME[5] promotion structures that include a physical space element (see figure 8).

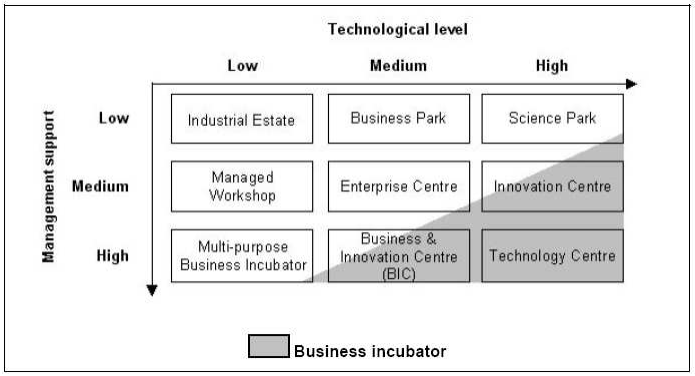


**Figure 8: Typology of Science and Technology Capacity-building initiatives (EC, 2002)**

[4] Technopole is here defined as a city or regional area.
[5] Small and Medium sized Enterprises (SME's) are here defined as enterprises with no more than 500 employees.

The two variables used for this taxonomy are 'technological level' and 'management support'. *Industrial estates* in the top left-hand corner generally have a non-selective intake, provide little or no management support and have no special criteria with regard to business activities and technological content. In the bottom right-hand corner the *technology centers* have highly selective admission criteria, provide extensive management support and have a highly specialized technological focus. *Science parks* are positioned in the upper right-hand corner since the main focus here is on the output of high-tech knowledge and not so much on the management aspect. According to this matrix the role of science parks is to support the ability of firms to develop and utilize advanced technologies for commercial ends (Hansson et al., 2005). *Business incubators* are positioned towards the bottom-right hand corner of the matrix since they combine a high degree of management support to residents and primarily cater for technology based enterprises. Figure 8 shows that there is overlap between the business incubator and science park, indicating that in specific settings a small part of a science park focuses on the incubation of new high-tech firms. It is common that successful science parks also hold a business incubator. The difference between the science park and the technology centre (business incubator) is that a science park also accommodates institutes, research organizations, universities, incumbents and service related enterprises whose primary goal is not necessarily on guiding small and starting companies through their growth process. In this paper the definition of the United Kingdom Science Park Association (UKSPA)[6] is adopted for portraying a science park. According to the UKSPA a science park is a business support and technology transfer initiative that:

- Encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses;
- Provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit;
- Has formal and operational links with centers of knowledge creation such as universities, higher education institutes (HEI) and research organizations.

This implies that a science park not necessarily has to be developed around a university but does have to provide physical or organizational links with HEI, universities or research organizations. Furthermore, the technology level is relatively high and the management support is relatively low. A business incubator is a feasible but not compulsory element of the science park because the function of incubating new businesses can also be performed by other institutional forms or dispersed throughout several institutions.

## 3.2. Positioning the Science Park

The definitions described in the first section incorporate the goal(s) of a science park, how to meet these goals and the actors involved. The involved actors are often identified with the triple helix model: Government, Business and Knowledge Institutes. The positioning of Science Parks as a means to enhance interaction between these three actors is regarded important.

The actors of this triple helix view can be split up into more actors than the three mentioned above. The commercialization of research concepts and the continuation of funding for research are perceived to be the main expectations of universities. On the other hand, entrepreneurial and small high-tech companies look for advanced facilities and management support, a close association to university/research institutes and other (on-site) complementary businesses (Storey and Tether, 1998). The large multinationals are perceived to have an interest in science parks as providers of flexibility for short-term projects and proximity to already established cooperation partners at universities (Hansson et al., 2005). Private sector organizations, such as banks, are likely to have a more strict set of commercial objectives towards investments in the park or the residents of the park (Löfsten and Lindelöf, 2002). Local governments see science parks as a medium for the regional development and an instrument of innovation policy implementation for the deployment of

[6] http://www.ukspa.org.uk

technology transfer programs. Local governments focus thereby on added value and fostering local and regional core technical cultures and vocational competencies (Bigliardi et al. 2006). Also within the same functions contradicting interests can arise. For example the management of a science park often is fraught with a large amount of complexity and multiple responsibilities (Gower et al., 1996). Science park management requires a high occupation rate in order to be commercially viable, but on the other hand restricting letting policies for residents are established to create the right mix of residents, thereby preventing the science park from becoming a sheer business park. Table 2 gives an overview of the most common stakeholders in a science park and their interests. Here stakeholders are defined as: "The stakeholders in an organization (science park) are the individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities, and that are therefore its potential beneficiaries and/or risk bearers" (Post et al., 2002).

**Table 2: Examples of common stakeholders in a Science Park and their interests**

| ***Stakeholder*** | ***Examples of interests*** |
|---|---|
| **Owners private/shareholders/ Support endowments** | Profit, Performance, Direction, Status. |
| **Government(s)** | Taxation, Legislation, Regional development, Reindustrialization, instrument of innovation policy implementation, deployment of technology transfer programs. |
| **Multinationals** | Flexibility for short-term projects and proximity to already established cooperation partners at universities. |
| **Universities/HEI** | Commercialization of research concepts and continuation of funding for research. |
| **Research Institutes** | Continuation of funding for research |
| **Entrepreneurs/Small high tech companies** | Access to advanced facilities and management support, close association to university/research institutes and other (on-site) complementary businesses. |
| **Science Park Management** | Performance, Targets. |
| **Intermediaries**[7] | Bridge gap between primary and secondary actors, and end-users |
| **Employees** | Jobs, Salaries, Working environment |
| **Local Community** | Jobs, Involvement, Environmental issues, Shares, Status. |

## 3.3. Performance of Science Parks

In this section subsequently the level of analysis and the performance measures are discussed. An overview of the empirical literature used for this review is depicted in appendix C.

### 3.3.1. Levels of Analysis

Phan et al. (2005) identify four streams of research in the literature on science parks. The first stream focuses on the companies located on science parks, the second stream assesses the science parks themselves, the third stream focuses on the systemic level of the university, region or country and finally, the fourth stream investigates the individual entrepreneur or teams of entrepreneurs on science parks. This is in line with the levels Chesbrough et al. (2006) propose for investigating Open Innovation. These authors propose five distinct levels for analysis; individual, organizational (firm), Value Network, Industry/Sector and National institutions.

Open Innovation has many similarities with the basic ideas of science parks in the sense that "*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*" (Chesbrough, et al., 2006, pp. 1). As such a science park can be seen as a means to operationalize the Open Innovation concept. But, until now no connection between these two concepts have been made.

[7] Examples are: technological innovation service centers, productivity promotion centers, technology markets, technology transfer centers, business information database centers, human resource head-hunters and regional scientific societies (Zhu and Tann, 2005)

The various levels of analysis have not been connected in a fruitful way (Phan et al. 2005) due to a lack of framework for analysis. The empirical literature focuses mainly on the firm-level or science park level (see appendix C). For example, on a national level economic theory proposes that in developed countries the aim of a science park should be on the development of basic scientific research and its technological applications whereas in countries which are in the early economic development stage they should encourage inward investment via transnational companies and then develop their technological capacity (Lin, 1997). Thus far, these and comparable relationships have not been studied and verified. The next section will discuss the performance measures used to study the success of science parks.

### 3.3.2. Performance Measurement

Researchers use different ways to define the performance of a science park. Apart from the location and administrative support advantages, several authors have questioned the value of science parks (Hansson et al. 2005; Chen and Choi, 2004). Survival, growth, HEI linkage, innovation output, reputation and agglomeration are studied on various levels and with different proxies. The measuring of the performance itself is subject to difficulties (Siegel et al. 2003a). According to the literature, science parks tend to underperform significantly in delivering the expected remuneration: residents' research productivity (Siegel et al., 2003b), employment growth in high-tech sectors (Shearmur and Doloreux, 2000), extraordinary growth or performance of R&D-intense firms situated in the park, and the development of strong and operational ties between firms, university research, national laboratories and other research institutions (Bakouros et al., 2002). As such, science parks fail to act as spanners of structural holes between industry and science (Hansson et al., 2005).

The primary method used in the literature for assessing performance is comparing the performance of technology-based firms located within science parks with the performance of similar firms' located off-park (Westhead, 1997). Westhead (1997) showed that the performance between UK on-park firms and off-park firms is not statistically significantly different in terms of R&D intensity, R&D spending and the research capability to introduce new products and patents. Löfsten and Lindelöf (2002) compared the performance of Swedish new technology-based firms (NTBF's) with comparable off-park firms. Their results show a significantly better performance for on-park firms. However, the better performance is ascribed to the characteristics of the entrepreneurs who are described as highly motivated individuals. In another study it is argued that the lack of a significant difference in terms of number of patents and new product introductions could also be due to the idea that science parks should be considered more as centers of learning than of innovation (Lindelöf and Löfsten, 2003). Literature showed that on-site businesses' growth in number of employees was lower than those of comparable off-site companies. This might suggest that parks were hindering the development of such firms. Further analysis indicated a more plausible reason; most businesses were founded by academics and ex-academics, and those businesses significantly under-performed (Lindelöf and Löfsten, 2003).

Hansson et al. (2005) argue that the comparative studies of the performance of on-park and off-park firms do not provide a complete picture of the value added by science parks. For example, R&D productivity and growth in employment are not the only measures of regional development and the objectives of (some) universities in establishing closer links with industry. Furthermore, science parks contain more than just small high-tech firms. As mentioned before science parks also accommodate units from large multinational research-based companies, consultancy firms with dedicated services to high-tech small and medium sized enterprises (SME's) and different kinds of non-company organized activities such as cross-institutional and cross-organizational research groups. Phan et al. (2005) argue that dependent variables like survival rates between off- and on-site

companies have little construct validity since incubators and science parks are designed to maintain and increase lifespan, creating an endogeneity[8] problem.
When looking to the wider geographical context of a science park, evidence shows that science parks have limited linkages to local industry and have no innovative network based on inter-firm co-operation and interactive learning within the science park themselves (Asheim and Coenen, 2005). So, one can argue that the added value of the science park for the wider regional environment can be considered questionable.
The complexity of science parks is one reason why it is difficult to asses the impact and effectiveness of science parks. Bigliardi et al. (2006) identifies several causes/determinants for the complexity of science park evaluation. Firstly, science parks statutes are often all-embracing, generic statements and are therefore not a useful point of reference for identifying the actual 'mission' and aims of the science park. Secondly, different stakeholders' objectives and expectations give problems in determining what the relevant performance criteria are (Bigliardi et al. 2006). Thirdly, the revitalization of traditional industrial cultures (structural change) leading to a diffusion in technological trajectories. Fourthly, science park holders adopt a wide variety of legal structures which influences and limits the mission in addition to conditioning administrative behavior. Finally, to date the literature mainly concerns a static view of a science park. Science parks evolve over time regarding their mission and operational procedures. The early stages will need a different management style compared with a full grown and developed science park.
Bigliardi et al. (2006) proposed a conceptual framework for science park performance, which is determined by the "real mission and strategy", which in turn is determined by the context, life cycle of the science park, its judicial form, the commitment of its stakeholders, and the availability of (or possibility to attain) the technical-scientific knowledge of university departments (or other research centers or professional structures) which actively collaborate with a park. Overall, science park performance is difficult to measure and to date no consensus is reached about performance indicators for science parks.

## 3.4. Conclusion

This chapter has shown that the definition of a science park is not straightforward and that a plethora of definitions and institutional forms exist. In this paper the definition of the UKSPA has been adopted. According to the UKSPA a science park is a business support and technology transfer initiative that:

- Encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses;
- Provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit;
- Has formal and operational links with centers of knowledge creation such as universities, higher education institutes (HEI) and research organizations.

A supplementary typology of a science park is that it is relatively more focused on high-tech knowledge but not on the management support. In contrast, business incubators focus more on the managerial aspects. The science park can therefore be seen as an ideal environment for bringing technologies to the market, although the commercialization itself can be developed outside the premises of the science park.
The phenomenon of the science park has gained a widespread recognition throughout the world from its origin of Stanford Science Park in 1951. The position of the science park as a means to enhance interaction (this does not imply that all parties have to be physical present on the Science Park) at the cross-section of the triple helix seems ideal. But the missions and number of

[8] In an economic model, an endogenous change is one that comes from inside the model and is explained by the model itself.

stakeholders of science parks have progressively broadened, making the complexity of science park performance more multifaceted. The number of potentially conflicting interests is complicating the management of a science park enormously. The main challenge for science park management therefore is to develop a strategic plan that aligns all the interests of the stakeholders and thereby maximizing the value for the involved parties.
The performance measurements of science parks show mixed approaches and results which is probably due to the various stakeholders that are involved in a science park. Performance measurement is difficult and no consensus is reached about criteria for measuring performance. At this moment the most used approach is comparing on- and off-site companies on their output. Survival, growth, HEI linkage, innovation output, reputation and agglomeration are studied on various levels and with different proxies. The challenge here is to define coherent (set of) measures of science park performance that reflects all the different interest of the various stakeholders. An interesting link could be made with Open Innovation since this stream of literature focuses on leveraging internal and external strength (what differentiates internal from external in a science park?) to bring technologies to market which in theory seems to fit with the objectives of a science park.

# 4. Science Parks Governance

The understanding and expression of the concept 'governance' is outlined in this section. First governance is defined followed by a proposed definition for 'science park governance'. Then science park governance is compared with the three generic governance forms after which this chapter is concluded.

## 4.1. Governance Defined

As the term governance suggests it has something to do with ruling or controlling (over) something. The word *government* is derived from the Greek *κυβερνᾶν* (*kybernan*), which means "to steer". In literature there is no single application of the expression governance. In general terms governance occurs on four levels; global governance, state and politics governance, corporate governance and project governance (or ICT-governance). Next to this, governance can be employed in terms of hierarchy, markets, and networks. Probably the most known and controversial form of governance is 'corporate governance'[9] (Clarke, 2004). From a historical point of view corporate governance (and the literature about corporate governance) mainly dealt and still deals with the safeguarding of a sound administration of the company (good governance) where the goal is to protect the interests of stakeholders and prevent opportunistic behavior from managers. The principal players are the shareholders, management and the board of directors. Other stakeholders include employees, suppliers, customers, banks and other lenders, regulators, the environment and the community at large. Although the governance of a science park closely resembles the governance of a corporate institution, the literature on corporate governance seems too narrowly focused on the shareholders, management and the board of directors of a company and as such is not suitable to answer the research question of this study.

When consulting the Merriam-Webster Online dictionary (Merriam-Webster, 2007[10]) it returns two definitions for the term governance:

- lawful control over the affairs of a political unit (as a nation)
- the act or activity of looking after and making decisions about something

Related to the first definition it can be said that governance is related to the exercise of authority or control on a political level; which can be a nation or some other institutional body. Regarding the second definition it can be said that governance is a method or system of government which closely resembles the function of management. When transferred to a business setting these two definitions resemble the top-down approach exercised in organizational forms like; 'small scale operations', the functional form, the vertical integrated company, the divisional form, business units, business groups, franchises, and the matrix-organization, where the basic premise is that the companies are supposed to act as autonomously as possible (De Man, 2004). This form of governance is also known as the 'hierarchical form of governance' (Dekker, 2004).

In the network literature other forms of governance are discussed where the top-down control mechanisms are not so useful (De Man, 2004). In networks and alliances the basic premise is to cooperate with other parties to achieve the goals of the participants. This form of governance is also referred to as 'hybrid governance structures' (Dekker, 2004). Jones et al. (1997) discuss governance on the network level. Network governance is the interfirm coordination that is characterized by organic or informal social systems which contrast with the bureaucratic structures described above (Jones et al., 1997).

[9] see for example the Enron saga; (Clarke, 2004)
[10] http://www.m-w.com/cgi-bin/thesaurus?book=Thesaurus&va=governance

Science parks have many overlapping aspects with networks but the definition of network governance is only partially applicable for the perspective of science park governance[11]. In the science park setting aspects of proximity, science park management, a wide set of different stakeholders, and formal contractual relationships are different when compared to the setting in networks. Therefore, in this paper a definition is proposed for science park governance which augments the network governance definition put forward by Jones et al. (1997). Science park governance can be thought of as an intermediate form between network governance and hierarchical governance (see figure 9).

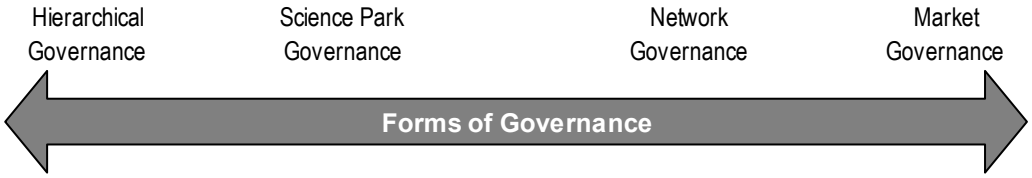


**Figure 9: Forms of Governance**

## 4.2. Proposed Definition of Science Park Governance

Science park governance involves a select, persistent, and structured set of autonomous firms (as well as non-profit agencies) that are located in a confined area and engaged in creating products or services. Science park management facilitates the linkages between the autonomous firms based on both explicit and implicit contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts can be both socially and legally binding.

In this definition 'persistent' implies that the science park members work repeatedly with each other over time. These collaborations are facilitated by the infrastructure and linkages made available by the members and the science park management and that, in turn, create and re-create the network structure. This implies that the science park governance is a dynamic process of governance, alike that of network governance, with the addition of a stable factor in the form of a science park management.

With 'structured' it is indicated that the transactions within the science park are patterned, thereby reflecting a division of labor within the science park. 'Autonomous firm[12]' points towards the (potential) legal independence for each element of the science park.

'Explicit contracts' refers to means of adapting, coordinating, and safeguarding transactions that are derived from authority structures or from legal contracts whereas 'implicit contacts' refer to means of adapting, coordinating, and safeguarding transactions that are not derived from authority structures or from legal contracts. In science park governance, science park management is the focal entity which enables cooperation between the members. This implies that not all members have to be connected to each other and can have their own networks that may or may not cross the boundaries of the science park. To enhance cooperation, science park governance incorporates a limited set of authority structures and legal contracts but rests for the larger part on social coordination and control, such as occupational socialization, collective sanctions, and reputations.

## 4.3. Science Park Governance and Governance Forms

Having defined science park governance, one fundamental question still remains from this governance perspective: *Why do firms cooperate in a science park setting as a specific governance mode?* Many hypothetical organizational forms never arise or die quickly because of inconsistently

[11] In line with the definition of network governance of Jones et al. (1997) the term 'science park governance' is used, rather than 'science park organization', because many scholars in management define organization as a single entity. 'Governance' more accurately captures the process and approach to organizing among firms that is discussed here. In a science park part of this 'governance' can be facilitated by a single entity like 'science park management' but next to this there are processes and approaches of organizing among the firms that fall outside the scope of a single entity.

[12] Jones et al. (1997) point towards the fact that these autonomous firms can also include 'quasi' autonomous firms like business units that share common ownership or that directly invest in each other.

combined features. The literature on science parks reports some successful examples but also many failed attempts. Examples of successful initiatives in developing regions in Asia are the creation of Zhonggunacun Science Park (ZSP, 1988) in Beijing (Zhu and Tann, 2005) and Hsinchu Science-Based Industrial Park (HSIP, 1980) and Tainan Science-based Industrial Park (TSIP, 1997) in Taiwan (Chen and Choi, 2004; Chen, Tzeng and Tarn, 2004; Lin, 1997). In contrast, India established 13 parks in the late 1980s but with the exception of Bangalore, India's Silicon Valley, all have failed (Phan et al., 2003). An empirical question remains whether science park governance is a sustainable governance mode, but as already stated, apart from the location and administrative support advantages, several authors even have questioned the value of science parks (Hansson et al. 2005; Chen and Choi, 2004).

Traditionally, transaction cost economics deal with defining the best generic mode (market, hybrid, firm, or bureau) to organize X (Williamson, 1999), so, can science park governance be defined as a new mode of governance or is it a mix of existing governance modes? Williamson (1999) notes that each governance structure has it own strengths and weaknesses and by mixing in elements of other governance modes it is believed that drawbacks can be mitigated (Powell, 1990). A related question is the size that a science park should have in order to be better than alternative governance modes.

Table 3 presents an initial institutional comparison of science park governance with market, hierarchy and network structures (see Williamson, 1991; Demil and Lecocq, 2006 for a discussion on the items). Science park governance is based on a neoclassical contract, which is defined as contracts in which the parties to the transaction maintain autonomy but are bilaterally dependent to a nontrivial degree (Williamson, 1991). As a governance form it closely seems to resemble network governance but shows some deviations in the tone or climate of relationship. An extra dimension of science park governance, besides the neoclassical contract with its residents, would be the aim for linking the residents to each other.

**Table 3: An initial comparison of generic governance structures (adapted from Demil and Lecocq, 2006[13])**

| | **Science Park** | **Market** | **Hierarchy** | **Network** |
|---|---|---|---|---|
| *Contract law regime* | Neoclassical contract | Classical contract | Employment contract | Relational (neoclassical) contract |
| *Normative basis* | Exchange | Market exchange | Forbearance | Exchange |
| *Identity of the parties* | Relevant | Irrelevant | Irrelevant | Relevant |
| *Mean of communication* | Routines and embedded ties | Price | Routines and hierarchical relations | Embedded ties |
| *Temporal framework* | Long term | One-shot | Unlimited | Long term |
| *Nature of incentives* | Reciprocity | Competition | Career advancement, status concerns | Reciprocity |
| *Incentives intensity* | Medium | High | Low | Medium |
| *Control intensity* | Medium | Low | High | Medium |
| *Tone or climate* | Cooperation | Precision and/or suspicion | Formal Bureaucratic | Coopetition |

One argument for the existence of science park governance can be the economies of scale and scope in terms of rental prices of the premises and offered services, which lowers the administrative costs. However, often these rental and service prices are higher than comparable alternatives outside the science park premises, indicating that there are sources of value that counterbalance these high costs. One could argue that these high costs for rental space and related services act as a natural selection mechanisms, where only companies would survive that really benefit from the added value of being located on the science park (or who can afford the investment of these costs for some other reason). However, this still presents a dilemma for one of the target customers, the (high tech) start-up companies, which cannot really afford these high fixed charges. One of the mechanisms invented to compensate this dilemma is the installation of (business) incubators, but these are primarily

[13] Demil and Lecocq (2006) also present a new governance form which they define as 'bazaar governance' and is originating in the governance of open source/ license initiatives.

aimed at bringing an existing technology to market with the help of seed capital. To date limited mechanisms are present, outside the artificial governmental grants, which offer high-tech start-ups the pre-seed capital to develop the technology itself. In the United States this dilemma is solved by the cultural habits of the entrepreneurs which people often relate to the so-called garage entrepreneurs (See Audia and Rider (2005) for a critical view on this highly popular contemporary legend). In contrast, in certain Asian countries this dilemma is off-set by the installment of heavy governmental support (Zhu and Tann, 2005). Philips, for example, supports these small new companies by providing specific services in exchange of shares in the small company. But this is only one example of how companies try to cope with this problem. What follows is that a better understanding is needed what exactly constitutes 'science park governance' and how this results in the specific added value in comparison with alternative governance structures.

## 4.4. Conclusion

In this chapter the term 'governance' is defined. A definition of 'science park governance' is formulated based on insights from transaction cost economics and network theory. Science park governance involves a select, persistent, and structured set of autonomous firms (as well as non-profit agencies) that are located in a confined area and engaged in creating products or services. Science park management facilitates the linkages between the autonomous firms based on both explicit and implicit contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts can be both socially and legally binding.
Science park governance seems to be a mix of hierarchical and network governance modes but until this point it remains unclear what the balance is between these two acting governance mechanisms.
In order to investigate why companies reside together on a science park an initial comparison of 'science park governance' is made with the three generic modes of governance. Questions that arise are whether the 'science park governance' is a distinct governance form and whether it is a sustainable one. The initial comparison points in the direction of a hybrid governance form but this does not explain why certain science park fail where others sustain. Also, it remains unclear what the added value is of the science park. It can be concluded that further investigation is needed to identify the existence of 'science park governance' and whether it is a sustainable governance structure.

# 5. Conceptual Framework and Research Design

This chapter deals with the conceptual framework and the empirical part of the research and consists of seven parts. The first part of this chapter introduces the conceptual framework used for this research. The second part discusses how strategy and organizational processes are linked with the business model concept. The third part shows the link between technological inputs and economic outputs. After this the fourth section introduces the four value sources that lead to value creation and appropriation. Section five and six discusses the aim, design and expected results of the empirical research. Finally, the seventh part concludes this chapter.

## 5.1. Introduction

Prior to this study, a set of seven organization theories (OT) have been reviewed to see to what extent they describe the characteristics of the science park phenomenon (see Appendix D for an overview of the results). It was found that none of these theories cover each distinct source of value creation within and between organizations in an equal matter (see also Amit and Zott, 2001). To cope with the problems of using one single organizational theory many scholars have argued for the application of a multidimensional approach (Amit and Zott, 2001; Gomes-Casseres, 2003; Madhok and Tallman, 1998). Because the theoretical frameworks have different units of analysis, the first step towards an integrated theory would be the definition of a unit of analysis that captures the sources of value (Amit and Zott, 2001).

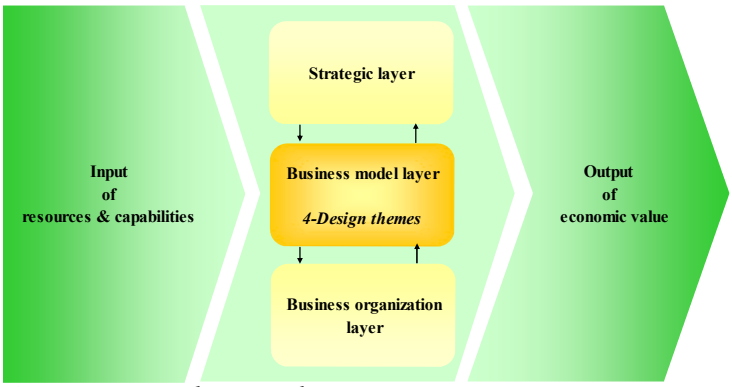


**Figure 10: Conceptual Framework**

The business model is used as the unit of analysis because it explains the value creation and appropriation during the transfer of knowledge into commercial value (Amit and Zott, 2001; Chesbrough and Roosenbloom, 2002; Osterwalder et al., 2005). A business model (BM) is defined as a conceptual tool that contains a big set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams (Osterwalder et al., 2005). This implies that the business model is a conceptual tool that can be used for analyzing the strategy and organization & processes of institutions. The concept of a business model is consistent with transaction cost economics (TCE), Schumpeterian Innovation, Resource Based View (RBV) and Network Theory (Amit and Zott, 2001). Furthermore, the business model has strong links with the Value Chain perspective (Porter, 1985; 2001) and plays a central role in the Open Innovation concept (Chesbrough, 2003). Agency theory and stewardship theory complement the business model concept by providing tools for understanding and aligning the interests of stakeholders (see Clarke, 2004 for a comprehensive overview on the subject of corporate governance). The business model is believed to be applicable in the context of a science park management because it closely resembles the management role of that in other industries and companies (Chen et al. 2004). One can think of the science park as a single entity (institutional form) with distinct strategic goals and the residents as her customers.

Figure 10 shows the place of the business model within the conceptual framework used during this study. Next to the relationships described above the business model can contain four sources of value creation and appropriation (Amit and Zott, 2001). In the subsequent sections the framework is discussed in more detail. First, the relationship with strategy and the organizational processes is described. Second, the business model as tool for converting technological inputs into economic outputs is outlined. Third and lastly, the four design themes (or value sources) are discussed within the context of science parks.

## 5.2. The BM: Linking Strategy and Organizational Processes

Following the definition of the business model, the concept can be seen as a translation of an organization's strategy into a blueprint of an organization's logic of earning money. In figure 11 the relationship between strategy, business model and the business organization[14] can be seen. This view of the business model differs from other perspectives. Chesbrough and Rosenbloom (2002) for example, view the *competitive strategy* as an integral part of the business model concept, although they do make a distinction between strategy and business model.

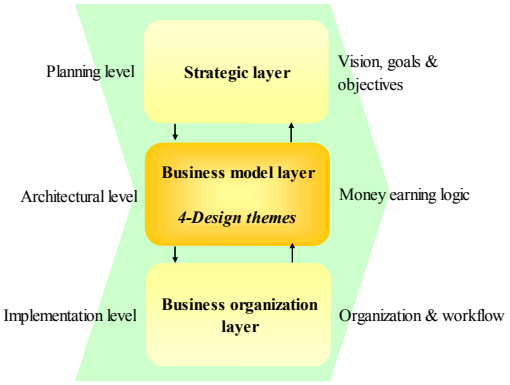


**Figure 11: Business layers (Osterwalder, 2004)**

*Business Strategy*

Business strategy is difficult to define because little consensus exist on the subject (Osterwalder, 2004). In this paper *business strategy* is defined as the vision, fit with SWOT, positioning, goals and objectives of a company (Osterwalder, 2004). The corporate strategy is a superset of business strategies (see Chesbrough and Rosenbloom, 2002). The strategy is to a large extent based on the objectives of the stakeholders, however, in this paper the perspective of contingency theory (Hatch, 1997) is adopted which postulates that the business strategy is moderated by the external forces a company faces. These external forces also influence the business model layer and the business organization layer since these layers address similar problems on different levels (Osterwalder, 2004).

*Business Model*

The business model literature puts forward several definitions and business model components (see for example; Amit and Zott, 2001; Chesbrough and Rosenbloom, 2002). As a result on this, Osterwalder (2004) developed a business model ontology that accurately describes the business model of an organization. He identified nine related business model elements for representing the business model (see table 4).

[14] in this specific context 'Business organization' matches the term 'science park governance' as defined in section 3.4

**Table 4: Nine related business model building blocks (Osterwalder, 2004)**

| | |
|---|---|
| ***value propositions:*** | The company's offers which bundle products and services into value for the customer. A value proposition creates utility for the customer. |
| ***target customer segments:*** | The customer segments a company wants to offer value to. This describes the groups of people with common characteristics for which the company creates value. The process of defining customer segments is referred to as market segmentation. |
| ***distribution channels:*** | The various means of the company to get in touch with its customers. This describes how a company goes to market. It refers to the company's marketing and distribution strategy. |
| ***customer relationships:*** | The links a company establishes between itself and its different customer segments. The process of managing customer relationships is referred to as customer relationship management. |
| ***value configurations:*** | The configuration of activities and resources. |
| ***core capabilities:*** | The capabilities and competencies necessary to execute the company's business model. |
| ***partner network:*** | The network of cooperative agreements with other companies necessary to efficiently offer and commercialize value. This describes the company's range of business alliances. |
| ***cost structure:*** | The monetary consequences of the means employed in the business model. |
| ***revenue model:*** | The way a company makes money through a variety of revenue flows. |

*Business Organization*
The business organization layer is the operationalized level of the business model and consists of the governance structure and mechanisms. This also includes issues like organizational form, structure and workflow.

## 5.3. The BM: from Technological Inputs towards Economic Outputs

A business model depicts the way of creating value through the exploitation of business opportunities (Amit and Zott, 2001). The three business layers together show the dominant logic of the firm that creates focus and internal coherence among the firm's activities. Chesbrough and Rosenbloom (2002) argue that this path-dependency optimizes the money-making organization for certain situations (or technologies) but makes them blind for other opportunities that do not fit well with firm's current business model. Figure 12 shows the business model as the mediating concept between the (technological) inputs of resources and capabilities into outputs in terms of economic outputs. As Chesbrough and Rosenbloom (2002) argue, the ultimate role of the business model is to ensure that the technological core of the innovation delivers value to the customer. In this paper the inputs are defined more broadly in terms of inputs of capabilities and resources, thereby also including more service-oriented organizations like science parks.
There is a strong link between science parks and 'value constellations' (Normann and Ramirez, 1993; Vanhaverbeke and Cloodt, 2006) which are defined as 'interorganizational networks linking firms with different assets and competencies together in response to or in anticipation of new market opportunities' (Vanhaverbeke and Cloodt, 2006, pg 259). In a value constellation the anchor company has as their strategic task to (re)configure the roles and relationships among this constellation of actors to mobilize the creation of value in new forms and by new players (Normann and Ramirez, 1993). In this constellation every role is aligned in such a manner to maximize the value for the end customer but more important, it also creates more value for the other actors in the constellation and this is where there is a break with 'traditional' strategy. In traditional strategy a firm tries to maximize value by positioning itself in the value chain in such a way to create a competitive advantage relative to its competitors by means of cost leadership or differentiation (Porter, 1985). The main focus is on the firm itself and not on the collaboration with other partners in the value chain (or network).

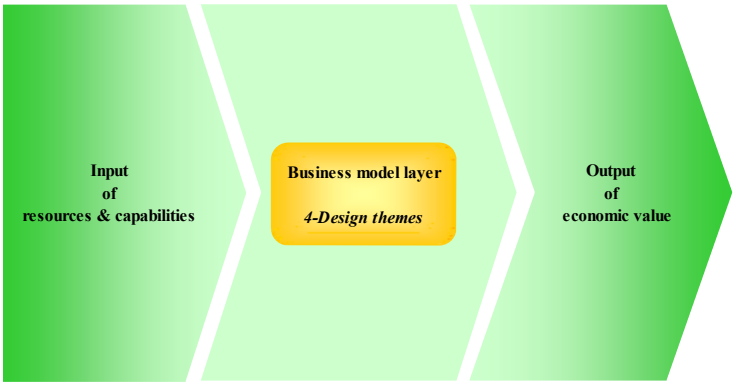


**Figure 12: The business model as a mediating construct (Chesbrough & Rosenbloom, 2002)**

In a value constellation the incentive for companies to collaborate lies in the possibility to maximize the joint value for each partner which could not have been realized outside the value constellation. Network partners have to find the optimal configuration that allows all the companies to benefit and prevent opportunistic behavior. In a science park the focus is not on aligning companies for the benefit of one product or service but on enhancing the opportunities for value creation and appropriation. In a sense, the value creation is facilitated on the level of the science park where the value appropriation is achieved on the level of the residents. On a science park the residents can both be the customer and partner in the value constellation. An example is a catering company which benefits from the scale opportunities brought forward by the science park concept but also is part of the value constellation with respect to the catering service it provides to the other residents. As such, the science park can be compared to a 'business ecosystem' where the primary goal is to create new value through the increased number and variety of information, services, and products available to the customer, or otherwise stated; its residents (Gossain and Kandiah, 1998).

## 5.4. The BM: Four Design Themes

The value created by a science park for its residents is the primary focus for the framework because this creates the drivers for residents to enter the science park and the possibilities for science park management to create value for the science park itself. The business model can contain four sources of value creation and appropriation (Amit and Zott, 2001). In a design-oriented view these sources of value creation can be regarded as the design themes of the business model. The business model can be built around the following design themes; *efficiency*, *complementarities*, *lock-in* and *novelty*. Novelty, efficiency, lock-in and complementaries also are useful design themes for science parks because both rest on complex network transactions between participants with different goals. The corresponding model is presented in figure 13. In the following sections the design themes are described in the context of a science park, loosely following the line of thought put forward by Amit and Zott (2001, 2002, and 2007). In addition, their links with governance modes are described.

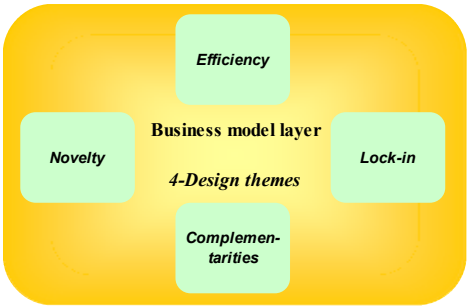


**Figure 13: Design themes of Business Model (adopted from Amit and Zott, 2001)**

*Efficiency*

Transaction efficiency increases when the costs per transaction decrease (Williamson, 1985). Beneficial efficiency mechanism for on-site participants, relative to off-line participants, can be realized in a number of ways. Science park management can reduce information asymmetry between residents in horizontal and vertical directions through the supply of up-to-date and comprehensive information. The proximity of a large pool of resources and capabilities and the application of a fast and convenient infrastructure makes a science park a potentially efficiently environment for participants[15]. By providing improved information for (potential) residents search and bargaining costs can be reduced, for example by providing a one-stop-shop facility for NTBF's. Furthermore, opportunistic behavior is reduced by providing transparent information to all participants (Williamson, 1975). The transaction efficiency is further enhanced by enabling faster and more informed decision making for residents (and especially NTBF's). According to agency theory the incentives for self-control of science park management can be enhanced by aligning goals of shareholders and managers and applying proper reporting and decision-making patterns (Clarke, 2004). But as stewardship theory proposes, different relationships in terms of agents versus stewards may be utilized to work as efficiently as possible.

Efficient processing of information is the criterion for choosing the right organizational form. Information technology can lead to a higher level of information and consequently lead to a reduction in the costs of coordinating and executing transactions (Clarke, 2004). Furthermore, by providing shared facilities, processes can be streamlined leveraging the benefits of scale economies. The efficiency of a science park is depending on the contributions of all partners in the value network where science park management can act as the intermediate coordinator. But, because specialized governance structures are costly, they are only used when the frequency of the transactions are high (Jones et al., 1997).

*Complementaries*

When a bundle of goods together provides more value than the total value of having each of the goods separately complementaries (or synergies) are presents (Amit and Zott, 2001). In an open innovation setting like that of a science park, the probability of interaction between possible complementors is larger due to the proximity and enhanced communication channels. Therefore, according to the Resource Based View (RBV) complementaries as a strategic asset can be a source of value creation (Amit and Schoemaker, 1993). Network theory implies that in a science park the formal and informal networks between participants can play an important role in enabling complementaries (Gulati, 1999). Next to this, as Jones et al. (1997) argue, network governance facilitates integrating multiple autonomous, diversely skilled parties under intense time pressures to create complex products or services. When science park management behaves as a team coordinator, where diversely skilled participants work congruently, the value added of the products and services increase due to the complementary benefits, but moreover efficiency increases due to improved communication and coordination. The implicit argument made here is that the residents of the science park should be related in such a way that there is a need for cooperation, implying focus in the mix of residents.

Besides this, science park management can offer bundles of services to participants (off- and on-site) and create linkages on a vertical and horizontal level between participants and partners. Science park management can play a role in providing diversified ways to market for technologies developed on-site or act as leverage in attracting technologies from outside. In this way science park management can create complementaries between on-site and off-site activities, which is the essence of creating value in open innovation (Chesbrough, 2003). Indirect complementary services like sport facilities and free communication channels are also desirable for value creation because it facilitates

[15] Here the term 'participant' is deployed instead of 'residents' because the environment outside a science park is also part of the ecosystem, which spreads beyond the borders of the science park.

communication among participants and can help in the creation of an '*esprit de corps*'. This is in line with transaction cost economics, where reciprocity of personal contacts is perceived as a tool to create coherence among participants concerning goals and interests (Jones et al., 1997).

*Lock-in*

Lock-in prevents residents to migrate from the science park or source services externally. In the case of a science park the value creating potential is enhanced by the extent to which residents are motivated to stay located on-site and engage in repeated transactions (e.g. make use of services provided by science park management directly or through third parties). Next to this, the extent to which strategic partners have incentives to maintain and improve their association with the science park is an important aspect for value creation because this may lead to increased willingness to facilitate the residents and also lower the opportunity costs for these strategic partners.

Switching cost (Williamson, 1975) is one form of lock-in, next to network externalities (Katz and Shapiro, 1985). Also the reputation of the science park, manifested in the perceived image and trust, are strategic assets to create lock-in (Amit and Zott, 2001) and which depends on the relational embeddedness that exists between all the (pairs of) stakeholders (Granovetter, 1992). Because science parks, in general, aim for long term goals (innovative output) trust in relationships is a very important factor. Personal power, in terms of respect and expertise, can create lock-in for the participants and is in line with stewardship theory. Furthermore, science park management can increase switching cost by creating loyalty programs (Varian, 1999) and by creating trustful relationships with the residents. One example of lock-in can be created by enabling residents to customize their products, services or information to their individual needs in a variety of ways just like is common in e-business (Amit and Zott, 2001). On the other hand, customization also makes the science park management dependent on the resident because the science park management cannot sell or transfer the product or service easily to another customer (Williamson, 1985). This raises questions about how to safeguard these exchanges, since both Science Park and resident become more vulnerable to shifts in markets (Jones et al., 1997). In a science park, where the most important type of information is tacit knowledge (high level of human asset specificity), an organizational form is required that enhances cooperation, proximity, and repeated transactions (Jones et al., 1997). From this follows that customized exchanges, which are based on the exchange of primarily tacit knowledge, are effectively coordinated by either hierarchies or networks.

Network externalities (Katz and Shapiro, 1985) are present in the science park because the science park becomes more attractable for residents when the size of the number of (value adding) residents and the wider ecosystem increases. When, for example, a research institute is establishing itself on a science park it is more attractive for other potential members. The opposite also holds, when a science park is unattractive and looses its residents it becomes less attractive for current residents.

In a science park the creation of a community bonds the residents to the science park because the networks which are built-up over time are a valuable asset, thereby raising switching costs.

Indirect network externalities exist when the presence of more residents makes the science park more attractive for potential employees, governmental institutes, research institutes and service companies. Efficiency and complementaries are a source of lock-in (Amit and Zott, 2001) and *vice versa*.

*Novelty*

Open innovation states that the way a company does business, by means of a business model, also can be a source of value creation (Chesbrough, 2003). So, next to the introduction of new products or services, new methods of production, distribution, marketing or the tapping of new markets (Amit and Zott, 2001) especially the business model determines success.

Science park management should promote a culture of innovation and provide an incubation function. Science park management can act as an intermediate for residents by supporting novel business models and linking internal and external ideas between on- and off-site companies. Managing intellectual property rights and create novel ways of measuring innovation capability and

performance are important aspects for a science park, and should be facilitated. Finally, novelty can enhance efficiency, complementaries and lock-in in unprecedented ways (Amit and Zott, 2001). Governing novel initiatives is related with uncertainty. From the perspective of the science park management this can be the uncertainty about the adoption of new services by its residents. From the perspective of the residents there is a relatively high demand uncertainty (new technologies, new markets) which leads to a situation where firms focus on certain parts of the value chain, and outsourcing or subcontracting other activities, because vertical integration becomes very risky (Jones et al., 1997). The science park governance structure therefore should support this need for flexibility, due to demand uncertainty, by enhancing the conditions for network and market transactions rather than hierarchy based transactions.

*Interaction effects of the four value sources*

Generally said, the four value sources can create value by increasing the residents' (customers') willingness to pay for the science park's offerings by means of novel and complementary services, by decreasing suppliers' and partners' opportunity costs through improved efficiency of transactions, and by increasing transaction volume by means of locking-in residents. These value sources are neither orthogonal nor mutually exclusive (Amit and Zott, 2001; 2007), hence, in theory they can reinforce each other. Specialized governance mechanisms that enhance efficiency should only be used when there is a high reciprocity, frequency, and/or complexity of transactions. But these governance mechanisms (which are most often hierarchical) should not interfere with the needed flexibility due to the high demand uncertainty. As Jones et al. (1997) argue, in the situation of demand uncertainty and customized, human asset specific transactions network governance balances the competing demands of, respectively, disaggregation and coordination and integration. This is where the added value of the science park management comes into play, the coordination (and integration) of transactions between independent organizations. The question still remains which balance the science park management should create between the deployment of hierarchical, network, and market based governance mechanisms to prevent negative effects on the potential value creation and appropriation by means of the four value sources. Next to the hierarchical and market mechanisms, Jones et al. (1997) provide an initial set of social mechanisms that are deployed in network governance. These social mechanisms are; (1) restricted access, (2) macro culture, (3) collective sanctions, and (4) reputation. Each of these mechanisms facilitate the adaptation, coordination, and safeguarding of transactions. Restricted access reduces coordination costs of customized, complex transactions but also has a tradeoff with novelty because the mix of residents is restricted. Macro culture, as a system of widely shared assumptions and values (Jones et al., 1997) reduces coordination costs for customized, complex transactions, and can both limit (not invented here syndrome) and enhance novelty. Collective sanctions facilitate safeguarding customized transactions for parties, therefore reducing monitoring costs. But on the other hand it also can harm potential value creation when the collective sanction was based on wrong information, therefore possible harming all four value sources. Finally, reputation enhances the safeguarding of customized exchanges, but can also be limiting because reputation can be based on inaccurate information. Next to this, new technology based firms often have to prove themselves making it difficult to use reputation as governance mechanism. As Jones et al. (1997) report, the interaction of these social mechanisms in network governance may promote cooperative behavior while at the same time creating problems (social dilemmas).

*Conceptual model*

Value creation and the value sources are supposed to influence each other in a particular way. These expectations are based on the findings in science park literature and knowledge from organizational theories which are combined in the conceptual framework developed in this chapter. The adopted view for the conceptual model is that the governance structure (or business model) of the HTCE should facilitate the business processes of her residents.

The main question during the empirical research is: *how does the governance structure/business model of the HTCE facilitate the business processes of its residents*? This is done by looking at how the four value sources are integrated in the business model of the HTCE and how this facilitates the value creation and appropriation on the HTCE (and its residents). Based on the literature research four expected relationships can be defined. First, it is expected that *efficiency offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because it reduces transaction costs within and between companies. Second, it is expected that *complementaries offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because it increases the opportunities for residents to co-operate with other residents, or even partners, and increase value. Third, it is expected that *lock-in offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because it lowers opportunistic behavior by residents and, hence, offers opportunities for long-term relationships. Fourth, it is expected that *novelty offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because this increases the chances for creating new products and services by the residents. The relationships all are expected to be positive.

## 5.5. Empirical Research: Aim and Variables

The aim of the empirical research is to give answer to the general research question: '*How can governance be structured at the High Tech Campus Eindhoven to benefit maximally from it, i.e. maximizing output in terms of technological innovations?*' (see section 1.5). To answer this question, the empirical research uses the findings from the theoretical analysis (previous chapter). These findings are expressed in independent and dependent research variables.

*Independent Variables*

In section 5.1 it was argued that the use of multiple theories provides interesting insights into the phenomena of science parks and that no single theory can explain all the characteristics by itself. Therefore, the idea was put forward to adopt a multidimensional approach with the business model as the unit of analysis. Next to this, the value sources that influence the potential level of value creation and appropriation on a science park were discussed. So, together with the nine building blocks of the business model and the value sources form the 36 independent variables of this study. See figure 14 for a visual overview and appendix E for a more detailed overview.

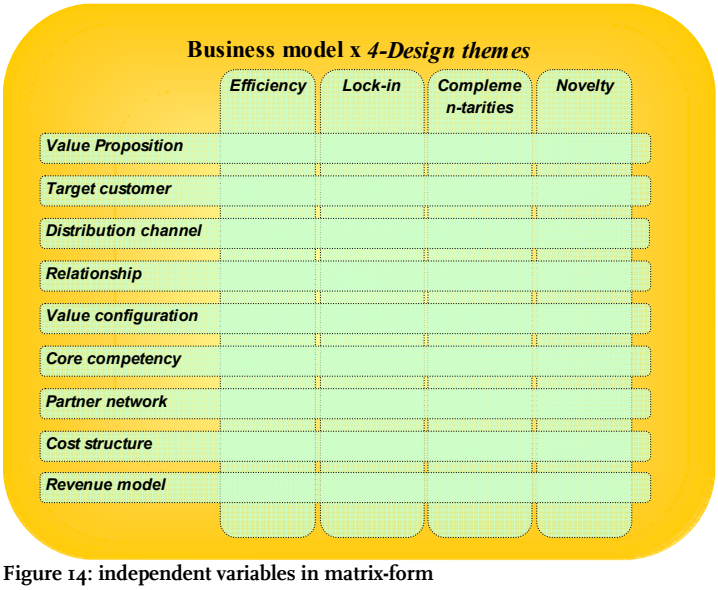


**Figure 14: independent variables in matrix-form**

*Dependent Variables*

The governance on the science park should support and strengthen the value creation and appropriation. The framework developed in the sections 5.2, 5.3, and 5.4 discussed the value creation and appropriation on the science park as the output variable. Value creation and appropriation are not directly measurable and should be operationalized. A number of problems occur if one wants to operationalize value creation and appropriation in this specific situation. First of all, Chapter 3 showed that the current performance measurement used for assessing science parks is subject to difficulties (Siegel et al., 2003a). Because different stakeholders have different expectations, a single measure of value creation and appropriation is not sufficient (see Table 2 in chapter 3 for an overview of the interests stakeholders have in a science park).

Secondly, there is considerable time-lag between an idea and the resulting commercial application of that idea in a particular technology area[16]. Because the HTCE is only open for other companies since 2004 it is likely to say that the output in terms of patents, (technological) innovations, and (financial) growth is not significantly influenced by being located on the HTCE. One could argue however that there is already a strong network originating from the former Philips Natlab which connects the residents. However, two arguments can be postulated against this, (1) this network was already in place before the HTCE opened up and in itself does not significantly prosper from specific benefits the HTCE gives and (2) new entrants with no connections with the Philips network cannot benefit from this network and need to get embedded in the local social network, which takes time. So, at a minimal it is questionable to say that the increase in output for the involved companies is due to the fact they are located on the HTCE.

Thirdly, measures of realized performance such as ROI, ROA are not used because they are less appropriate for young, high growth entrepreneurial firms that often have negative earning, few tangible assets and low (even negative) book values (Amit and Zott, 2007). Besides this, the financial figures are often difficult to acquire from small and entrepreneurial firms.

Fourthly, for larger corporations and institutions it is difficult to objectively measure the amount of value creation and appropriation that emanates from activities performed at the science park because it is difficult to asses which part of value is created at the science park, especially when the innovation is commercialized in a different business unit outside the specific science park.

Finally, regarding value appropriation of the residents and HTCE itself it is difficult to objectively define who gets a share of which pie because different value networks (constellations) can be identified.

In order to cope with the problems stated above value creation and appropriation is measured on two different levels, namely; value creation is measured at the science park level and value appropriation at the resident level. Because the HTCE is still in its growth phase, on the science park level it is reasonable to measure multiple indicators for growth. For this study the 'growth of new residents' is identified as a proxy for value creation at the HTCE level. Proxies like 'growth of FTE's (%)', 'growth of external investments' and 'growth of new services' also would be interesting measures for value creation but at this moment not all residents at the HTCE are growing (Philips has divested a lot of activities), all investments have been made by Philips, and no new services have been added.

[16] Matolcsy and Wyatt (2004) found that the average technological development period (TDP) is 7.75 years with a minimum of 1.5 years ranging up to a maximum of 39.24 years. Data was drawn from a commercial patent citation and scientific paper citation database (CHI Research Tech-Line¤) which covers about 67 percent of the total US and foreign patenting into the US patent market. The Tech-Line industries are: Aerospace; Automotive; Biotechnology; Chemicals; Computers; Conglomerates; Consumer Products; Electrical; Electronics; Energy; Engineering., Oil Field Svcs; Food, Bev. & Tobacco; Forest & Paper Prods.; Govt. Agencies; Health Care; Instrument. & Optical; Machinery; Materials; Metals; Misc. Companies; Pharmaceuticals; Research Institutes; Semiconductors; Telecommunications; Textiles; Universities.
Other studies show: "...companies applied for patents around 1 year before marketing their products" (Kondo, 1999). Time-lag of 3 years between patent applications and first commercial use was found by Comanor and Scherer 1969 (in: Ernst, 2001).Two-thirds (66.66%) of inventions were commercially exploited within 2 years of the patent application being filed (Napolitano and Sirilli, 1990). So these studies confirm a longer development time than the 3.5 years since the opening of the HTCE. Moreover since most new companies are relatively new to the HTCE.

Of course one could argue whether growth of new residents is a proxy for value creation on the resident level. This is indeed questionable, but for HTCE and CSM this directly will create value in terms of more revenue. But for the residents it will only indirectly create value by means of network externalities, reputation an alike. The danger in this is that one gets involved in circular reasoning because these items are already measured with the four value sources. A challenge lies here for future researchers to define better proxies for value creation, although in time the direct effects of the HTCE-concept are better measurable in terms of products and innovations.
On the resident level the value appropriation is measured by asking key respondents the perceived business performance of the company on the HTCE. In the alliance and network literature asking key respondents to what extent objectives were achieved proved to be an effective and scientifically established manner to establish success (Duysters, 2002). Next to this, various studies confirm that subjective or perceptual performance assessment highly correlates with objective performance assessment (Lyles and Salk, 1996; Hansen and Wernerfelt, 1989; Bart et al., 2001; Gehringer and Herbert, 1991; Kale et al., 2002). As such, the perceived measures can replace objective measures of business performance (Dess and Robinson, 1984). The Bontis (1998) approach is used for measuring the perceived business performance of the organization on the HTCE (Bontis et al., 2000; Khong and Richardson, 2003; Khong and Mahendhiran, 2006). See appendix F for an overview of the items. Note that value appropriation here is defined as the value that shareholders appropriate (Amit and Zott, 2002). This is different from the value appropriation used in value constellations where the players in a value constellation have to receive a relative equal share of the pie in order to be sustainable successful (Normann and Ramirez, 1993; Vanhaverbeke and Cloodt, 2006).

*Control Variables*
A number of control variables are taken into account for this research to control for possible confounding variables. On the firm level several characteristics are used; years on the HTCE, part of incumbent/multinational, type of firm/institute, and size of the firm on the HTCE. The years of the firm on the HTCE might influence the performance of firms because, it can be expected that these firms perform better due to their larger experience (Amit and Zott, 2002). The same logic goes for firm who are part of a multinational and the size of the firm due to possible economies of scale. All relations are expected to have positive signs. Furthermore, the sample will be controlled for the type of firm; this implies that service providers are compared with technological oriented firms. These technological oriented firms include technical service providers because these companies also develop new technological knowledge regarding the services they provide.

## 5.6. Empirical Research: Method

In this research the governance structure of the HTCE is investigated by looking how it influences the output in terms of technological innovations. Since the empirical research contains a single case, it is called *a single-case* study approach (Yin, 1994).

*Justification of the case study approach*
There are several reasons that justify the case study approach for this research. First, the case study approach takes the contextual conditions into account (Yin, 1994). Furthermore, it provides an integral image and acquires more aspect knowledge than other methods (Verschuren and Doorewaard, 2000). Besides this, the context is important for the acceptance of the solution in the wider organization (Verschuren and Doorewaard, 2000).
Second, the case study is especially useful when the research questions are in the *how* or *why* form (Yin, 1994). In this instance the empirical research tries to identify *how* the governance structure of the HTCE facilitates the output in terms of technological innovations (of its residents) and *why* it does that in that way. Furthermore, it is important to know *how* important the different aspects of the governance structure are for the stakeholders.

Finally, a case study uses multiple sources of evidence to improve construct validity, called triangulation (Yin, 1994). It is argued that triangulation will help improve construct validity because it forces the researcher not to rely on only a single source of information. In this study triangulation is necessary because information is stored in people's minds, documents and processes. The empirical research requires this data to converge in a triangular fashion.

*Unit of Analysis*
The unit of analysis is a critical factor in the case study. It is typically a system of action rather than an individual or group of individuals and tends to be selective, focusing on one or two issues that are fundamental to understanding the system being examined. The unit of analysis is in general related to the research question or proposals (Yin, 1994). In this research on governance on the HTCE the unit of analysis is the *governance structure of the HTCE*, as defined in chapter 1.5.

*Sample, Data Collection, and Methods*
To improve construct validity, data should be collected both qualitatively as well as quantitatively. Yin (1994) identifies at least six sources of evidence that provide the necessary information in case studies. This study uses multiple sources of evidence:

- Documents
- Discussion groups
- Questionnaire
- In-depth interviews

The documents used for the research are the E-magazines published on the website of the HTCE, the website itself and brochures. Because this research is part of a larger project, also preliminary and intermediate meetings, discussion groups, and personal interviews were organized and served as input for this research. The questionnaire is designed to test the propositions drawn up in chapter 5. The interviews are conducted to explain the findings obtained from the questionnaire and explore new patterns (Wass and Wells, 1994). The design of the questionnaire and the interviews are discussed below.

*Questionnaire Survey*
The survey is based on the four value sources put forward by Amit and Zott (2001). It draws on the questionnaire Amit and Zott (2002) developed for their study of business model design. By using this validated questionnaire a considerable gain was made with respect to time. The subjects of the questions of the original survey are changed to the context of science parks without changing the intent of the questions, thereby maintaining the validity of the measurement scales.
Two indicators of the novelty construct are discarded because of their irrelevance (see Appendix G for the adapted questionnaire). This results in 13 indicators for efficiency, 9 indicators for complementarities, 15 indicators for lock-in and 11 indicators for novelty, hence 48 indicators altogether. The strength of the indicators was measured using a Likert-type scale. The questionnaire was first pre-tested by four well-informed respondents to check for any ambiguity concerning the questions. After pre-testing, data was collected from 28 respondents during the period from 1 may 2007 till 15 June 2007 (see Appendix M for an overview of the respondents). The current population of the HTCE consists of 51 companies. The coding rules proposed by Amit and Zott (2002) for translating the measurements into standardized scores are depicted in appendix H. After coding, the indicators were aggregated for each value source into an overall score for the value source, using equal weights. This process yielded distinct quantitative measures for the level of efficiency, complementarities, lock-in and novelty associated with the HTCE business model as perceived by the residents of the HTCE. Because this approach discards the variance between the items for each construct they are analyzed separately to uncover patterns from these items.
The dependent variable was measured with the Bontis (1998) approach in order to define the perceived business performance of the organization on the HTCE (Bontis et al., 2000; Khong and Richardson, 2003; Khong and Mahendhiran, 2006). See appendix F for an overview of the items.

The internal consistency of the measures is validated with standard econometric techniques. The standardized Cronbach alpha coefficient was 0.762 for the efficiency measure, 0.759 for the complementaries measure, 0.723 for the lock-in measure, 0.679 for the novelty measure, and 0.831 for the performance measure. Therefore, all these measures sufficiently satisfy the threshold suggested by Nunnally (1978) for internal consistency.
The results from the questionnaire are analyzed with OLS regression analysis after checking the basic assumptions underlying this technique (Hair et al., 2004). Tests showed that the sample has no missing values and no outliers. Furthermore the assumptions for normality and linearity are in somewhat violated making it hard to interpret the results of the regression analysis in a sound manner (see Appendix I). The effect of the negative value for the kurtosis value for 'complementarities' and the effect on heteroscedasticity for some variables also could be influential for the results. All these violations of the data are probably a result of the small sample and should be taken into account with during the analysis. Furthermore, the validity and robustness were tested with three distinct approaches (Amit and Zott, 2002); (1) the model was tested for multicollinearity using variance inflation factors; (2) analyses were performed with different dependent variables; and (3) the data was checked for influential observations. The sample is too small to test for over-fitting of the data with help of a holdout sample. Appendix I shows an overview of these findings.
This OLS regression was used to investigate whether the four value sources are related with the identified proxies for growth on the HTCE. First, a base model was created after which all possible combinations of independent variables were introduced. Applying this protocol ensures that any discovered effects would be robust to the order in which the variables were entered. The full model consists of the four independent variables.
Due to the low sample size the probability of a type II error is relatively high, thereby decreasing the power of the statistical test. In this situation, with a model with one variable, a power of 80%, n=28, and $\alpha$=0.10 a significant change of 0.189 in the $R^2$ can be measured[17]. With a model consisting of four variables this figure increases to 0.290 for the $R^2$ measure.

*Interviews*
To increase the explanatory power of the questionnaire a set of semi-structured interviews with key decision makers are conducted. In totality, 32 in-depth interviews are conducted with respondents from 27 different residents (companies or business units) at the HTCE. Respondents are selected on decision making power regarding the location of the company (or business unit) on the HTCE. Respondents are CEO's, account managers, project managers, business unit managers and founders. Appendix N presents the full list of interviewees. The research was introduced in the Technology Liaison Club (TLO) by Cees Admiraal to increase the response rate. The respondents where contacted either by phone or e-mail. The willingness to cooperate with the study was relatively high; of the 41 persons who where addressed only 9 respondents had time-constrains or did not respond. This results in an effective response rate of 78%. Appendix J shows that the sample is representative for the whole population of residents at the HTCE.
Appendix K presents the utilized semi-structured interview scheme. The semi-structured interview scheme is based on the framework and reflects the nine building blocks of the business model. During the interviews no reference was made to the four value sources to prevent any bias to occur regarding these topics. During the interviews extensive notes were taken and recorded (audio) to prevent loss of information. The recorded conversations were written out in order to analyze the data with the program Nvivo. The recorded interviews have an average duration of 53.81 minutes and a total duration of 1614.23 minutes.

[17] Calculated with software available on http://www.power-analysis.com/ [Accessed on 17-6-2007]

## 5.7. Conclusion

In this chapter a framework is presented which places the business model in the center of logic doing business and earning money. The science park is defined as a single entity with distinct strategic goals and the residents as her customers. But next to this, the residents also are partners of the science park management since the latter needs to cooperation of the former to leverage the benefits of the science park to its fullest sense. The business model is useful as a unit of analysis because it covers multiple organizational theories in a systematic manner and therefore can combine several perspectives (or interests) in one framework. The framework explicitly combines three interrelated applications of the business model concept. The business model links the business strategy and business organization, serving as a conceptual tool for aligning the internal processes in both directions. This research focuses on the governance of the science park, which is part of the science park (business) organization. But in order to understand the organization it is essential to understand the strategic goals; the business model clarifies this in a conceptual manner. The same argument goes for understanding the governance and linking it with the strategy of the science park.
Next to this, the business model explains the money earning logic of a company where (technological) inputs are transferred into economic outputs. Because in a science park setting numerous stakeholders are involved, all with different interests, it is important to identify how inputs are transferred into outputs of economic value. Especially at the level of the value network, with partners, residents, and science park management as the primary stakeholders, it is important to identify how each stakeholder benefits. Lastly, the business model can contain or be designed around one or more of the four design themes efficiency, complementarities, lock-in and novelty. These design themes influence the potential level of value creation and appropriation of the company throughout all business model elements and business layers and describe how the stakeholders create value by means of the science park. Although all value sources are present in the business model of science parks, it is interesting to identify which value sources are of primary interest in creating and appropriating value. When this becomes clear, the strategy of the science park can be developed around of these value sources, then becoming the design themes of the business model, and hence the strategy and governance structure.
In the empirical part of this study the proposed framework forms the basis for the research design and analysis. By means of a case study the situation at the HTCE is analyzed. Using a questionnaire and semi-structured interviews, a rich dataset is collected that describes the current level of the value sources at the HTCE and its link with the value creation and appropriation. But what is more interestingly is the exploratory nature of the semi-structured interviews. By only using the business model as a reference during the interviews it becomes possible to uncover new patterns in the data that might explain formerly unknown characteristics of science park governance.

# 6. Results and Discussion

In this section the results from the questionnaire and the interviews are discussed. First an overview is given on the descriptive statistics and subsequently the conceptual model is tested. In the third section the theories of innovation are used to interpret these findings in the right context. The fourth section concludes this chapter.

## 6.1. Descriptive Statistics and General Results

Table 5 shows the descriptive statistics from the questionnaire. It shows that the average size of the companies in terms of number of employees is 69.8 employees; however, the high standard deviation indicates outliers in terms of numbers of employees due to a couple of large residents like Philips Research. Furthermore, the average time that the residents are located on the HTCE is 22.5 months (Opening HTCE = $t_0$ [01/01/2002]). When looking at the mean and median it is visible that most companies perceive the 'complementarities' as the primary value source in the HTCE-concept at this moment closely followed by 'lock-in' and 'novelty'. 'Efficiency' is perceived the least developed value source indicated by the negative sign. Moreover, all four value sources are not significantly different from the neutral zero. In contrast, the perceived business performance (PBP) is significantly positive, indicating that the residents perform well on the HTCE. When looking at the other measures of the 'PBP' it becomes clear that the standard deviation and range are relatively small. Given the population of the sample this is an obvious result because most companies are well funded initiatives with low uncertainty about the short future in terms of business survival.

**Table 5: Descriptive Statistics Questionnaire**

| | Mean | Median | Min | Max | STD | t-test [μ = 0] (p-value) | Number of Observations |
|---|---|---|---|---|---|---|---|
| *Efficiency* | -0.0907 | -0.192 | -0.88 | 0.42 | 0.329 | -1.459 (0.156) | 28 |
| *Complementarities* | 0.1032 | 0.0556 | -0.50 | 0.78 | 0.386 | 1.414 (0.169) | 28 |
| *Lock-In* | 0.0685 | 0.0944 | -0.60 | 0.73 | 0.273 | 1.325 (0.196) | 28 |
| *Novelty* | 0.067 | 0.1364 | -0.68 | 0.77 | 0.318 | 1.107 (0.278) | 28 |
| *Perceived Business Performance* | 0.4918 | 0.4857 | 0.20 | 0.80 | 0.164 | **15.895 (0.000)*** | 28 |
| *Number of Employees* | 69.8 | 6 | 0 | 1100 | 213.2 | - | 28 |
| *Months on HTCE* | 25.2 | 13 | 4 | 65 | 21.5 | - | 28 |

* Significant at the 0.001 level (1-tailed)

**Table 6: Testing Several Sub-groups of Sample (t-tests)**

| | Size [Cut-off < 10 FTE] | Part of Incumbent (No vs. Yes) | Service vs. Research | Time on HTCE [Cut-off = 13 months.] |
|---|---|---|---|---|
| *Efficiency* | 0.378 (0.356) | 0.622 (0.273) | 1.0172 (0.165) | -0.821 (0.213) |
| *Complementarities* | -0.517 (0.307) | **1.604* (0.067)** | -0.300 (0.384) | -0.687 (0.252) |
| *Lock-In* | 0.491 (0.316) | 0.614 (0.275) | 0.798 (0.220) | -0.071 (0.472) |
| *Novelty* | 1.232 (0.120) | 1.030 (0.162) | **2.618** (0.011)** | 0.290 (0.388) |
| *Perceived Bus. Perf.* | -0.196 (0.424) | 0.396 (0.349) | 0.867 (0.201) | **-2.878*** (0.006)** |

* Significant at the 0.10 level (1-tailed), Power = 64%
** Significant at the 0.05 level (1-tailed), Power = 93%
*** Significant at the 0.01 level (1-tailed), Power = 78%

As already discussed in chapter 3.2 there are multiple reasons for the residents (and stakeholders at large) to be involved in the HTCE concept. To test whether there are also differences in the sample of

the questionnaire the respondents are analyzed on their size, whether they are part of a larger company, whether their focus is technology or service, and the time they are established on the HTCE. The findings are depicted in table 6. The cut-off point for 'Size' and 'Time on HTCE' is determined by the median of the sample as the measure of central tendency. In this case the median is taken because this gives a better indication of what the typical score is with few deviant scores in the distribution (Graziano and Raulin, 2004).
Three significant differences are found in the results of the subgroups. Firstly, it appears that companies which are not part of an incumbent appreciate the complementaries significantly better than their counterparts. Secondly, service oriented companies perceive the HTCE-concept as more novel than the (technological) research oriented companies. Thirdly, companies that reside longer on the HTCE have a significantly higher 'Perceived Business Performance'. Table 7 shows the Pearson correlation among the variables used in the regression analysis.

**Table 7: Pearson Correlation Coefficients (2-tailed; N=28)**

| | **Efficiency** | **Com.** | **Lock In** | **Novelty** | **Perf.** |
|---|---|---|---|---|---|
| *Efficiency* | 1 | .472(*) | .536(**) | .444(*) | .142 |
| | | p=0.011 | p=0.003 | p=0.018 | p=0.473 |
| *Com.* | .472(*) | 1 | .453(*) | .385(*) | .365 |
| | p=0.011 | | p=0.016 | p=0.043 | p=0.056 |
| *Lock In* | .536(**) | .453(*) | 1 | .656(**) | .148 |
| | p=0.003 | p=0.016 | | p=0.000 | p=0.453 |
| *Novelty* | .444(*) | .385(*) | .656(**) | 1 | .105 |
| | p=0.018 | p=0.043 | p=0.000 | | p=0.597 |
| *Perf.* | .142 | .365 | .148 | .105 | 1 |
| | p=0.473 | p=0.056 | p=0.453 | p=0.597 | |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

**Table 8: OLS Regression Results. Dependent Variable: 'Perceived Business Performance'**

| | **Reg. 1** | **Reg. 2** | **Reg. 3** | **Reg. 4** | **Reg. 5** |
|---|---|---|---|---|---|
| *Constant* | 0.498 | 0.476 | 0.486 | 0.488 | 0.474 |
| *Efficiency* | 0.70 | | | | -0.16 |
| *Complementarities* | | 0.155* | | | 0.165* |
| *Lock-in* | | | 0.089 | | 0.010 |
| *Novelty* | | | | 0.054 | -0.022 |
| *R-squared* | 0.020 | 0.134 | 0.022 | 0.11 | 0.136 |
| *Adjusted R-squared* | -0.18 | 0.100 | -0.16 | -0.027 | -0.15 |
| *F* | 0.531 | 4.007 | 0.581 | 0.287 | 0.903 |
| *N* | 28 | 28 | 28 | 28 | 28 |

* $p < 0.15$

The results of the OLS regression with dependent variable 'Perceived Business Performance' are shown in table 8 (Appendix I shows the test with the inverse of 'months on HTCE', which is a proxy for growth of new residents, and gives comparable results). None of the regressions show a high R-square value; therefore the variance of the data is poorly explained by the regression model. Also, none of the Beta-coefficients is significantly different from zero ($p < 0.10$) indicating no significant relation between the value sources and the dependent variable. The models were also tested for the subgroups and this also gave no significant results. This can be a direct result of the low N of the sample because, as explained earlier, the probability of a type II error is relatively high and therefore the results fail to reject the $H_o$ of the regression models while it is not sure whether this is due to error or not. Another reason is the low variance in the dependent variable and the resulting low and non-significant correlation between the dependent and independent variables. This lack of correlation violates the linearity assumption of OLS regression analysis and makes interpretation of OLS regression results, at the least, difficult.

Figure 15 shows an overview of the distribution of discussed topics by the interviewed respondents. The percentage shows which proportion of the respondents mentioned that specific topic. In this calculation not the times a respondent recalls the same topic is measured but only whether the respondent mentions the specific topic to avoid bias regarding certain topics.
'Value configuration' is the most discussed 'Business Model' topic. When looking at the value sources 'efficiency' and 'lock-in' are important subjects. Especially the current 'lock-in' situation is positively rated. Efficiency is most often negatively rated, but on the other hand also receives an almost equal amount of positive comments. Somewhat surprisingly 'complementarities' is not very much entered upon, signaling that the respondents are more concerned with topics regarding 'efficiency' and 'lock-in'. Only a couple respondents discussed novelty, one reason for this should be looked for in the data collection method where the emphasis was not on the value sources but on the business model.

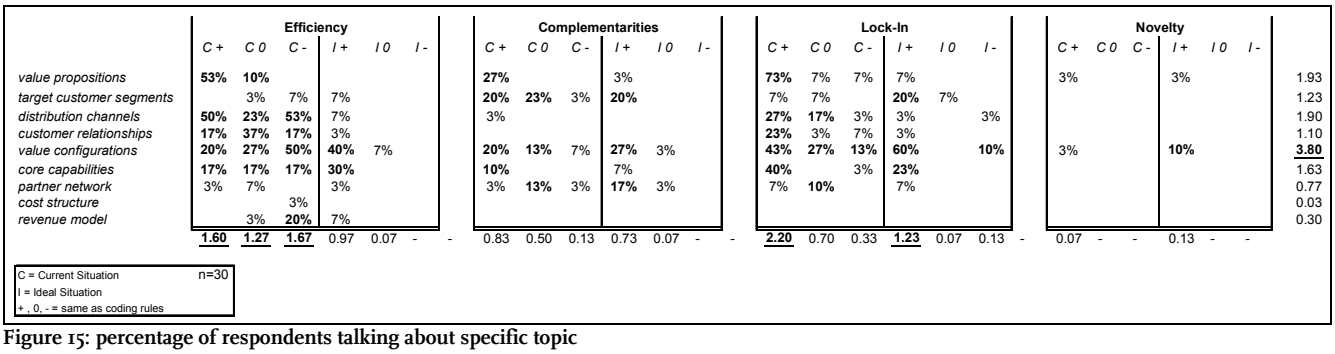

**Figure 15: percentage of respondents talking about specific topic**

## 6.2. Propositions Tested

In this section the propositions put forward in Chapter 5.3.6 are tested. The effect of the four value sources on the dependent variable is discussed with help of the findings from the questionnaire and the interviews. First efficiency is discussed followed by complementarities, lock-in, and novelty respectively. The findings are summarized in the last section.

**Table 9: Descriptive Statistics & t-test Efficiency Items**

| Item | N | Mean | Std. Error Mean | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | t | df | Sig. (2-tailed) | Mean Difference | 95% CI of the Difference | |
| | | | | | | | | Lower | Upper |
| e1 | 28 | .071 | .1142 | .626 | 27 | .537 | .0714 | -.163 | .306 |
| e2 | 28 | -.321 | .1156 | -2.780 | 27 | **.010*** | -.3214 | -.559 | -.084 |
| e3 | 28 | -.054 | .1101 | -.486 | 27 | .631 | -.0536 | -.280 | .172 |
| e4 | 28 | -.375 | .0838 | -4.473 | 27 | **.000*** | -.3750 | -.547 | -.203 |
| e5 | 28 | -.161 | .1386 | -1.159 | 27 | .256 | -.1607 | -.445 | .124 |
| e6 | 28 | .161 | .0964 | 1.667 | 27 | .107 | .1607 | -.037 | .359 |
| e7 | 28 | -.107 | .1216 | -.881 | 27 | .386 | -.1071 | -.357 | .142 |
| e8 | 28 | -.304 | .1040 | -2.920 | 27 | **.007*** | -.3036 | -.517 | -.090 |
| e9 | 28 | -.179 | .1098 | -1.627 | 27 | .115 | -.1786 | -.404 | .047 |
| e10 | 28 | -.089 | .1338 | -.667 | 27 | .510 | -.0893 | -.364 | .185 |
| e11 | 28 | .357 | .1202 | 2.970 | 27 | **.006*** | .3571 | .110 | .604 |
| e12 | 28 | -.071 | .1920 | -.372 | 27 | .713 | -.0714 | -.465 | .322 |
| e13 | 28 | -.107 | .1131 | -.947 | 27 | .352 | -.1071 | -.339 | .125 |

* p <0.05

### 6.2.1. Efficiency

The first proposition is; *efficiency offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because it reduces transaction costs within and between companies. This proposition is <u>not</u> supported by the results from the OLS regression analysis (see table 8). The negative sign (see Table 5) indicates that, in general, the residents perceive a slightly

inefficient working environment. This is reflected in the responses from the interviewees where more residents discuss the negative efficiency than the positive parts. When looking one level deeper into the efficiency items of the questionnaire it becomes visible that 'e2' (*reduce inventory costs*), 'e4' (*lower transaction errors*), and 'e8' (*transparent transactions*) are significantly negative while only 'e11' (*access to resources*) is significantly positive (see Table 9). These findings are also reflected in the results from the interviews.

During the interviews 50% of the respondents explicitly mentioned the proximity, and the ease of access, to their (potential) clients, resources or knowledge as their most important source of efficiency: "*The proximity is an advantage; you will get more easily into contact with other parties. An example is an employee from Philips who now is working part-time for us. Without the proximity this never would have happened.*" [AB] [18].
The service providers are primarily located on the HTCE in order to be close to their (potential) customers whereas the technological oriented companies primarily favor the proximity to technological resources, capabilities, and knowledge and besides this also look for information about technological trends. Interestingly, of all interviewed residents only a few interviewees perceived the sharing of facilities and the resulting cost-reductions as a source of value. Most other respondents (37%) perceived a lack of differentiation of offerings of the HTCE and the resulting high prices as a drawback: "*There is a high standard of facilities en they are also expensive. This brings me to an important aspect, for start-ups the HTCE is very expensive; there is no differentiated offering as far as this is concerned. A start-up cannot afford themselves high accommodation costs and 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. I know C. Admiraal and Campus Site Management are working on this topic, but it is not transparent.*" [M].
However, certain residents do not perceive the high prices for the rent and facilities as problematic; these are the service providers and the technological oriented companies who have large direct incentives to be located on the HTCE, for example because they have to collaborate with MiPlaza. One of the smaller service providers says: "*[T]here are plenty of facilitators like us who are willing to bear the costs only because they have to be here. These are the smaller corporations with little added value. You have to create an environment which is market conform and has an added value. At this moment the difference is too big. This [HTCE] is created and developed from the perspective of Philips, and when they continue on this path within ten years they have to buy back everything or so. I think that the current concept has large faults.*" [AF].
A respondent from a small technological oriented company argues: "*The prices are rather high but on our total budget this is marginal and not significant. The costs for using MiPlaza are much higher; in this business it simply is that expensive. Of course you have the option to go to Twente, but that is nearly as expensive and then it is better to be located in Eindhoven.*" [N]. In general, CSM is seen as the landlord of the HTCE (73%), providing the rental spaces, infrastructure, and the facilities. Most parties communicate with CSM but some companies in the sample have contracts with Philips Research.
The communication with CSM, and especially with C. Admiraal and M. Giebelen, is perceived to be efficient. The contacts are rather direct "*...we have a lot of direct contact [with C. Admiraal and his staff] because we have to relocate. It is a transparent organization where one can get easily access to the persons concerned.*" [M]. However, one third of the respondents claim that the follow-up and response time of the CSM on their questions are not handled efficiently. Next to the direct and personal contact by e-mail or telephone, the E-magazine (HTCE-newsletter) and CTC are widely appreciated means of communication.
Regarding the information itself, 50% of the respondents indicate that certain information about available services on the HTCE is difficult to uncover: "*The website presents general information about*

[18] In order to keep confidentiality regarding the specific statements of the respondents between brackets the reference to appendix N is made. This appendix will not be part of the public document.

*the Campus. There is a lot of information available but people do not take the effort to find it. The question therefore is whether it is transparent and accessible enough.*" [P]. This last aspect also includes the information about other residents' activities and contact persons.

The service providers are clearly more content with the information provided by the CSM than the technological oriented companies. The reason for this should be sought in the fact that service providers have the search for information about their clients as one of their core activities in contrast with the technological oriented companies who focus on other activities. The same logic can be applied to small and large companies, where larger companies integrate this function of information seeking into one or more separate positions within the company, smaller companies have to integrate it. So there is a difference in utilization of resources and capabilities between the companies. One respondent from the technological oriented companies argues: "*...something that is very bad is the financial structure; this is enormously slow and bureaucratic. Look, the problem really is not with the people, they are very cooperative, but the process of payment is chaos. The first time I approach a person from the workshop I can convince them to fix the job but the second time they refuse to do anything unless they see some money. The problem is the slowness of payments which can last up to several months. It is impossible for me to wait two months...the payment is, like I already said, very difficult; to whom do I have to pay? The workmen who carry out the work do not even know it themselves...*" [U]

For the interviewees with a Philips background or several years of experience on the HTCE the problems of visibility and access to information are not so profound: "*...because of the years of experience, I am on the Campus since 1988, I know all the shortcuts already. For companies who are new and unfamiliar the situation is very different, you can hear from them the most fantastic stories about their problems with finding out where to be. For us it is a completely different situation, I cannot separate this.*" [N].

In summary, the proximity is of great value for the residents. As a consequence the residents have a high perceived ease of access to different kinds of resources. On the other hand for most residents is it not clear which resources are available on the HTCE and it takes a long time for the residents to identify the 'rules of the game'. Organizational transparency is important for several value sources, and especially lock-in since the organizational transparency correlates positively with the dyadic and group-level trust (Williams, 2005). This lack of transparency could be resolved for example by means of a so-called 'Yellow page book' or by assigning knowledge (or network) brokers.

Another problem is the lack of differentiation in the offerings (facilities and housing) that is available on the HTCE. Especially the focus on the high end of the market and the resulting high prices are seen as problematic. In the analysis it also became clear that a real distinction can be made between certain types of companies for their reason to be located on the HTCE and the resulting perceived efficiency.

**Table 10: Descriptive Statistics & t-test Complementarities Items**

| Item | N | Mean | Std. Error Mean | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| c1 | 28 | -.089 | .1180 | -.757 | 27 | .456 | -.0893 | -.331 | .153 |
| c2 | 28 | .107 | .1295 | .827 | 27 | .415 | .1071 | -.159 | .373 |
| c3 | 28 | .107 | .1295 | .827 | 27 | .415 | .1071 | -.159 | .373 |
| c4 | 28 | .089 | .1093 | .817 | 27 | .421 | .0893 | -.135 | .313 |
| c5 | 28 | -.018 | .1106 | -.162 | 27 | .873 | -.0179 | -.245 | .209 |
| c6 | 28 | -.125 | .1250 | -1.000 | 27 | .326 | -.1250 | -.381 | .131 |
| c7 | 28 | .304 | .1369 | 2.217 | 27 | **.035*** | .3036 | .023 | .584 |
| c8 | 28 | .143 | .1357 | 1.052 | 27 | .302 | .1429 | -.136 | .421 |
| c9 | 28 | .411 | .1261 | 3.256 | 27 | **.003*** | .4107 | .152 | .670 |

* p <0.05

### 6.2.2. Complementarities

The second proposition is; *complementaries offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because it increases the opportunities for residents

to co-operate with other residents, or even partners, and increase value. This proposition is slightly supported by the results from the OLS regression analysis ($p < 0.15$; see table 8). Also, the respondent of the interviews acknowledge that the HTCE offer complementarities which are important for their company's performance. The items of the questionnaire show that only 'c7' (*horizontal complementarities*) and 'c9' (*overall complementarities*) are significantly positive and no item scored negative (see Table 10). This finding is somewhat surprising, horizontal complementarities are facilities like 'The Strip', sport facilities, and child care and one would expect that the added value also would be in the vertical complementarities.

One reason for this can be found in the differences between technological and service oriented companies. Service oriented companies do not need the vertical complementarities for their business; on the other hand they are strongly depending on the horizontal complementarities. For the technological oriented companies it is the other way around. Furthermore, the analysis of the sub-groups (see Table 6) showed that non-incumbent companies appreciate the complementarities significantly more than their counterparts. This could be explained by the fact that incumbents see this as obvious complementarities because they are already integrated in their businesses independently of the HTCE. The results from the interviews confirm these insights.

The technological services, and therefore the vertical complementarities, offered by MiPlaza, Philips Research and other parties are conceived as the most important complementarities. More than 50% of the respondents use the services of MiPlaza. These respondents all are technological oriented companies and is in line with the reasoning described above about the difference between vertical and horizontal complementarities. As mentioned before, some companies are depending on the offered services and equipment which are present at the HTCE. In combination with the proximity of the offered services companies can utilize the complementarities to their fullest potential: '*Recently, I had to adapt a piece of silicon rubber and right around the corner they can do that. Than you can leave the silicon rubber there and you can pick it up the same afternoon. If you had to look for such a competency anywhere in the world you would not even find it or abandon the whole idea because it takes to much time to investigate. So, you can say it is handy.*' [F] The same respondent also acknowledged that it is essential under the current situation to be already familiar with the complementarities available on the HTCE because information regarding these services is not readily available due to the lack of transparency.

Regarding the mix of companies on the HTCE, 40% of the residents perceive this (to some degree) as complementary to their business activities. Besides this, numerous respondents indicate that the mix of residents is 'too much Philips' (like spin-offs, incubators): '*You could broaden the current technology domains but this depends on the current players on the HTCE. It would be a good thing when one or two non-Philips domains would be added. This could also engender several new synergetic domains.*' [O].

In addition some people are concerned with the ratio of technological and service oriented companies: '*The mix is fine, although I have the impression that recently a lot of "employment agency" types of companies are added. This is not a really positive development…a mix of specialized companies, with competencies in for example plastics, joining technology, and metals have added value for the HTCE.*' [E].

Complementary facilities like The Strip are very much appreciated. The Strip as meeting point for people is beginning to bear fruit since people meet acquaintances, for example people they have met at the CTC: '*Here on the Campus it is compact and you have mandatory shared-services, for example the central canteen. Today, for example, I met someone during lunch-time and this resulted in a new appointment. Of course you first have to know the people; you will not talk with strangers that easily. It's a little bit like the chicken and egg story.*' [P]

When looking to figure 15 it is clear that most respondents did not regard complementary services, both direct and indirect, as the primary source for value creation and appropriation. Besides the highly appreciated MiPlaza and facilities, like The Strip, not much consistency could be detected regarding complementary services. One reason for this can be the already discussed lack of transparency about the available services. Another reason could be found in the interviewed respondents, who in general do not utilize the services and therefore do not reflect the total population of workers on the HTCE. The most important finding is the relationship between

(horizontal and vertical) complementarities and type of company. Furthermore, there is a rising concern about the mix of residents.

### 6.2.3. Lock-in

The third proposition is; it is expected that *lock-in offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because it lowers opportunistic behavior by residents and, hence, offers opportunities for long-term relationships. This proposition is <u>not</u> supported by the data (see table 8). When inspecting the results for the items of the lock-in variable separately it becomes visible that there are five items significantly positive and four items significantly negative (see Table 10).
These items are respectively; 'l8' (*dominant design*), 'l9' (*community*), 'l11' (*direct network externalities*), 'l12' (*indirect network externalities*), and 'l15' (*overall lock-in*) for the positive items and 'l1' (*loyalty programs*), 'l3' (*methods to personalize services*), 'l7' (*other methods that promote trust*), and 'l10' (*affiliate programs*) for the negative items.

**Table 11: Descriptive Statistics & t-test Lock-in Items**

| Item | N | Mean | Std. Error Mean | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| l1 | 28 | -.214 | .1162 | -1.844 | 27 | **.076*** | -.2143 | -.453 | .024 |
| l2 | 28 | .036 | .1231 | .290 | 27 | .774 | .0357 | -.217 | .288 |
| l3 | 28 | -.226 | .1085 | -2.085 | 27 | **.047*** | -.2262 | -.449 | -.004 |
| l4 | 28 | .179 | .1098 | 1.627 | 27 | .115 | .1786 | -.047 | .404 |
| l5 | 28 | .018 | .1192 | .150 | 27 | .882 | .0179 | -.227 | .262 |
| l6 | 28 | -.107 | .1058 | -1.013 | 27 | .320 | -.1071 | -.324 | .110 |
| l7 | 28 | -.371 | .0924 | -4.019 | 27 | **.000*** | -.3714 | -.561 | -.182 |
| l8 | 28 | .429 | .1113 | 3.852 | 27 | **.001*** | .4286 | .200 | .657 |
| l9 | 28 | .429 | .1198 | 3.576 | 27 | **.001*** | .4286 | .183 | .674 |
| l10 | 28 | -.286 | .1271 | -2.248 | 27 | **.033*** | -.2857 | -.547 | -.025 |
| l11 | 28 | .357 | .1117 | 3.198 | 27 | **.004*** | .3571 | .128 | .586 |
| l12 | 28 | .411 | .1180 | 3.481 | 27 | **.002*** | .4107 | .169 | .653 |
| l13 | 28 | .018 | .1348 | .132 | 27 | .896 | .0179 | -.259 | .294 |
| l14 | 28 | -.018 | .1192 | -.150 | 27 | .882 | -.0179 | -.262 | .227 |
| l15 | 28 | .375 | .0838 | 4.473 | 27 | **.000*** | .3750 | .203 | .547 |

* p <0.05

The results from the interviews give more insight in these findings. The attractiveness of the HTCE is the number one reason for companies to be located on the HTCE; 80% of the respondents indicate that they perceive the image and attractiveness of the HTCE as very important.
This attractiveness results in multiple advantages for its residents. First of all, 60% of the respondents acknowledge that the attractiveness due to the mix of companies, technological facilities, social facilities, and the pleasant working environment attract third parties like companies, talented personnel, and governmental support (link with direct & indirect network externalities): '*When looking at the Campus the attractiveness is the important added value. When you tell others that you have a residence on the HTCE everybody directly makes the association with the idea that we have a lot of knowledge of high-tech things and that everybody should be at this office, whereas our other offices are every bit as good as our office. This is pure attractiveness of the HTCE, something you will not have when being located 1000 meters further on in Aalst. So, attractiveness is important, you do not want to be on the Hurk.*' [AE].
As already is clear from the previous example, the second advantage (50% of respondents) of the HTCE image is the association the residents receive with "High Tech" and "leading edge research" which results in significant marketing gains for the residents (part of high tech community): '*The attractiveness and especially Philips, since the HTCE still is a little baby of Philips, is an important factor. When I tell others that I am located on the Hurk no one will recognize it. But when I say, independent from*

*where I am on the world, I reside on the HTCE, am a spin-off of Philips and still use the infrastructure of Philips, everybody instantaneously recognizes it.*' [M]

From the interviewed respondents 67% perceives the network opportunities with other companies as an added value. They especially perceive the CTC as a great tool to create these networks on a managerial level: '*What also is important but did not play any role regarding the question of being located on the HTCE is the infrastructure, the attractiveness of the HTCE on new employees, and the networking. The networking is pleasant by means of the CTC; it breaks down barriers to come into contact with other people and companies and to identify oneself with the HTCE.*' [AA]

Others, however, philosophize whether the concept of CTC will attract the right people in the long term. Something that seems to be missing are the network activities at the non-managerial level: '*...they are doing already a lot of things, [but the question is] how can you commence the knowledge transfer between researchers and our people? The HTCE should create an environment in which researchers are also interested in these things. On a management level the networking is quite good, but what is much more interesting is to accomplish the same on a different level.*' [A]. While, on the other hand, there are also some signals of emerging informal networks that happen spontaneously just because the setting is right: '*Building informal network is relatively successful. I have spoken with other people who pass on the information to their colleagues and who consequently contact us. So that is working out quite well. Next to this the contacts at the coffee machine are also very good. We even have drawn up new contacts, at the coffee machine we talked with Oce and at this moment we have scheduled an appointment. This, of course, is a direct result of the proximity; we are all located on the same corridor in this building.*' [J]

A nice example of lock-in is Cytocentrics; they have no alternative choice for relocation because they use a lot of specialized machines from MiPlaza which is not readily available at other locations without the resulting high switching and investment costs. However, from all interviewed companies a non-significant part is locked-in due to customization and dependency on specialized resources and capabilities. Interestingly, there is also another form of lock-in at the level of the individual person, as one of the respondents describes: '*An advantage of a Campus like this one is that people can change between companies during their career and do not have to work in the same company for the rest of their life.*' [AF].

Of course things like the previous example have to prove itself on the long term development of the HTCE. In summary, the attractiveness of the HTCE is probably the most important source of value for the HTCE and her residents. A nice second place is for the networking opportunities at the HTCE, especially at the managerial level (CTC). Drawbacks are the lack (of transparency) of networks at the non-managerial level and the absence of trust-building initiatives (see discussion on efficiency). Regarding the transparency of networks on the non-managerial level a reference can be made to the study performed by Birkinshaw et al. (2002). When knowledge is highly embedded and unobservable, like is common in research environments where knowledge is highly tacit and often highly sensitive to its social and physical environment (e.g. due to dedicated physical infrastructure). the organization tends to be '*opaque*' (see figure 16) – 'they [knowledge] cannot be understood even by the firm that owns them, let alone their competitors' (Birkinshaw et al., 2002, pp. 282). So the lack of transparency of networks at the researchers' level seems to be inherent to the kind of knowledge.

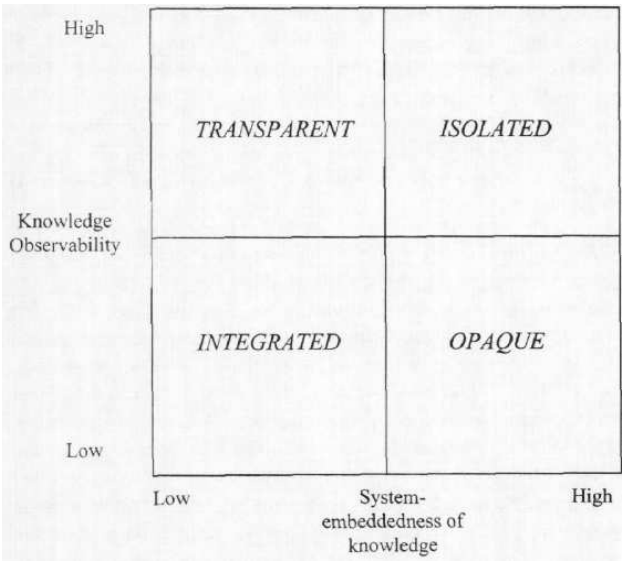


**Figure 16: Knowledge and organizational structure (Birkinshaw et al., 2002)**

### 6.2.4. Novelty

The fourth proposition is; *novelty offered through the business model of the HTCE* is important for its residents' *value creation and appropriation* because this increases the chances for creating new products and services by the residents. This proposition is <u>not</u> supported by the results of the OLS regression analysis (see table 8). Table 6 already showed that service oriented companies perceive the HTCE-concept significantly more novel than the technological oriented companies.

**Table 12: Descriptive Statistics & t-test Novelty Items**

| item | N | Mean | Std. Error Mean | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| n1 | 28 | .143 | .1282 | 1.114 | 27 | .275 | .1429 | -.120 | .406 |
| n2 | 28 | .357 | .1282 | 2.785 | 27 | **.010*** | .3571 | .094 | .620 |
| n3 | 28 | -.161 | .1152 | -1.396 | 27 | .174 | -.1607 | -.397 | .076 |
| n4 | 28 | .054 | .1345 | .398 | 27 | .693 | .0536 | -.222 | .329 |
| n5 | 28 | -.089 | .1261 | -.708 | 27 | .485 | -.0893 | -.348 | .170 |
| n6 | 28 | -.036 | .1148 | -.311 | 27 | .758 | -.0357 | -.271 | .200 |
| n7 | 28 | .143 | .1905 | .750 | 27 | .460 | .1429 | -.248 | .534 |
| n8 | 28 | .036 | .0960 | .372 | 27 | .713 | .0357 | -.161 | .233 |
| n9 | 28 | -.232 | .1012 | -2.294 | 27 | **.030*** | -.2321 | -.440 | -.025 |
| n10 | 28 | .214 | .0977 | 2.194 | 27 | **.037*** | .2143 | .014 | .415 |
| n11 | 28 | .304 | .0939 | 3.232 | 27 | **.003*** | .3036 | .111 | .496 |

* p <0.05

When looking at the level of the items depicted in table 12 it is visible that from the eleven novelty items four are significantly different from zero; 'n2' (*new participant*), 'n10' (*other novel aspects*), and 'n11' (*overall novel concept*) score significantly positive while 'n9' (*leapfrogged by alternative concepts*) scores significantly negative.

From the other value sources discussed above it is already apparent that access to a large variety of other participants is perceived as an important source of value. That these residents will come into contact with new participants is almost self-evident. The respondents did not really discuss novel aspects of the HTCE-concept during the interviews, one reason can be found by looking at the items. It is clear that the respondents perceive the HTCE as (potentially) novel but they cannot discern what exactly is novel about the HTCE-concept. Perhaps the short existence of an open HTCE has not resulted in clear examples of novelty and more time has to pass before this materializes. The perceived novelty of the HTCE-concept is according to the respondents not enough to ward off alternatives that could leapfrog the HTCE. Reasons for this could be the already identified problems detected with the other value sources, like lack of transparency, low differentiation, and lack of trust-building initiatives.

As already discussed the service oriented companies' primary reason to be located on the HTCE is the proximity with their market. The HTCE provides in some sense the ideal situation for them because al large part of their customers is located on a square kilometer. Next to this, the attractiveness and association these companies receive is something they would not have when being located on an alternative location. From the analysis it appeared that the technological companies do not perceive these advantages as important. When discriminating between these two groups on the item level it appears that 'n1' (*new combinations*), 'n2' (*new participants*), 'n4' (*access participants/goods*), 'n5' (*novel linkages*), and 'n6' (*richness of links*) are valued significantly higher by the service oriented companies. These findings affirm the previous findings.

To give an idea what CSM could do to leverage the opportunities in a novel manner and also increasing the other value sources two examples are given; the first example shows how to leverage existing on-site resources while the second example applied external resources to strengthen the four value sources. Of course the novel opportunities are not restricted to technologies but also can be in business models, organizational structures and other things.

*Leveraging Internal Strengths*

One way for CSM to be novel is leveraging the already existing internal strengths. One of the companies is iRex, which is a spin-off of Philips, which develops a device called the iLiad (see figure 17). This device is a portable device that lets you read and write like on paper, everywhere you go (the so-called Electronic Paper Display). Next to this, with the iLiad you can also send, receive and share documents with family, friends or business colleagues. The iLiad is not competing with the personal computer or laptop but with paper. The benefits of the device are self-evident. CSM could tranfer the iRex to (part of) the TLO-members. The members can improve their personal efficiency; examples are because they do not longer need paper and can easily synchronizing information with their computers. For iRex the benefits are a higher visibility of their product among the other residents which may even decide that more employees in their companies should use an iLiad. For CSM there are also several benefits. Firstly, they can use the iLiad as a communication platform for all the TLO-members, keeping members updated with information (like newsletters). Secondly, it works positively for the HTCE when one can show to the outside world that the innovations developed at the HTCE are successfully introduced and integrated at the HTCE.

Thirdly, with the iLaid as new communication channel residents of the TLO (and maybe later on more people) can communicate with each other, thereby strengthening their networks. Fourthly, CSM can generate some revenue by asking advertisement fees for adverts in the newsletters from (external) companies who want to promote their company or event. Perhaps it is even possible to have newsletters for every network (e.g. nano science, healthcare). Of course this is a simple case and more research should be done to investigate the feasibility but it shows that there are possibilities to improve the current situation and letting all partners benefit (like in value constellations).

**Figure 17: The iLiad by iRex (http://www.irextechnologies.com)**

*Leveraging External Strengths*

The second example is in the light of an article on Nu.nl[19] about Google Earth. Chikai Ohazama, the man responsible for Google Earth asserts that Google Earth is limited by the creativity of the user. CSM could use Google Earth as a complementary service next to their website and other communication platforms as a tool to order al their information about the HTCE and her residents in a geographical and more transparent manner (see figure 18).

With unprecedented possibilities to link information in a geographical manner and with a community of more than 200 million users it is a fertile ground for creating new ideas. The same argument would count for an HTCE on 'Second Life'[20].


**Figure 18: Image of High Tech Campus on Google Earth**

[19] http://www.nu.nl/news/1110237/50/rss/Google_Earth_biedt_meer_dan_satellietfoto%27s.html accessed on 18 June 2007
[20] A special thanks goes to F. Aalders for bringing this example to my attention (http://secondlife.com)

### 6.2.5. Summary of Findings

It is clear that at this moment there is little evidence found for the relationship between the value sources and value creation and appropriation. The statistical power of the questionnaire is to low to derive strong conclusions; however the findings from the interviews give some interesting insights. The brand image of the HTCE is very strong at this moment, creating numerous benefits for both residents and CSM. Also the benefits that are inherent to a Science Park, like proximity and ease of access are found to be positive aspects of the HTCE. Furthermore, the technology oriented firms perceive the vertical complementarities as primary interest whereas the service oriented firms primarily benefit from the horizontal complementarities.
However, other aspects of efficiency, complementarities, lock in, and novelty needs to be developed and aligned with the demands of the respondents in order to create a real and sustainable added value. Especially the lack of transparency of the HTCE organization and the residents should be improved. There are also indications that networks are not present (or transparent) at the non-managerial level. But as already noted, this can be due to the type of knowledge that flows through these networks. This finding indicates that different approaches are needed for different network types, differentiating on the knowledge base of that specific network.

## 6.3. What do Theories of Innovation tell us?

In the previous sections the current situation is analyzed and described. The efficiency, complementarities, lock-in, and novelty of the current business model are discussed. The question that remains is how to interpret these new gained insights? In the following sections these insights are analyzed with the theories of innovation (Christensen et al., 2004). First, the signals of change will be discussed. This will be followed up with a description of the current situation after which in section three the strategic choices will be discussed.

### 6.3.1. Signals of Change

In order to look for signals of change three groups of customers can be evaluated, namely 'undershot customers', 'overshot customers', and 'noncustomers' (Christensen et al., 2004). Figure 19 gives an overview of the HTCE-context. In the following sections these types of customers will be discussed.

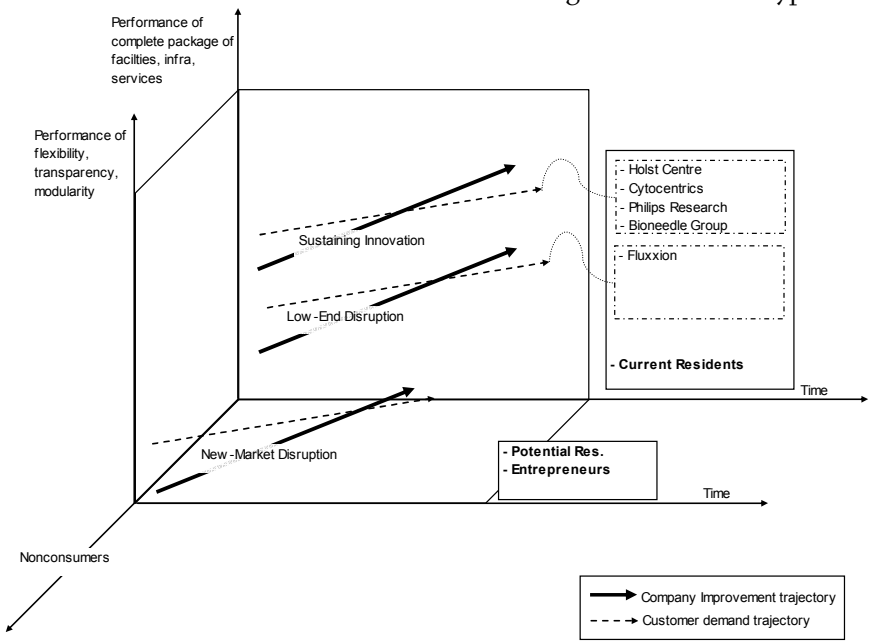


**Figure 19: Overview of the Disruptive Innovation Theory applied in the Context of the HTCE (Christensens et al., 2004)**

*Undershot Customers*

The current HTCE-concept serves the undershot customers and follows a sustaining innovation trajectory. Undershot customers are existing customers that are not happy on every dimension of the products' or services' functionality and reliability (Christensen et al., 2004). These customers are willing to pay more for enhancements along these dimensions. When looking at the current situation of the HTCE the main performance measure seems to be creating state-of-the-art facilities, infrastructure, and services. The website of HTCE states: '*With access to high-tech infrastructures like prototyping, clean rooms, materials analysis and testing, companies can really accelerate development of new ideas*'[21]. In 2006 the HTCE was elected as the best industrial estate of the Netherlands. One of the notes from the jury was: '*Those companies [on the HTCE] are nonetheless facilitated optimally.*' Undershot customers in the HTCE context are companies and institutions that need leading edge infrastructure, facilities, equipment, and knowledge in order to accomplish their goals. Examples of these companies are: Holst Centre, Philips Research, Cytocentrics, and Miortech. These companies have a growing demand regarding the performance of resources. From the analysis it became clear that these companies are locked-in due to the high customization/specialization of resources and high switching costs. According to Porter (1985) this kind of differentiation creates a uniqueness which is widely valued by buyers. In this situation the HTCE and service providers like MiPlaza can ask a premium price for their offerings. As a consequence these companies also perceive the problems with transparency and inefficiency as less problematic because they value other, for them more important services.

One note should be made regarding this situation; in itself it does not create a situation where these companies co-operate more with each other than otherwise would be the case (or it should be due to proximity and serendipity). Some respondents argued that they co-operate with MiPlaza, but all in all a service is purchased from the MiPlaza and therefore it should be regarded as a buyer-seller relationship.

Who are competitors (potential) of the HTCE at this moment? University based science parks like in Twente (see http://www.sciencepark.nl) can follow focused differentiation and thereby serving a part of the (potential) customers of the HTCE. Other competitors can be found in Grenoble and similar regions in Europe and around the world. In general, differentiation is not sustained when competitors can imitate the principle and when the bases for differentiation become less important to buyers (Porter, 1985). One respondent for example argued that when the development of their product arrives at the production stage, they will relocate the company to a low cost setting because that fits the strategy more at that point in time. They would relocate because the company then is less dependent on the resources of the HTCE for research [N].

*Overshot Customers*

The second group of existing customers is the group of overshot customers. These customers do not want to pay for the further improvements in performance of products and services. Liquavista is a former overshot customer in some aspects. They found out that they did not need the state-of-the-art clean rooms but also could work with so-called 'clean offices'. Furthermore, they did not want to pay high prices for rental space that also did not fit their need for flexibility. When growing more, they would have to relocate resulting in additional costs and delays in time. Besides this specific case, the most heard complaint on the HTCE was the lack of transparency, inefficiency, and high prices for certain services and rentals. So what can be witnessed here is a signal of change in the needs of certain customer segments: some residents look for transparency of information, access to resources, efficiency of handling requests, and more differentiation in offerings of facilities and rental places (read: lower functionality = lower price). One example is a small technological company [*company H*]

[21] See http://www.hightechcampus.nl/campus_info/general_information/more_on_thecampus.html accessed on 21 June 2007

that was not wiling to pay the high prices for the internet connection (€1,500.- per connection per year) and arranged a cheap solution for internet by themselves. The reason for this company to stay located on the HTCE is because they need some of the technological facilities. But when this reason for lock-in disappears, like what happened in the Liquavista situation, these kind of companies will prefer the alternatives. For these types of customers numerous less-than-perfect solutions exist like industrial parks or university campuses. The problem is that the alternative solutions will not cover the whole (potential) package of benefits that is available on the HTCE, like the availability and proximity of complementary resources, reputation, or networks. But because their primary needs are not covered fully by the HTCE a threat is present that a new entrant will present a (low-cost) business model which suits the needs of the overshot customers. By doing this the new entrant will disrupt the business model of the HTCE and consequently become a treat to the HTCE in the long run, *ceteris paribus*.

*Non-Customers*
Non-customers lack the ability, wealth, or access to conveniently accomplish an important job for them; they typically hire someone to do the job for them or patch up a less-than-adequate solution. Non-customers in the HTCE context are (1) companies that decide to locate on an alternative location (e.g. Liquavista, TomTom, HiSense) and (2) people who want to start a company but cannot afford it or cannot get access to the resources needed (e.g. potential entrepreneurs like students, researchers), (3) every company that fits the profile of the HTCE but resides elsewhere.
An interesting example is Liquavista, appendix L describes the reasons for Liquavista to locate elsewhere. Their primary reason for relocating was to accelerate the process of becoming independent from Philips. Lord et al. (2002) define four reasons for spin-offs to fail and one of them is the 'Umbilical Cord Trap' where parent companies cannot untangle with the spin-off company. Lord et al. (2002) also argue that continued entanglement can scare off key outside stakeholders. In the case of Liquavista key stakeholders applaud the decision to relocate to the business park the Hurk. In hindsight this was a good choice for Liquavista, especially because the technology is not close to the core of Philips (not a Crown Jewel for Philips) and Liquavista is not depending on the resources of Philips or the HTCE. But what's attention-grabbing from this specific case are the other advantages that especially are important for non-Philips companies (or 'non-spin-outs' in general). These reasons are the higher efficiency and flexibility and the significant lower costs for locating elsewhere (outside the HTCE) and, which we know from the previous analysis, are not the strong points of the current HCTE-concept. Besides this, the HTCE is not the ideal situation for companies that have to scale up their production significantly. For these circumstances companies will consider different aspects like environment policies, investment climate, and (cheap) workforce.
So, who are trying to serve these customers at this moment? Well, places are: universities, industrial parks, people at their homes (in USA called the garage entrepreneur), and all kinds of entrepreneurial groups and networks. New entrants that focus on these non-customers can create business models based on modular housing (see http://www.portakabin.nl) and facilities like clean rooms (see for example http://www.hemcocorp.com/rooms.html). This will be a relatively simple, affordable solution that increases the access and ability by making it easier for customers to get jobs done (Christensen et al., 2004). The interesting thing of disruptive innovations is that, when successful, the sustaining innovations in this 'new-market disruption' will improve the performance of the offerings to such a level that they will become attractive for the overshot customers, and finally perhaps will surpass the performance of the business model that serves the current undershot customers.

### 6.3.2. Current Situation

Figure 20 gives a schematic overview of the current 'Open Innovation' situation for technological companies at the HTCE-ecosystem level, based on the previous analysis. This picture shows that the boundaries for the 'research' stage and the 'development' stage are porous, implying that companies can locate on the HTCE, for example Cytocentrics, but also can leave the HTCE, for example

Liquavista. But what is more interesting is the stage of 'idea generation' and the resulting step towards the 'research' stage. In the current situation mainly ideas generated inside current residents, and more specifically Philips Research, have a chance of developing into a business within the boundaries of the HTCE. These ideas can be funded internally and spin out when the project is big enough. Start-up companies (who have to start-up from scratch) or 'idea generation' initiatives do not find the right environment for their activities. These non-customers look for an environment that is flexible, convenient, and cheap in order to do their business. Note that these non-customers also can be researchers already working for one of the current residents or people who draw up their ideas on their attic. The current HTCE-concept therefore provides low ability for non-customers to fulfill their needs. One building (the Betà-build) belongs to NV Rede, an Economic Development Organization for the Eindhoven region. This building is aimed at serving small-scale enterprises ranging from 5-45 employees and tries to provide a solution for some of the overshot customers and non-customers who satisfy the specific conditions. But, this initiative has a focused approach and therefore does not provide a solution for the very small entrepreneurial companies.
However, this will not be a problem in two specific cases: (1) when the output in terms of spin-outs from companies like Philips and research institutes like Holst Centre is large enough to populate the HTCE and (2) when there are enough companies like Cytocentrics that have no other viable alternative than the HTCE for doing there business (lock-in).

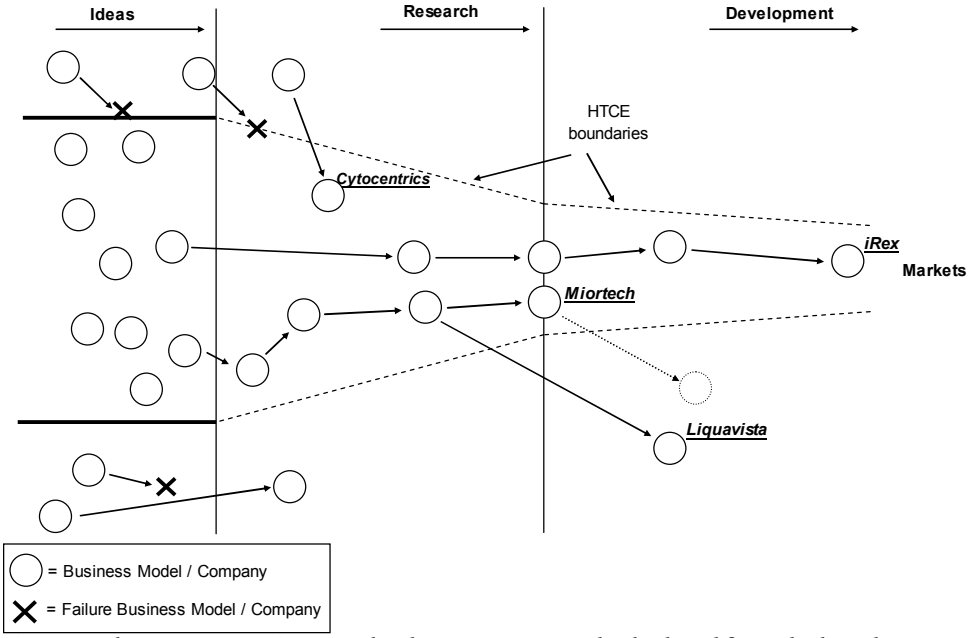


**Figure 20: The 'Open' Innovation Funnel at the HTCE-ecosystem level (adapted from Chesbrough, 2003)**

*Non-Market Context*

In the current situation Royal Philips Electronics owns everything on the HTCE. Some of the older buildings still belong to Philips Research while the remainder belongs to Philips Real Estate. CSM manages the buildings for Philips Real Estate and also some of the buildings of Philips Research. When we add the residents, the picture results in the triangle of Management, Users, and Owners as depicted in figure 21. In this triangle Philips is present in every function. Furthermore, CSM partly falls under the authority of Philips (Research) Eindhoven but also has to comply with the objectives of Philips Real Estate and other stakeholders. This situation restricts their resources, processes, and values to a large degree. This situation becomes even more complicated when considering the fact that at this moment still a large part of the infrastructure of Philips Research is used for al the residents. This infrastructure is created to cope with the specific characteristics of a large

organization and therefore does not suit the needs of some smaller companies very well (like efficiency and transparency).
In this section the level of motivation and ability of the CSM to innovate (disrupt their business model) to a situation that suits the needs of the start-up is investigated at an abstract level (see figure 22). Note that at this moment the non-market factors are largely defined by Philips (they can be seen as the government of the 'nation' HTCE). Motivation is defined as market incentives to innovate and ability is defined as the capability to obtain resources, craft them into products and services, and offer those products and services to customers (Christensen et al., 2004).

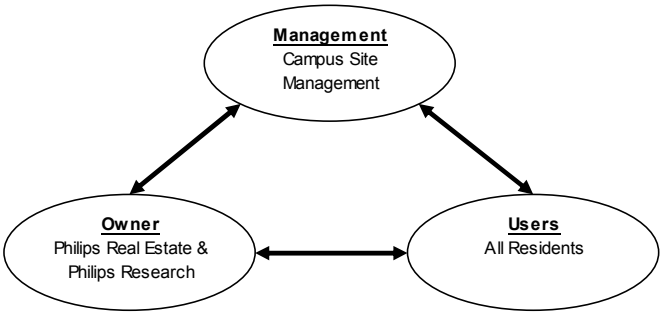


**Figure 21: Governance relationships of Management, Owner, and Users (Philips is involved in every role)**

*Motivation*
At this moment the motivation for CSM to change the rules of the game to better serve the overshot customers and non-customers is at the medium level. The aim of TLO, being part of CSM, is to attract new residents and support the residents with the next services[22]:

- put companies in touch with the right people for technologies that residents are willing to share;
- support companies in understanding Intellectual Property Rights and connect them with the right service providers;
- offer techno start-ups a management support program;
- organize workshops, business meetings, network events and one-to-one meetings;

CSM wants to be 'the cradle of innovation' and this implies that the creation of new start-ups from non-Philips activities is also a highly sought-after market. Getting a successful track record of start-ups at the HTCE also improves the reputation of the HTCE. The market for start-ups is growing significantly in recent years. In the area 'Oost-Brabant' 8,300 companies were founded in 2006 with a growth of 21% compared to 2005[23]. In the industry sector the growth rate was 15% in 2006 (3,700) for the Netherlands. In 2005 companies with 10-50 employees invested 466 million euros in R&D. Of these R&D investments 16 million euros (3.4%) were invested in the buildings[24]. These figures indicate a high potential for the start-up segment. On the other hand there are currently a lot of initiatives targeting this specific segment (see for example http://www.rede.nl; http://www.bom.nl), indicating an already well served segment.
From the perspective of the CSM, the motivation is limited by the way the HTCE is set up. Large fixed costs results in high rental prices (around €250,- per $m^2$) and a mark-up of €5000,- per FTE per year for usage of general facilities like parking lots, The Strip, and maintenance of the green area. Related to this are the motives of the investors, in the case of the HTCE the investor is Philips Real Estate. At this moment Philips Real Estate has invested a lot of money into the development of the HTCE (around a half billion euro). This situation increases the incentives to grow quickly and reap premium benefits from the investments (in this case the real estate). This situation demands deliberate strategy and won't tolerate emergent forces like small scale and cheap offerings in terms of

[22] See http://www.hightechcampus.nl/campus_location/contact_tlo.html, accessed on 29 May 2007
[23] Source: http://www.kvk.nl/artikel/artikel.asp?artikelID=46706&sectieID=200
[24] Source: http://statline.cbs.nl/StatWeb/Table.asp?HDR=G2&LA=nl&DM=SLNL&PA=70919ned&D1=a&D2=0&D3=a&D4=a&STB=G1,T,G3

rental space and facilities because this would decrease the value of the surrounding landholdings (Christensen et al., 2004, pp. 62). So this situation forces the strategy of the HTCE towards a setting where premium prices must be demanded from the residents, thereby lowering the motivation to innovate towards low cost solutions.
A solution in terms of selling the HTCE to an external investor would not solve the problem in the sense that these large up-front investment also needs to provide attractive returns for that investor. This also would lead it to turn down a small, profitable opportunity that could launch it on a truly disruptive trajectory. Besides this, there is the risk that the new investor will focus on relatively short term profits, thereby neglecting other aspects, like R&D, that focus more on the long term. An example would be the exploitation of the real estate in a more profitable manner by attracting residents like service providers. Furthermore, selling at this point in time is very risky due to the complexity of the system of players and the complex involvement of Philips in most of the current processes and values. These processes and values configure the resources in such a way that they suit the needs of Philips. The standardization from Philips will not suit the transparency and efficiency needed by the non-customers and overshot customers.
Another important barrier to motivation is the current reward structures for CSM. Because the HTCE is now in the growth phase the reward structures are linked with attracting renowned companies, external capital, and the image of the HTCE. Providing low costs solutions for non-customers and overshot customers does not fit with these reward structures.

*Ability*
The ability of CSM is relatively low. Being part of the larger Royal Philips community the CSM organization has access to a relatively large pool of technology, products and funding. Looking at the more intangible resources it is clear that the brand 'HTCE', 'CSM', and 'TLO' are becoming renowned names within the community and is further supported by the installment of the Campus Technology Liaison Club (CTC), a network association for decision-makers on the campus. Furthermore, the human capital is quite high. Management has many years of experience in an international setting and other people are recruited through the corporate companies' recruitment office. This way of recruiting also implies that people are recruited that have a fit with the Philips organization in terms of capabilities and values while in a disruptive setting other capabilities and resources may be needed. This indicates a potential lack of ability regarding the more disruptive innovations.

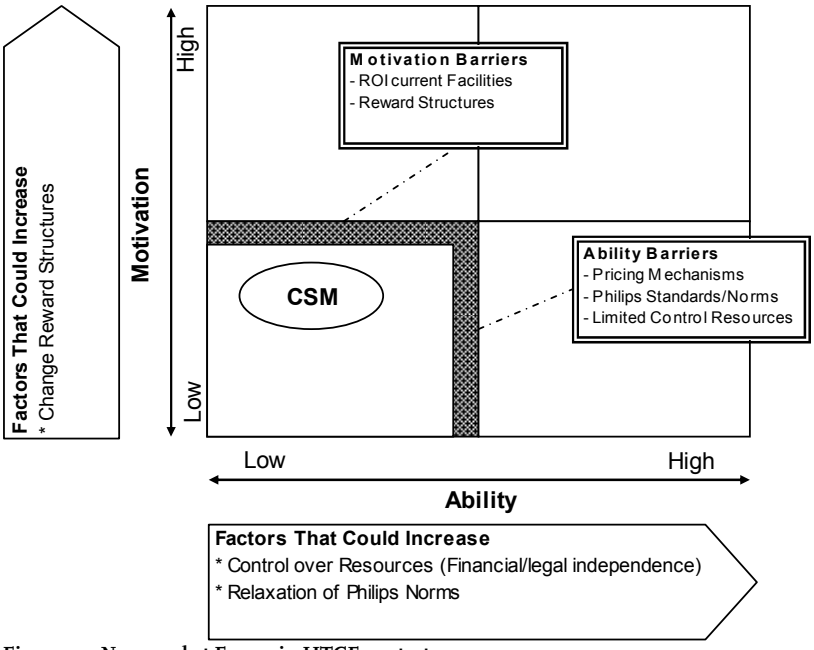


**Figure 22: Non-market Forces in HTCE-context**

Besides this, just like is the case with the motivation, the way the HTCE is set up also decreases the ability for the CSM to provide differentiated offerings towards the low-end segment. When CSM starts offering low priced rental space and facilities the current buildings and facilities may become overpriced. Also the fact that a large part of the infrastructure is supplied by Philips gives some problems. Most residents have to comply with the rules set up by Philips. As an added problem Philips is unwilling (at this moment in time) to open up certain processes to other residents. An example of this is given by one of the respondents: "*[W]hen I had to make an admission pas they asked me whether they could add me to the photo book. The strange thing is that I self don't have access to that photo book. I don't understand that, you are blocked from so much information by Philips while the information is not of any strategically value.*' [U]. Philips Research also does not have the motivation to open the market for some services for new entrants to enter the HTCE because that would undermine their own objective of lowering internal costs by sharing facilities. An example is the ICT-service; a certain part of the residents cannot choose another provider and have to pay relatively high prices (compared with market prices) for a 1 gigabyte internet connection. The same principle goes for the MiPlaza; by offering state of the art equipment they do not have any incentive to attract low-end disruptors to the HTCE that may harm their business. These are some examples of factors that decrease the ability of CSM to service the non-customers and overshot customers to their specific needs. Lastly, CSM has limited access or control over resources to allocate them to their specific needs. Being part of Philips they have to negotiate and handle with several parts of the Philips enterprise like Philips Research, Philips Real Estate, and the Philips CTO Office to get things done.

### 6.3.3. Strategic Choices

Figure 22 gives an overview of the barriers for CSM to innovate their business. Christensen et al. (2004) argue that when a company faces the situation of CSM (coined 'The Dilemma') it is hard for CSM to create and exploit innovations. Getting out of the Dilemma is hard and takes a lot of time. When Philips is trying to increase both motivation and ability unforeseen problems are abound (see Christensen et. al ((2004) for numerous examples) because this probably will destroy the position of Philips and therefore the catalyst of the HTCE. Theory suggests that concentrating on one of these problems is best and then especially the ability barriers. Motivation is a stronger incentive but when barriers in ability are present entrepreneurs will circumvent the ability problem in unexpected ways. When increasing the ability by means of more independency in legal and financial matters CSM can allocate money to more innovative projects as those put forward in section 6.2.4. With help of these innovative projects many needs of residents can be fulfilled in terms of efficiency, convenience, and transparency. Giving CSM more independency is a prerequisite to benefit maximally from the internal and external strengths that are present on the HTCE. At this moment the motivation and ability of CSM (and HTCE in general) are not to optimize the situation for the residents. For example, the Campus ICT has no incentives to differentiate their offerings to serve the needs of their customers in terms of performance demands and prices. Another example is the low motivation for certain suppliers to optimize their services, making it more efficient and transparent. One could say that the HTCE is lacking market mechanisms that control the price and quality levels to a level that fits with the demand of the customers.

When future research points out that the market in terms of new residents from spin-outs and locked-in companies is large enough the motivation for CSM to disrupt their business is relatively low. Increasing an artificial higher motivation by means of different rewards structures will then have a counteracting effect. In this case increasing ability is better because this will point CSM in the specific segments where motivation is highest. Then the current 'Open Innovation' model shown in figure 20 is a viable model that can be complemented with other places that focus on the lower end of the markets. An example is that HTCE collaborates with other locations that target specifically on these non-customers or overshot customers, like the Technical University or other Business Parks. These alternative locations can be viable alternatives for companies like Liquavista or other overshot/non-customers. In this way CSM can attract new residents from these location when their

needs better fit with the HTCE-concept but also CSM can help companies with leaving the HTCE. CSM can play an important role in this region-wide approach. See figure 23 for a visual overview.

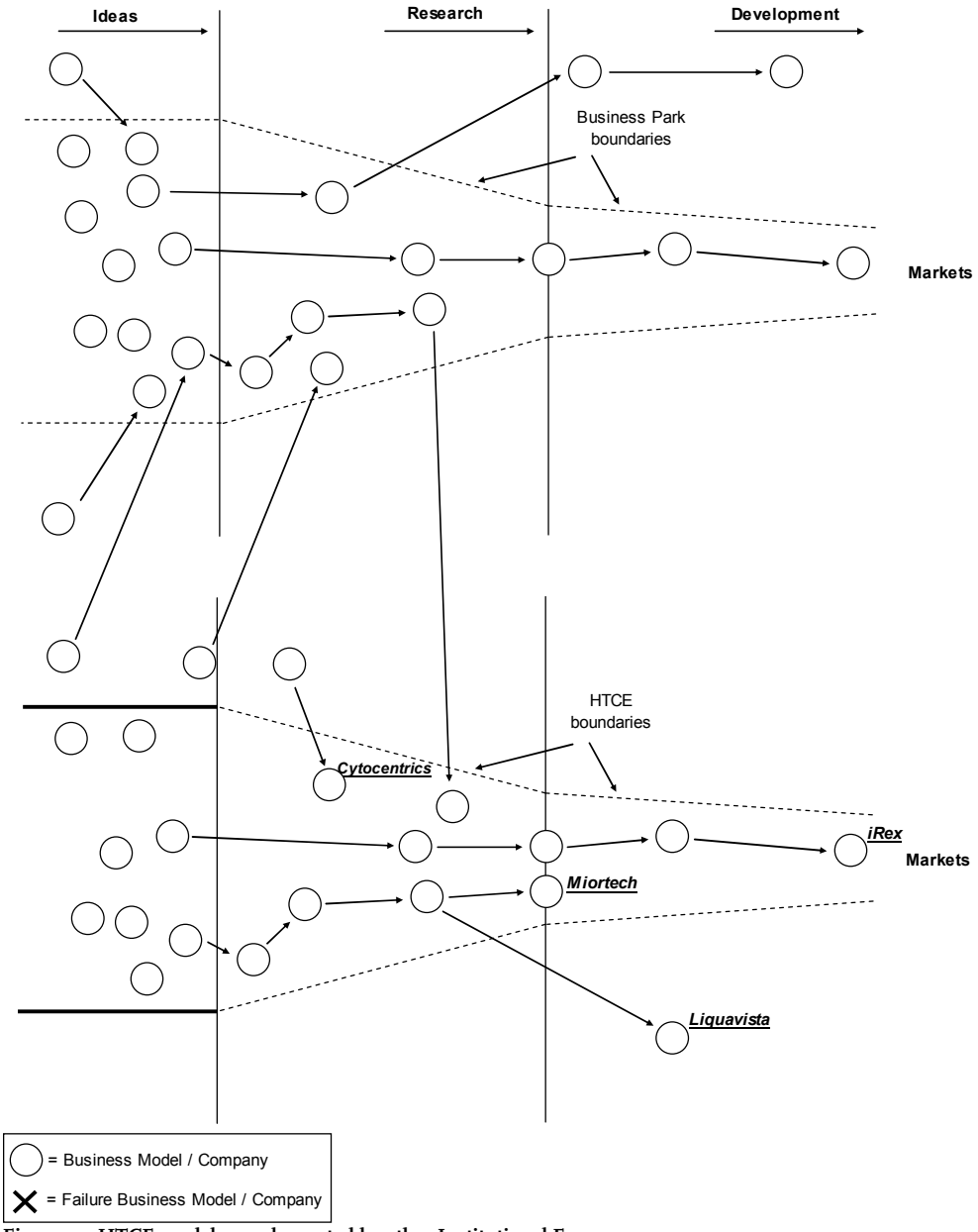


**Figure 23: HTCE-model complemented by other Institutional Forms**

Other solutions to serve the low end of the market on the HTCE itself also can be developed. The Bèta building is a first initiative on the HTCE. But creating special value propositions for these customer segments imply that 'clever' constructions have to be developed that cure the weaknesses of the current HTCE-concept. These constructions, for example funding, will create asymmetries in the concept that result in unwanted situations. So, more investigation is needed to determine all possibilities to serve the low end of the market and whether this is necessary at all.

## 6.4. Conclusion

This study found little evidence of a relationship between the value sources and value creation and appropriation. The findings indicate that the HTCE-concept does not have a profound impact on the profitability of the studied companies partly due to the fact that the HTCE-concept is not well aligned

with the processes of the residents. One reason for this missing link between the value sources and value creation and appropriation is the short existence of the HTCE. Another important reason for the low correlations (of the regressions) is the low N of the sample. As argued before, the low power of the statistical test for the regression is primarily caused by the low sample size. Although no statistically significant relationship between the value sources and value creation (and appropriation) could be found important insights could be drawn from results from the questionnaire and the interviews. The most important requirements for the stakeholders, that are uncovered during the analysis, are now summed up.

First, the HTCE-concept should retain the current level of reputation or improve this level. The image and attractiveness of the HTCE is the most important value source for the residents. This attracts all kinds of companies and people, which is beneficial for the current and future residents. The smaller companies like NTBF's and small service providers benefit from the association with the HTCE, making it easier to obtain a strong identity. This counteracts the often occurring problem that newly founded small businesses suffer from the 'liability of newness' (see Goldberg et al. (2003) for a study on reputation building of small businesses).

Second, the residents' business models should have a fit with the strengths of HTCE-concept. In the current situation a specific market segment is served; the so-called undershot customers. In general this implies that the facilities and other offerings are of a high standard and therefore also more expensive. The basic premise underlying this model is that the model overshoots the demands of other market segments; consequently these companies do not find an added value on the HTCE that outweighs the premium prices. An important question that needs to be solved is whether the undershot market is large enough for the HTCE, in specific the time that it takes to 'fill' the HTCE.

Third, the HTCE should focus on 'vertical complementarities' that fit the needs of the technological companies. The analysis indicated that especially the technological oriented companies perceive the vertical complementarities as an added value. In contrast, the service oriented firms more rely on the horizontal complementarities since this augments their businesses. The service oriented firms are willing to pay the price premium primarily to be close to their market, while the technological oriented companies look for benefits in terms of vertical complementarities that outweigh the higher price of being located on the HTCE. One aspect that should be noted here is that these companies also have benefits in terms of lower costs since they do not have to make the initial investments for these complementarities. From this, one could argue that vertical complementarities should be the focus since service oriented companies are attracted anyhow and technological oriented companies primarily are attracted by the vertical complementarities. The number of service oriented companies should be kept at a minimum; just enough to serve the needs of the technological oriented companies.

Fourth, the CSM should increase the transparency of the HTCE organization and its residents. From the analysis it became apparent that the transparency is not very high. Information is difficult to acquire therefore increasing the search costs for the residents. The transparency influences the trust on the HTCE, so the higher the transparency the higher the trust which in turn influences the communication on several (functional) levels in at the HTCE. Especially the transparency of available resources (both human and technological) is an added value.

Finally, CSM has an opportunity to complement the HTCE-concept by collaborating with other regional institutions that serve lower tiers of the market. As argued before, the current model of the HTCE focuses on the high end of the market where undershot performers (mainly technological oriented companies) are served. When further investigation shows that this market is large enough, and the current model is viable, the CSM can augment this model by collaborating with other organizations that serve different market segments. These market segments can be non-customers like startups, but also companies that need production facilities. The overshot customers are companies like Liquavista that have to relocate because they do not longer have a fit with the strengths of the HTCE. By collaborating with organizations that focus on these market segments CSM can scan the trends in the market (for example by screening startups) and provide an exit strategy for current residents that do not longer have a fit with the strengths of the HTCE.

# 7. Conclusions

This concluding chapter consists of four sections. In the first section the research questions postulated in section 1.5 are answered. In the second section the implications of these conclusions for Campus Site management are discussed. This chapter and study conclude with some reflections on the methodology and some suggestions for future research.

## 7.1. Answers to the Research Questions

Based on the assignment for this research, three expected deliverables were defined in section 1.5. These deliverables resulted in a number of questions for which the research should find an answer in order to answer the research question. In the following part these expected project deliverables are reviewed by answering the questions. By answering these research questions the general research question can be answered: *How can governance be structured at the High Tech Campus Eindhoven to benefit maximally from it, i.e. maximizing output in terms of technological innovations?*

**1 Better understanding of the key concepts of governance of Science Parks**

*a) What is meant by Science Park?*

The term Science Park is a widely used and misused term often mixed up with terms as 'Technopoles', 'Incubators', and 'Clusters'. These latter terms are related but not the primary interest of this research because the High Tech Campus Eindhoven is a park based initiative. In order to keep focus, the Science Park literature is used as the principal source of literature. A science park is defined as a business support and technology transfer initiative that:

- Encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses;
- Provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit;
- Has formal and operational links with centers of knowledge creation such as universities, higher education institutes (HEI) and research organizations.

This implies that a science park not necessarily has to be developed around a university but does have to provide physical or organizational links with HEI, universities or research organizations. Furthermore, the technology level is relatively high and the management support is relatively low. A business incubator is a feasible but not compulsory element of the science park because the function of incubating new businesses can also be performed by other institutional forms or dispersed throughout several institutions.

*b) Which governance principles are available in Organizational Theory literature?*

Organizational theory provides a rich history on specific aspects of governance. From the literature review two important insights were developed; (1) the problem with these theories is that they all take different units of analysis and therefore are difficult to compare and (2) on the level of Science Park no literature exist regarding governance. To cope with the first problem the business model was adopted as the unit of analysis because it is consistent with the analyzed organizational theories. The second problem implied that a definition needed to be developed about what exactly constitutes 'Science Park governance'. Based on network governance and hierarchy governance the following definition was adopted: "S*cience park governance involves a select, persistent, and structured set of autonomous firms (as well as non-profit agencies) that are located in a confined area and engaged in creating products or services. Science park management facilitates the linkages between the autonomous firms based on both explicit and implicit contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts can be both socially and legally binding.*"

The literature defines four value sources that create added value through the business model. This added value can be generated by means of four value sources, namely 'efficiency', 'complementarities', 'lock-in', and 'novelty'.

*c) Which governance principles are available in Open Innovation literature?*
The Open Innovation paradigm is a relatively new stream of literature. On the level of the Science Park little to no research has been conducted. One important insight from the Open Innovation literature is that the business model plays a focal role in the context of a Science Park. Science Park management has to define a business model with as primary aim (value proposition) to serve her residents. But these residents also have business models that need to 'fit' with the characteristics of the Science Park in order to leverage its benefits.

*d) How should a Science Park be set up to benefit optimally from governance principles?*
The conceptual framework as presented in chapter 5 presents an overview about how to relate governance to innovation and strategy. The business model is the focal aspect of the framework and links inputs with outputs and strategy with Science Park organization. The business model of the Science Park should be aligned with the interests of the stakeholders involved in the Science Park in order to provide added value to the Science Park and the stakeholders. The business model of the Science Park should add value by means of four value sources. The levels of these value sources define the potential added value for the residents and Science Park. A basic assumption made in this model is that the organization of a science park (the management) equals the governance of the Science Park.

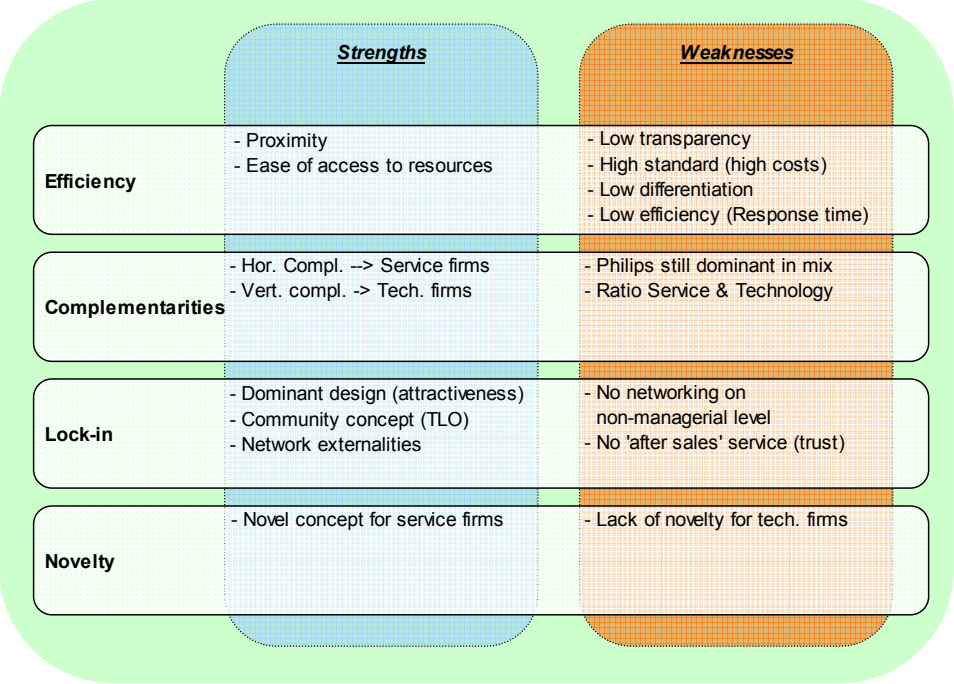


**Figure 24: Summary of findings**

## 2 Analysis of the current way of governance at the HTCE

*a) How can governance be analyzed?*
To analyze a specific situation a reference is required. For this study, the choice was made to use organizational literature as a reference. The analysis started from a broad perspective, reducing the chance of ignoring important issues to a minimal level.
However, an extensive and ready-to-start analysis tool for governance on Science Parks was not found in literature. Consequently a conceptual framework was developed. This conceptual framework describes a large number of governance aspects from organizational literature, though it cannot be considered as complete. Describing and analyzing all aspects of Science Park governance would take more resources than those that were available for this research.

*b) What are the strong and weak points of governance at the HTCE?*
Using the four value sources as the basic part for the study it can be concluded that at this moment the results did not support a link between the value sources and value creation and appropriation. However, several strengths and weaknesses could be identified in the current Business Model of the HTCE. Chapter 6 has shown that the reputation of the HTCE is the most important strength at this moment. Also the proximity of resources is an important positive aspect of the current concept. However, some points of the current situation can be regarded as relatively weak. Especially the transparency, low differentiation, and high prices were found to be weak points in the efficiency. The analysis showed that the high standard (low differentiation) causes path dependency for the HTCE but this does not necessarily has to be a weakness in the long term. Furthermore, the high costs can be lowered when more residents are located on the HTCE (scale advantages) and by making processes more efficient. Figure 24 provides an overview of the main strengths and weaknesses identified during this study.

*c) Which principles are considered as important by the various stakeholders?*
The case study analysis shows that there are differences between the various stakeholders considering the importance of principles. Efficiency and Lock-in are the most mentioned value sources. For service oriented companies the proximity and resulting easy access to their market is considered the most important principle. The only thing they expect from the Campus Site Management is to be able to be located on the HTCE and communicate with the residents. In general the easy access to resources is perceived as an important source of value. From the analysis it became clear that multiple stakeholders conceive the lack of transparency of the HTCE organization and its residents as something that should be improved.
The reputation of the HTCE is the most important source of value for all residents. This form of lock-in attracts more residents and consequently increases network externalities and complementarities. Also the efficiency is increased because residents have lower marketing costs.
Complementarities are also considered important although there is a difference between technological oriented companies and service oriented companies. The latter perceives horizontal complementarities like conference rooms as important whereas the former conceive access to vertical complementarities like clean rooms as the primary added value for being located on the HTCE. Companies who are not part of an incumbent or multinational appreciate the complementaries significantly better than their counterparts which can be explained by the fact that these incumbents often have integrated these functions.
The fourth value source, novelty, is perceived to be important in some aspects but the analysis did not reveal how this exactly is realized. Besides the discussed residents, the owners of the HTCE (Philips Real Estate/ Philips Research) expect a high return on investment. As expected, this limits the motivation and ability for Campus Site Management to deliver added value to start-up companies because this conflicts with the interests of the owners.

*d) What is the position of these governance principles in the complete analysis?*
In section 6.3 the insights from the analysis are used to define whether the current HTCE-concept is a viable one. The current context of the HTCE limits the ability and motivation of the Campus Site Management (and other stakeholders) to serve the low-end of the market. This implies that residents that seek a low cost environment cannot sustain in the current HTCE-context due to the high standards and resulting high costs. The way the founders designed the HTCE resulted in a situation where the range of potential residents is limited to those companies that find a real added value on the HTCE and who consequently are willing to pay the price premium. The governance principles should be aligned with these residents in order to leverage the strengths of the HTCE and to maximize the added value in terms of technological innovations.
When seeing the HTCE as an institution that enables business models reaching market it acts as an 'Open Innovation' model on the level of the science park. In this situation the 'Open Innovation' model does not describe the boundaries of a single company but the boundaries of a science park

consisting of several business models from different companies. This, consequently, also implies that the main focus of CSM should be on attracting technological 'business models' that have a fit with the ecosystem of the HTCE. Besides this, CSM is also responsible for attracting the right mix of complementary service oriented companies to a level that these companies suffice the needs of the technological oriented 'business models'. CSM should therefore pursue an acquisition policy that focuses on these aspects.

## 3 Prioritization for improvement points

*a) What are the most important requirements for the (potential) stakeholders?*

Chapter 6.4 sums up the five most important requirements for the stakeholders. First, the HTCE-concept should retain the current level of reputation or improve this level. Second, the residents' business models should have a fit with the strengths of HTCE-concept. Third, the HTCE should focus on 'vertical complementarities' that fit the needs of the technological companies. Fourth, the CSM should increase the transparency of the HTCE organization and its residents. Finally, CSM should complement the HTCE-concept by collaborating with other regional institutions that serve lower tiers of the market.

*b) Which actions have to be taken to comply with the needs of the various stakeholders?*

Before any actions can take place it is necessary to investigate the current and future market of undershot customers that can be served by the HTCE. This is an essential first step because it gives insight in the viability of the current HTCE-concept. When this market of potential residents that need to be located on the HTCE is large enough there is no problem. But when this is not the fact, a real threat exists for the sustainability of the HTCE on the long term because the current HTCE-concept cannot serve the lower tiers of the market without resulting in conflicting interests between the stakeholders. When the undershot market is large enough the transparency of the HTCE-organization and its residents need to be improved. This could or example be realized with the help of a HTCE-Yellow page book or the novel examples shown in chapter 6.3.

The independency of Campus Site Management also should be increased to increase the ability to implement these novel initiatives that serve the interests of the various stakeholders. Giving CSM more independency is a prerequisite to benefit maximally from the internal and external strengths that are present on the HTCE. At this moment the motivation and ability of CSM (and HTCE in general) are constrained to optimize the situation for the residents. One could say that the HTCE is lacking market mechanism that controls the price and quality levels to a level that fits with the demand of the customers. However, CSM should take initiatives to implement things that already lie within their power. For example, the yellow page book can be developed by merely using public information, therefore not needing the consent of all the stakeholders.

*c) Which hindrances might stand in the way of successful implementation?*

With respect to the focus on the value added resident that have a fit with the current HTCE the different interest of stakeholders might be blocking points. Therefore the cooperation and sufficient communication between the owners, management, and users are success factors.

Another hindrance might be the limited amount of available resources for the Campus Site Management. Without the right amount of resources in terms of time, money, and people the changes cannot be implemented.

Lastly, there is a chance that the undershot market is not large enough for the HTCE. In this specific situation the HTCE needs to refocus to a market segment that has a higher potential. These market segments can be the lower ends of the market or other technological domains. Because the current situation does not allow moving to the lower ends of the market without harming one or more of the stakeholders it seems better to augment the HTCE-concept with a new technological domain.

*d) What is the expected result of implementing the prioritized improvement points?*
The expected benefits that are realized by implementing these improvement points are a better focus of all stakeholders on the strengths and weaknesses of the HTCE-concept. Next to this, with a sufficiently large market of undershot customers the current HTCE-concept is proven to be viable.
The focus on vertical complementarities results in a situation where the interest of the (potential) residents are better served and also resulting in a higher lock-in. Of course, an additional task for Campus Site Management is to prevent that this kind of lock-in results in path-dependence that shields off the HTCE for new technological developments.
The improved transparency of the HTCE organization and its residents has several benefits; (1) it will increase the networking between residents because they know which resources can be acquired on the HTCE and (2) external organizations have a better insight in the added value of the HTCE, thereby increasing the attractiveness for those companies that seek the environment provided by the HTCE.
Finally, by collaborating with other, regional, institutions that serve the lower tiers of the market the HTCE can play a role in the wider region. This ensures that the HTCE keeps informed about new trends and can attract potential companies at more mature stages in their development when they better fit with the strengths of the HTCE. Also, these collaborations can provide the residents of the HTCE with an alternative when these residents become overshot by the resources of the HTCE and seek more low costs alternatives.

## 7.2. Implications for CSM

In the late 1990's Royal Philips started with the forming of an open high tech campus. Supported by the book Chesbrough published in 2003 about 'Open Innovation' Philips adopted a new approach for innovation. But where Chesbrough wrote about open innovation from the perspective of the firm, Philips envisioned a High Tech Campus as the hotspot for multiple companies to co-operate to a common goal; introducing innovations. This ecosystem will become the 'cradle of innovation' but the question remains how this should take form. Next to improving or solving the current weaknesses shown in figure 24 other insights are gained.
This study shows mainly three important issues regarding the emerging concept of the HTCE. First of all, by drawing on the concept of the business model as unit of analysis multiple theoretical insights are combined which are needed to cope with such a complex situation. CSM has to manage a multitude of interests from the stakeholders in the ecosystem of the HTCE. By focusing on those residents that are best supported with the HTCE-concept CSM can leverage the strengths of the HTCE without compromising several key stakeholders. This should be done by focusing on spin-outs from current residents and locked-in start-ups like Cytocentrics.
Second, by collaborating with other institutions who target the low-end of customers the CSM and HTCE in general can play a leading role in the wider region and develop the first 'Open Innovation' ecosystem on a science park and regional level. A first step could be the creation of a regional or national association for science parks for this specific context just like the UKSPA in the United Kingdom.
Third, Philips should provide CSM with a higher ability to act as independently as possible. By giving the CSM more control over resources they can serve the current residents to a higher degree. By targeting weaknesses with the help of novel solutions, leveraging both internal and external strength, CSM can strengthen all four sources of value and consequently increase the potential value creation and appropriation for both HTCE and the residents.

## 7.3. Reflections

*Reflections on methodology*
The conceptual framework of this study was useful for describing the current situation at the HTCE. But because the governance of a Science Park was not defined before a preliminary set of characteristics was developed that made it possible to compare the science park situation with network and hierarchies. Because the scope of this research was to identify the specific situation at

the HTCE a general definition of science park governance could not be developed. Investigating other science parks would ameliorate the current definition. Also the usage of four value sources that originate from the e-business literature is an assumption that might not be completely true. It is possible that other value sources exist that influence the performance of a science park. Although the interviews were exploratory in nature and no indication of other value sources could be found it still is something that remains unclear.
The complex environment that Campus Site Management faces asked for an exploratory research approach. Therefore, the choice for the case study approach with both qualitative and quantitative measures was a good one. By using the questionnaire a structured approach towards the investigated items was assured. This also systemized the interpretation of the findings form the semi-structured interviews. These interviews resulted in detailed insights into the finding of the questionnaire and also added new insights.
A drawback regarding the questionnaire was the small sample size. Taking the company as the level of research the size of the population was limited and in combination with the limited resources not every company could be included in the research thereby decreasing the power of the findings from the questionnaire. The triangulation used in this study did increase the validity of the findings to some extent but the generalizability of the findings is limited anyway.
The four value sources and value creation and appropriation interact in several ways with each other and the current analysis shed some light on these interrelations but cannot give a conclusive answer regarding all causal relationships between the value sources. The analysis showed that reputation is very important for the HTCE-concept for example because it increases the efficiency in marketing activities due to positive association. The analysis, however, did not reveal what its effect is on the level of value creation and appropriation. The main question still remains how the HTCE and its residents monetize from these value sources.
Respondent and case selection is another important issue. By interviewing key decision makers the danger arose that only the high level problems are discussed. One of the interviews I had was with a project manager and this directly led me into the world of the daily operations of the HTCE. Talking with these persons may give a completely different view of what the HTCE constitutes. Whereas the managers and key decision makers steer their enterprises based on summarized information the risk lies in the fact that important but small problems are left out of the picture.

*Further Research*
Firstly, to increase the external validity the results of this analysis should be compared with findings from other comparable initiatives. These findings can be compared in a cross-case analysis and thereby providing deeper insights in the relationship between the identified variables.
Secondly, an interesting aspect to investigate is how to measure the value creation and appropriation at the Science Park level. Especially the different phases in the life cycle of the Science Park in relation to these measures are interesting to investigate. During this study it became clear that in the first phases of the life cycle a number of standard measures are not appropriate for defining the level of value creation and appropriation. So more insight is needed regarding these measures. In the form of a longitudinal research this also will give more insights in the dynamics of the Science Park.
Thirdly, the definition of science park governance should be studied in more contexts to identify whether it is a combination of network and hierarchy governance forms (hybrid) or whether it is a distinct governance form. This study indicates that there are some differences. For example, one could argue that in a science park setting one thinks about business models as the primary means of communication, thereby diverging from the price (market), hierarchical relation (hierarchies), and embedded ties (networks).
Finally, in the HTCE-context it is an important first step to identify whether the potential market for undershot customers is large enough for the future. When this is not the case there is a distinct threat for the sustainability of the current HTCE-concept. This study gives a first starting point on how to place these questions in the right context.

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# Appendix A: Overview Current Residents HTCE

- Accenture
- Algemeen Octrooi- en Merkenbureau
- amBX
- ASML
- Atos Origin
- Bioneedle Group
- Business & Technology Accelerator (BÈTA)
- Cedova
- Center for Translational Molecular Medicine
- Ceratec Technical Ceramics B.V.
- Cytocentrics
- Dalsa
- DSP Valley
- FEI Company
- Fluxxion
- FOM
- Handshake Solutions
- High Tech People
- Holst Centre
- IBM
- Inkjet Application Centre / Océ
- Innos
- iRex Technologies
- Mat-tech
- Miortech
- MiPlaza
- New Venture Partners
- NXP
- NXP Software
- Philips Applied Technologies
- Philips Content Identification
- Philips 3D Solutions
- Philips ElectroMagnetics & Cooling Competence Center
- Philips EMEA Recruitment Services
- Philips Healthcare Incubator
- Philips Intellectual Property & Standards
- Philips Lifestyle Incubator
- Philips Research
- Philips RF Solutions
- Philips Technology Incubator
- Point-One
- Polymer Vision
- Profit Consulting
- SAP
- Silicon Hive
- STMicroelectronics
- Sun Microsystems
- Technific
- VDL Enabling Technologies Group
- Vereenigde
- Yacht

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# Appendix B: Overview Institutional Forms

**Technopoles**

Technopoles are relatively new entities that extend over a well-defined geographical area where scientific and industrial activities are co-located, and where exchanges of expertise are greatly facilitated, owing to the proximity of the various institutions and their willingness to collaborate. For existing firms in new and evolving areas of applied science, technopoles offer an attractive environment, including ready access to research facilities. Technopoles usually involve urban development and may extend over a region that includes several cities. They comprise research laboratories for large firms, universities, research institutes and high-technology enterprises, as well as services for technology transfer.

**Technology parks**

Technology parks are similar to technopoles, but with more emphasis on the transfer of technological know-how and industrialization. Technology parks tend to have somewhat casual selection criteria, with a target clientele that is not always sharply defined. They may include technological and entrepreneurial residents as well as service firms, financing institutions and governmental agencies.

**Science/research parks and science cities**

A park in which scientific R and D activities are predominant, whether in co-operation with research laboratories at universities or research institutes in the same location or somewhere nearby, is known as a "Science Park" or a "Research Park". When the park extends over a wide geographical area, it may be called a "Science City".

**Innovation centers**

Innovation centers, on the other hand, are capacity-building initiatives based on incubation schemes. Their principal aim is to help new high-technology firms survive their pre-launch, launch and early operational phases. They may also provide existing small firms with suggestions on improving their production processes. Members of an innovation centre are provided with access to R and D facilities and equipment from research centers or university laboratories, and are also offered guidance and assistance in becoming members of local or regional innovation networks. Naturally, firms that are selected as members of innovation centers tend to have a high-technology focus. Furthermore, owing to the demanding nature of the work involved, younger entrants often enjoy priority in tenant selection schemes.

**Centers of excellence**

These centers generally emphasize distinctive aspects of their output that set them apart from other institutions in the same field. Almost invariably, they operate at the forefront of S and T with the idea of producing an impact that will result in ground-breaking applications of new technologies.

**Technology incubators**

Technology incubators are a special form of business incubators. They focus on new enterprises whose operations are based on novel technological ideas that are likely to lead to a marketable new product. They provide common services as well as financial, legal and business support to these newly formed enterprises. The incubation process ends after a limited period of time, either with "graduation" of successful start-ups that move outside the incubator, or with the termination of incubation arrangements for one reason or another.

**High-technology industrial clusters**

This term signifies groups of entities from various sectors that use relatively large amounts of each other's products and are characteristically based on innovative efforts and/or production linkages. Their activities relate to firms or sectors that co-operate in the process of diffusing innovations. Linkages relating to firms or sectors that form value-added production chains constitute another area of cluster activities.

**Innovation networks**

Innovation networks include managers, bankers, venture capitalists, professors, graduates, scientists, artists and government employees working on, or toward, innovation-related targets in a variety of application areas. Of the several types of institutional forms discussed above, innovation networks are best suited to the adoption of virtual status.

**Virtual research centers/networks**

Today's information and communications technologies make collaboration among distant researchers feasible by creating on-line research centers and co-laboratories. They can lead to virtual laboratories where widely separated researchers work with colleagues in different countries on specific projects or fields of knowledge.

In the real world, however, it is quite possible for some parks to defy classification in any of the above categories, as they may embody characteristics that derive from more than one scheme. Thus, a given park may possess residents that are research-oriented, qualifying it for research park status, while at the same time it accommodates innovative firms seeking a favorable location in which to establish themselves, suggesting that it is actually an innovation centre.

Other terms that are sometimes used, such as "technology valley" and "Innovation Park", denote entities that are barely distinguishable from those defined above.

Source: Economic and Social Commission for Western Asia (ESCWA), (2001)

# Appendix C: Overview Empirical Research on Science Parks

| *Author* | *Unit of analysis* | *Method* | *Period* | *Region* | *Sample* | *Results* |
|---|---|---|---|---|---|---|
| Appold, 2004 | County | Switching regression | 1960-1985 | US | 3024 | A |
| Bigliardi, 2006 | Science park | Case study | not reported | Italy | 4 | PE |
| Chen et al. 2004 | Firm | Survey Research: correlation analysis | not reported | Taiwan | 45 | M |
| Chen et al. 2006 | Industry sectors | Data Envelopment Analysis (DEA) | 1991-1999 | Taiwan | 54 | G |
| Ferguson and Olofsson, 2004 | Firm | Matched pair | 1995-2002 | Sweden | 30-36 | S(+), G |
| Fukugawa (2006) | Firm | Matched pair; recursive bivariate probit model | 1998-2003 | Japan | 203 | H(+) |
| Gower and Harris, 1995 | Science park | Survey research | 1994 | UK | 18 | FM |
| Gower et al. 1996 | Science park | Suvey research | 1994 | UK | 18 | FM |
| Hansson et al. 2005 | Science park | Case study | 2003 | Denmark, | 2 | G |
| Lindelof and Lofsten, 2006 | Firm | Multivariate (t-test; correlations) | 1999 | Sweden | 134 | I(+), E |
| Lindelof and Loftsen, 2003 | Firm | Matched pair | 1999 | Sweden | 134-139 | I |
| Lindelof and Loftsen, 2004 | Firm | Matched pair | 1999 | Sweden | 134-139 | G(+), I(+), H(+) |
| Link and Link, 2003 | Science park | OLS | 2002 | USA | 50 | G |
| Link and Scott, 2003 | University | Ordered probit | 2001 | US | 29 | I(+), R(-) |
| Loftsen and Lindelof, 2001 | Firm | OLS | 1994-1996 | Sweden | 163-100 | G(+) |
| Loftsen and Lindelof, 2002 | Firm | Matched pair; OLS | 1999 | Sweden | 134-139 | G(+), H(+) |
| Phillimore, 1999 | Science park | Case study | 1998 | Australia | 1 | H(+) |
| Siegel et al, 2003b | Firm | Stochastic Frontier Estimation | 1992 | UK | 89-88 | I(+) |
| Vedovello, 1997 | Science park | Case study | 1993 | UK | 1 | H(+) |
| Westhead and Storey, 1995 | Firm | Matched pair | 1986, 1992 | UK | 75-62 | S(+), H(+) |

S: survival; G: growth; H: HEI linkage; I: innovation output; R: reputation; A: agglomeration
E: external environment; M: Motivations to enter SP; FM: Facility Management; PE: Performance Evaluation

# Appendix D: Overview Organizational Theories

| Approach | Primarity Unit of Analysis | Issues Highlighted | Issues Hidden | Strenghts | Shortcomings |
|---|---|---|---|---|---|
| **Transaction cost approach** | Costs of organizing science park | Transactional View<br>Participant shortcomings | Results gained<br>Productivity of work | Strong theory background<br>A good conceptual set | Difficult concepts<br>Difficult to operationalize<br>Neglect technological complementaries<br>Neglect synergetic effects |
| **Agency Theory** | The principal-agent relationship | Different Goals<br>Monitor and Control (Control) | Co-operation | A good conceptual set | Easily stresses contradictions<br>Difficult concepts |
| **Stewardship Theory** | The principal-steward relationship | Common goals<br>Faciltate and Empower (Trust) | Risks of stewardship | A good conceptual set | Long term focus not always applicable |
| **Resource-based approach** | Resources used and saved by science park | Competitive Advantage<br>Cumulating Resources<br>Workers as Valuable Resource<br>Relational capabilities | Outputs, results | Discussed reality | Not established,<br>application intuitive<br>Concepts unsettled |
| **Network Theory** | Network Structure | Network density<br>Centrality<br>Network externalities<br>Access<br>Timing<br>Referral benefits<br>Trust<br>Resources and capabilities | Value creation | Pragmatic approach | Unable to explain 'new' transactional forms |
| **Value Chain** | Activities | policy choices, linkages, timing, location, sharing of activities among business units, learning, integration, scale and institutional factors | Customers | Well-defined framework<br>Relatively easy to grasp | Does not cover collaboration |
| **Open Innovation** | Innovation | External sources of knowledge<br>External and internal R&D<br>Business Model<br>Intellectual property | Open source<br>Long term R&D | Broad scope<br>Open attitude | Principles not yet grounded |

As Fligstein (2001) described organizational theories have three origins: Max Weber's original work on bureaucracies which came to define the theory for sociologists, a line of theory based in business schools that had as its focus, the improvement of management control over the work process (e.g. Taylor, Barnard, Simon, March), and the industrial organization literature in economics (Coase, Schumpeter, Williamson, Jensen).
Previous to this thesis a literature review was conducted to investigate whether the Organizational Theories can explain the characteristics of the science park phenomenon. In order to cope with the broad spectrum of stakeholders and the resulting characteristics a wide spectrum of organizational theories was investigated that cover each of the three origins described by Fligstein. The selection of these seven organizational theories is primarily based on the existence of previous theoretical links with the business model as unit of analysis. The business model can be used to integrate he different perspectives and act as a focal point of reference. There are more interesting theories that could augment the current set of theories, like transaction value and resource dependence theory, but these are not yet linked with the business model concept. The primary literature for the link between business models and organizational theory is:

- Amit R, Zott C. (2001)
- Chesbrough, H. and Rosenbloom, R. S. (2002)
- Chesbrough, H. (2003)
- Osterwalder A.(2004)
- Osterwalder A., Pigneur Y., Tucci L.T. (2005)

# Appendix E: Conceptual Framework

| | | ***Efficiency*** | ***Complementaries*** | ***Lock-in*** | ***Novelty*** | ***Constraints*** |
|---|---|---|---|---|---|---|
| *Product* | *Value Proposition* | Provide support for NTBF<br>Provide Physical Facilities | Link activities of participants<br>Combining off-site and on-site activities<br>Installation of new services<br><br>Mediate between agents and steward models | Emergence of a beneficial image<br>Creation of durable and stable jobs<br><br>Provide linkages with HEI/University/ Research Institutes | New participants<br>New links between participants<br>Unprecedented richness (quality and depth) of linkages<br>Creation of new products and processes<br>Emergence and use of new technological knowledge | Needs Tenants<br>Behavior of stakeholders |
| *Customer Interface* | *Target Customer* | NTBF<br><br>Multinationals | NTBF<br><br>Multinationals | NTBF<br><br>Multinationals | NTBF<br><br>Multinationals | Resources, Capabilities, Willingness Tenants |
| | *Distribution Channel* | Create 'easy to access' formal networks | Links with Vertical products/services<br><br>Links with Horizontal products/services | Importance of community concept<br><br>Tenants control use of personal information<br>Informal Networks | Link on-site and off-site participants | Resources SP/ tenants |
| | *Customer Relationship* | Efficient communications<br>Short term (Contract) | | Affiliate programs<br>Loyalty programs<br>Long term (Trust) | | |
| *Infrastructure Management* | *Value Configuration* | One stop shop for all facilities<br><br>Transaction actors are identified/ reviewed making more informed decisions possible for tenants<br>Scalability of transaction volume | Incentives to develop co-specialized resources<br>Intermediate for on-site and off-site knowledge flow | Customized/ personalized offerings and features | New incentives (e.g. customers can create linkages)<br>New (combinations of) products, services, information<br><br>Unprecedented number of participants and/or goods | Quality of Offered services vs. Needs<br>Resources SP |
| | *Capability* | Transaction speed<br><br>Align goals of stakeholders<br>Information made available as a basis for decision making;reduces asymmetry of information about goods<br>Information made available as a basis for decision making;reduces asymmetry of information about participants<br><br>High administration efficiency<br><br>Efficient Incubation Function<br><br>Efficient Information System<br><br>Efficient Infrastructure<br>Capable management team<br>Capable marketing function (to market its products and services)<br>Capable to provide marketing expertise and managerial skills to firms<br>Capable to select or reject which firms will enter the park | Combining on-site and off-site resources and capabilities<br><br>Access to complementary products, services, and information from Science Park<br>Access to complementary products, services, and information from tenants & partner firms<br><br>Access to complementary products, services, and information from customers<br><br>Appropriateness concerning intellectual property rights | Transaction reliability<br><br>Transaction safety mechanisms<br><br>Promotion of trust through third party<br><br>Information flow security and control processes<br><br>Capable to attract consultancy firms and technical services firms<br>Provide qualified research and development personnel | Promote culture of Innovation<br><br>Provide support for novel Business Models<br><br>Novel use of IPR<br><br>Absorp and promote internal and external ideas | Resources SP<br><br>Legislation |
| | *Partnership* | Efficient linkages with/between partners:<br><br># HEI<br># Universities<br># Governments<br># Service Providers<br># Research Institutes | Alliance capabilities of partners<br><br>Technologies of participants | Participants deploy specialized assets<br>Reputation of Science Park | Develop novel partnership constructs | Legislation<br><br>Resources |
| *Financial Aspects* | *Cost Structure* | Infrastructure costs<br><br>Development costs<br>Logistic costs<br>HRM costs<br>Service costs<br>Marketing & Sales costs<br>Operations costs | | Learning investments made by participants | | Resources<br><br>Legislation |
| | *Revenue Model* | Real Estate rentals<br>Fees for direct provided services | | | | Legislation |

# Appendix F: Items Dependent Variable (Subjective)

Primary sources are Khong and Richardson (2003) and Khong and Mahendhiran (2006). The perceived business performance measures (PBPM) depicted below have a positive and significant relationship with the measures of return on sales and return on assets. The Bontis (1998) approach incorporates the assessment of an enterprise within the organization, the departments and individuals. Because for this research only the enterprises or the sub departments who are located on the HTCE are of interest, the department variables are left out and the Enterprise questions are translated to the initiatives on the HTCE (see Table below).

- Bontis (1998) suggest that the variables in the organizational level have positive impacts on objective business performance hence are important indicators of perceived business performance measures (PBPM).
- Bontis and Fitz-enz (2002), Bart et al. (2001) and Bontis (1998) suggest that the variables in individual level have a positive impact on objective business performance hence are important indicators of PBPM.

| **Variables manifesting PBPM (benchmarked with competitors)** | |
|---|---|
| V1 | *Enterprise on HTCE is successful* |
| V2 | *Enterprise on HTCE meets its clients' needs* |
| V3 | *Enterprise's (on HTCE) future performance is secure* |
| V4 | *Enterprise on HTCE is well respected within the industry* |
| V5 | *Individuals are satisfied working here* |
| V6 | *Individuals are generally happy working here* |
| V7 | *Individuals are satisfied with their own performance* |

# Appendix G: Adapted Questionnaire

** SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree; Y = Yes; N = No*

| | **BUSINESS MODEL DESIGN FOR EFFICIENCY** | **Scale*** |
|---|---|---|
| | • *Transaction speed* | |
| e1 | ○ The HTCE-concept enables faster transactions for my company | SA, A, D, SD |
| | • *Degree of automation* | |
| e2 | ○ The HTCE-concept reduces inventory costs for my company (i.e. office supplies, raw materials, etc.) | SA, A, D, SD |
| e3 | ○ The transactions are simple from my company's point of view | SA, A, D, SD |
| e4 | ○ The HTCE-concept enables a low number of errors in the execution of transactions for my company | SA, A, D, SD |
| e5 | ○ Costs other than those already mentioned for my company are reduced (i.e., marketing and sales costs, transaction processing costs, communication costs, etc.) | SA, A, D, SD |
| e6 | ○ The HTCE-concept is scalable (in the sense that the HTCE-concept is suitable for handling small as well as large number of transactions) | SA, A, D, SD |
| | • *Breadth and depth of information provided* | |
| e7 | ○ The HTCE-concept enables my company to make informed decisions | SA, A, D, SD |
| e8 | ○ Transactions are transparent, that is, my company can easily verify flows and use of information, services, and goods | SA, A, D, SD |
| e9 | ○ As part of the transaction, information is provided to my company that reduces the asymmetric degree of knowledge amongst residents regarding the quality and nature of the goods being exchanged | SA, A, D, SD |
| e10 | ○ As part of the transactions, information is provided to my company, residents and partners that increases the knowledge amongst them about each other (i.e., buyers learn more about trustworthiness of sellers, vendors learn about consumers, etc.) | SA, A, D, SD |
| | • *Ease of access to potential transaction participants* | |
| e11 | ○ Access to a large range of products, services and information, or to a large number of other residents and partners is provided | SA, A, D, SD |
| e12 | ○ The HTCE-concept enables demand aggregation (bringing together large number of buyers who may benefit from volume discounts) | Y, N |
| e13 | • *The HTCE-concept, overall, offers high transaction efficiency for my company* | *SA, A, D, SD* |

** SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree; Y = Yes; N = No*

| | **BUSINESS MODEL DESIGN FOR COMPLEMENTARITIES** | **Scale*** |
|---|---|---|
| | • *Bundling of resources and capabilities* | |
| c1 | ○ There are complementarities for my company between on-site and off-site elements of the transactions on the HTCE (i.e., HTCE enables support from companies outside HTC, like government or manufacturing companies) | SA, A, D, SD |
| c2 | ○ The HTCE-concept enables complementarities for my company with activities of participants (i.e., supply chain integration) | SA, A, D, SD |
| c3 | ○ The HTCE-concept enables complementarities for my company between the technologies offered by the HTCE and technologies provided by residents and partners of the HTCE | SA, A, D, SD |
| | • *Bundling of products and services* | |
| c4 | ○ The HTCE-concept offers my company a wide range of complementary services and products from various residents and partners of the HTCE | SA, A, D, SD |
| c5 | ○ The HTCE-concept offers my company a wide range of complementary services and products from the HTCE itself | SA, A, D, SD |
| c6 | ○ Additional services offered by the HTCE, that combine with existing services (cross-selling) are important for my company | SA, A, D, SD |
| c7 | ○ There are strong vertical complementaries for my company in terms of service offerings of the HTCE (i.e., clean- and test rooms, laboratories, experts knowledge) | SA, A, D, SD |
| c8 | ○ There are strong horizontal complementaries for my company in terms of service offerings of the HTCE (i.e., management/staff support, financial support, intellectual property service, catering, conference rooms) | SA, A, D, SD |
| c9 | • *Overall, the bundling of complementary products/services are important to the HTCE-concept* | *SA, A, D, SD* |

** SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree; Y = Yes; N = No*

| | **BUSINESS MODEL DESIGN FOR LOCK-IN/ CUSTOMER RETENTION** | **Scale*** |
|---|---|---|
| | • *Direct incentives* | |
| l1 | ○ The incentives offered, to my company and their employees, by loyalty programs to engage in repeat transactions are strong (use of facilities like cleanrooms and restaurants become more attractive when used more often) | SA, A, D, SD |
| l2 | ○ My company and their employees can customize products, services, or information to their needs | SA, A, D, SD |
| l3 | ○ State the methods used by the HTCE to personalize services: | |
| | ▪ Personalized office spaces | |
| | ▪ Security services | |
| | ▪ Secretarial/ reception services | |
| | ▪ Child care | |
| | ▪ Sport facilities | |
| | ▪ Others | |

| | | |
|---|---|---|
| l4 | ○ This personalization is effective in attracting and maintaining residents and employees | SA, A, D, SD |
| | • *Trust and reliability* | |
| l5 | ○ The HTCE-concept promotes transaction safety and reliability | SA, A, D, SD |
| l6 | ○ Methods offered by HTCE that promote trust by giving my company and the employees control over the use of personal information: | |
| | ▪ Control of Phonebook information | |
| | ▪ Control on information (news) | |
| | ▪ Information on new technology | |
| | ▪ Others | |
| l7 | ○ Other methods offered by the HTCE that promote trust: | |
| | ▪ No use of overt control-mechanisms by HTCE | |
| | ▪ Referral services to expert companies | |
| | ▪ Transparency and honesty of HTCE towards residents | |
| | ▪ Information available about residents | |
| | ▪ Organization of communal activities for residents | |
| | ▪ Availability of references on previous transactions | |
| | ▪ Customized services | |
| | ▪ Others | |
| | • *Network effects* | |
| l8 | ○ The HTCE has a dominant design (i.e., an environment for my company that is far better than alternative concepts) | SA, A, D, SD |
| l9 | ○ The concept of 'community' plays an important role in the HTCE-concept and for my company | SA, A, D, SD |
| l10 | ○ Affiliate Programs, which are designed to enable transactions originating from the HTCE partners, play an important role in the HTCE-concept and for my company (i.e. residents receive credits for attracting new residents) | SA, A, D, SD |
| l11 | ○ The HTCE-concept exhibits important direct network externalities; my company benefits from increasing numbers of (similar) participants | SA, A, D, SD |
| l12 | ○ The HTCE-concept exhibits important indirect network externalities; my company benefits from increasing numbers of participants from another group (i.e., participants groups can be buyers and sellers) | SA, A, D, SD |
| | • *Irreversible up-front investments* | |
| l13 | ○ My company must make considerable HTCE-specific investments of time and effort in order to learn how to leverage the opportunities of the HTCE | SA, A, D, SD |
| l14 | ○ My company must have specialized assets (like specific technological knowledge) in place to leverage the opportunities of the HTCE | SA, A, D, SD |
| l15 | • *Overall, the HTCE-concept succeeds in creating lock-in/ customer retention* | *SA, A, D, SD* |

** SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree; Y = Yes; N = No*

| | **BUSINESS MODEL DESIGN FOR NOVELTY** | **Scale*** |
|---|---|---|
| n1 | ○ The HTCE-concept offers new combinations of products, services and information for my company | SA, A, D, SD |
| n2 | ○ The HTCE-concept brings together new participants for my company | SA, A, D, SD |
| n3 | ○ The incentives (beyond the services offered) offered to my company to take part in transactions are novel | SA, A, D, SD |
| n4 | ○ The HTCE-concept allows my company to access an unprecedented variety and number of participants and/or goods | SA, A, D, SD |
| n5 | ○ The HTCE-concept links my company to transactions in novel ways (these refer to who linked to whom and in which direction) | SA, A, D, SD |
| n6 | ○ The richness (quality and depth) of some of the links between my company and participants is novel | SA, A, D, SD |
| n7 | ○ Does the HTCE, according to you, claim to be a pioneer with the commercial introduction of its HTCE-concept? | Y, N |
| n8 | ○ Since the issuing of the prospectus, the HTCE has continuously introduced innovative services in its HTCE-concept | SA, A, D, SD |
| n9 | ○ There are competing concepts in sight that have the potential to leapfrog the HTCE-concept | SA, A, D, SD |
| n10 | ○ There are other important aspects of the HTCE-concept that make it novel | SA, A, D, SD |
| n11 | • *Overall, the HTCE-concept is novel* | *SA, A, D, SD* |

** 1 = Low; 10 = High*

| | **VALUE CREATION & APPROPRIATION** | **Scale*** |
|---|---|---|
| v1 | • *Enterprise on HTCE is successful* | 1… 10 |
| v2 | • *Enterprise on HTCE meets its clients' needs* | 1… 10 |
| v3 | • *Enterprise's (on HTCE) future performance is secure* | 1… 10 |
| v4 | • *Enterprise on HTCE is well respected within the industry* | 1… 10 |
| v5 | • *Individuals are satisfied working here* | 1… 10 |
| v6 | • *Individuals are generally happy working here* | 1… 10 |
| v7 | • *Individuals are satisfied with their own performance* | 1… 10 |

# Appendix H: Coding Rules

*Questionnaire*

The coding rules used for the questionnaire are in line with the coding rules defined by Amit and Zott (2002). These rules are briefly described in the subsequent section.

For the questions two types of answers were possible; Likert scale or multiple checkbox responses. An implicit five point Likert scale was used for the responses "strongly disagree – disagree – agree – strongly agree". There is an implicit neutral response between agree and disagree in order to motivate the respondents to really choose a non-neutral answer. The coding scheme was consistent with the assumption of an implicit five point Likert scale: "strongly disagree" received 0, "disagree" was coded 0.25, "agree" was coded 0.75 and "strongly agree" was coded 1. The coding gap between "disagree" and "agree" implied a neutrality point at 0.5. If the possible answers were "no – yes" responses were "no" responses were coded as 0 and "yes" responses as 1.

The coding rule for multiple check box response was applied as follows. If all check boxes were checked (with the exception of the "others" response), then the assigned code was 1. If no of these possible choices (with the exception of the "others" response) were checked a number of 0 was assigned. All other cases translated into a score between 0 and 1 that was proportional to the number of boxed checked (e.g., if 4 out of 5 boxes were checked, the standardized score was 0.6).

*Interviews*

The interviews were coded with the help of the software program Nvivo 2.0. Statements of the respondents were coded based on the defined conceptual framework. This framework consists of two parts; the nine elements of a business model and the four value sources (design themes).

Because interviewees don't only give their opinion about the current state of affairs, but also on subjects they wish for or really don't want, the coding scheme for the four value sources is augmented to cover these opinions. For the *current* situation, that means items which are already present in the concept of the High Tech Campus Eindhoven, items can be coded as being "positive", "negative" or having "no significant effect". The last coding rule, "no significant effect", is defined as an item which has is present in order to do business but has no real advantage compared to other alternatives (e.g., the internet accessibility is almost mandatory but gives no real advantage over other working spaces in the Netherlands once installed). The other situation would be the *ideal* situation for the interviewee; in this case an item is not present in the concept of the High Tech Campus Eindhoven. In this situation items can be coded as "desired", "not desired" or "mandatory". Also here, "mandatory" implies an item that needs to be in place in order to keep up with alternatives, but once in place does not offer any competitive advantage. See the table below for an overview.

**Table: coding rules used for value sources**

| *Current* | *Ideal* | *Code* |
|---|---|---|
| Positive effect | Desired item | 1 |
| No significant effect | Mandatory item | 0 |
| Negative effect | Not desired item | -1 |

The number of codes for each coding item was standardized per interviewee in order to be able to compare the weight certain respondents give to an item relative to other respondents.

# Appendix I: Testing Assumptions Sample (Regression Analysis)

1 The data has no missing values

2 The data shows not indication outliers (standardized variables do not exceed the absolute value of z=2.5)

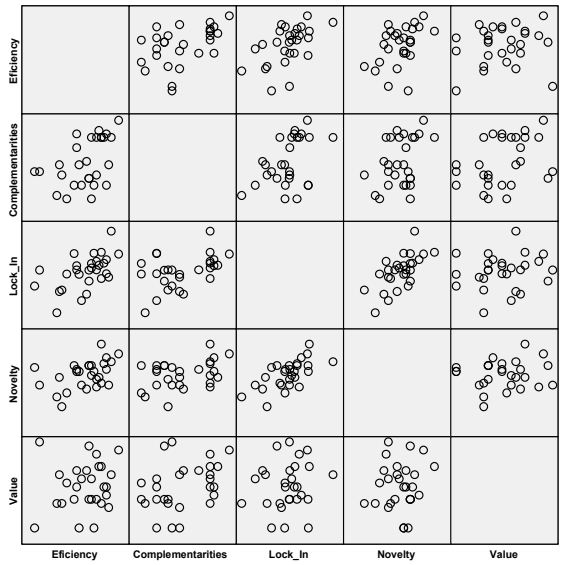
3 The normality assumption is not seriously violated by the data. Values of skewness and kurtosis below absolute 1 are not a serious deviation from the normality assumption (see table of descriptive statistics). The only deviation is the kurtosis of complementarities which has a higher value than 1. A further check by means of normal probability plots (can be requested from the author) showed no serious deviation from the normality assumption. The high value is probably the direct result of the small sample size.

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Eficiency | 28 | -.88 | .42 | -.0907 | .32873 | -.820 | .441 | .235 | .858 |
| Complementarities | 28 | -.50 | .78 | .1032 | .38600 | .082 | .441 | -1.355 | .858 |
| Lock_In | 28 | -.60 | .73 | .0685 | .27345 | -.238 | .441 | .873 | .858 |
| Novelty | 28 | -.68 | .77 | .0666 | .31818 | -.192 | .441 | .246 | .858 |
| Value | 28 | .20 | .80 | .4918 | .16374 | .004 | .441 | -.416 | .858 |
| Valid N (listwise) | 28 | | | | | | | | |

4 The assumption of homoscedasticity is violated (see correlation matrix of variables). This implies that the dependent variable shows unequal variance across the predictor variables. The occurrence of the heteroscedasticity is probably related to the small sample size. Also the small variance in the dependent variable can be a reason for this effect. In this situation this results in a higher insensitivity of the test.

**Correlation matrix of variables**




5 The linearity assumption is also violated (see correlation matrix of variables). Whereas the independent variables show some sign of linearity, the linearity between the dependent variable and the independent variables seems to be missing completely. The small sample size and the low variance in the dependent variable also here are possible reasons for this nonlinearity. No appropriate transformations could be found to achieve normality and homoscedasticity.

6 In the table of the coefficients the collinearity statistics are added. The variance inflation factor (VIF) is not high for the variables. The VIF of the variables is less then 3. A common threshold for assessing the presence of multicollinearity is a VIF of 10. As a rule of thumb for multicollinearity if the simple correlation coefficient >0.7, then multicollinearity exists between the variables. This is not the case. Also see the table of collinearity diagnostics. The highest condition index is 2.840. If the condition index is 15, multicollinearity is present; if it is greater than 30 you should consider multicollinearity as a serious concern. Because the highest condition index is 80.221 multicollinearity is clearly a concern. Furthermore the eigenvalues in the table which are not very close to zero also indicate a lack of multicollinearity. These measures indicate that there is no multicollinearity present between the variables.

**Coefficients(a)**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95% Confidence Interval for B | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Tolerance | VIF |
| 1 | (Constant) | .474 | .037 | | 12.685 | .000 | .397 | .551 | | |
| | Eficiency | -.016 | .121 | -.033 | -.136 | .893 | -.266 | .234 | .638 | 1.566 |
| | Complementarities | .165 | .097 | .390 | 1.699 | .103 | -.036 | .366 | .715 | 1.399 |
| | Lock_In | .010 | .168 | .017 | .059 | .953 | -.337 | .357 | .479 | 2.088 |
| | Novelty | -.022 | .134 | -.042 | -.161 | .874 | -.299 | .256 | .553 | 1.810 |

a Dependent Variable: Value

**Collinearity Diagnostics(a)**

| Model | Dimension | Eigenvalue | Condition Index | Variance Proportions | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (Constant) | Eficiency | Complementarities | Lock_In | Novelty | (Constant) | Eficiency |
| 1 | 1 | 2.435 | 1.000 | .01 | .04 | .06 | .06 | .06 |
| | 2 | 1.254 | 1.393 | .35 | .17 | .00 | .00 | .00 |
| | 3 | .629 | 1.967 | .01 | .03 | .62 | .07 | .24 |
| | 4 | .379 | 2.534 | .47 | .54 | .31 | .04 | .26 |
| | 5 | .302 | 2.840 | .16 | .22 | .01 | .84 | .44 |

a Dependent Variable: Value

**Regression with 'Inverse of Months on HTCE' as dependent variable (t0 = 01-01-2002)**

The inverse of the 'months on the HTCE' is used as a proxy for the growth of new residents because growth of residents is a non-negative integer value and therefore not appropriate for OLS regression. With this measure the difference in time is also included. It is assumed that companies that arrive later on the HTCE will benefit more from the emerging strategy (also network externalities, complementarities, efficiency). Of course one also could argue that companies that are longer on the HTCE are more familiar with the processes but it is argued that this effect is smaller than the benefits of arriving later since the HTCE is still in its growth phase. This test also fails to reject the null hypothesis.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | R Square Change | F Change | df1 | df2 | Sig. F Change | R Square Change | F Change | df1 | df2 |
| 1 | .328(a) | .107 | -.048 | .07709 | .107 | .692 | 4 | 23 | .605 |

a Predictors: (Constant), Novelty, Complementarities, Eficiency, Lock_In

**Coefficients(a)**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95% Confidence Interval for B | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Zero-order | Partial | Part | Tolerance | VIF |
| 1 | (Constant) | .095 | .017 | | 5.465 | .000 | .059 | .132 | | | | | |
| | Eficiency | -.018 | .056 | -.080 | -.326 | .747 | -.135 | .098 | -.022 | -.068 | -.064 | .638 | 1.566 |
| | Complementarities | -.038 | .045 | -.196 | -.842 | .409 | -.132 | .056 | -.102 | -.173 | -.166 | .715 | 1.399 |
| | Lock_In | -.005 | .078 | -.018 | -.063 | .951 | -.167 | .157 | .089 | -.013 | -.012 | .479 | 2.088 |
| | Novelty | .086 | .063 | .363 | 1.370 | .184 | -.044 | .216 | .240 | .275 | .270 | .553 | 1.810 |

a Dependent Variable: Inv_mths

# Appendix J: Sample (generalizability)

*General information of the population of the High Tech Campus Eindhoven (HTCE)*
The total population of the HTCE consists of 51 companies. Of these 51 companies 14 (27.5%) still belong to the Royal Philips business. Of the total population, 26 (51.0%) businesses originated from the Royal Philips Corporation. When looking at the number of employees the current Philips departments employ 46.2% (2600) of the total HTCE population. This is also reflected in the higher average size (in terms of FTE's) of the Philips departments in comparison with the other residents.
Of the total sample 74.5% is a technology oriented company, the rest of the residents are service oriented. When comparing the companies that originated from Philips to those that did not originate from Philips then we see that for the latter the ratio [technology: service] is 24:2, while the former is 14:13, so most service oriented companies are not related to Philips.
The sample is checked on two dimensions to see if it represents the total population of companies on the HTCE. Furthermore, the two dimensions are controlled for three potential influential factors: [part of Philips], [Service company], and [non-incumbent/ non-multinational]. 4 of the 26 companies were part of the Philips Corporation while of not-interviewed residents 10 of 25 residents is part of Philips. Of the 26 interviewed residents 17 are technology oriented whereas of the non-interviewed residents 21 out of 24 are technological oriented. Finally, the from the interviewed sample 15 out of 26 are part of a incumbent or multinational whereas from the non-interviewed residents 20 out of 25 residents are part of an incumbent or multinational.

## 1 Time on HTCE

In this case we want to prove that the groups are comparable. The table shows that in terms of FTE's the two groups are different. When controlled for Services oriented companies and non-incumbents and non-multinationals we fail to reject the null hypothesis that the groups are equal. So this indicates that especially service oriented companies have a relatively large influence on the average time on the HTCE. The time of the interviewed service oriented companies on the HTCE is relatively shorter. This partly can be explained by the fact that the non-interviewed service companies are primarily Philips oriented and reside longer on the HTCE. So there is a bias in terms of interviewed residents. During the research a higher ratio of younger, service oriented, non-incumbent companies were investigated. When looking at the two groups most new companies are interviewed, these companies are to a large extent non-Philips and very important for the growth of the HTCE. During the research the decision was taken to focus primarily on these new companies because they are presumed to have a better representation of potential new residents and therefore the future.

| | *Time* | | *Time (controlled for Philips)* | | *Time (controlled for Service)* | | *Time (controlled for non Inc./Mult.)* | |
|---|---|---|---|---|---|---|---|---|
| | *0* | *1* | *0* | *1* | *0* | *1* | *0* | *1* |
| **Mean** | 35.16 | 22.77 | 30 | 16.73 | 34.48 | 27.35 | 35.3 | 23.53 |
| **Variance** | 513.22 | 405.46 | 360.57 | 215.26 | 471.96 | 523.62 | 529.69 | 487.84 |
| **Observations** | 25 | 26 | 15 | 22 | 21 | 17 | 20 | 15 |
| | | | | | | | | |
| **t Stat** | 2.062 | | 2.282 | | 0.976 | | 1.532 | |
| **P(T<=t) one-tail** | 0.022 | | 0.016 | | **0.168** | | **0.068** | |

t-test assuming unequal variances
0 = Non-interviewed group; 1 = Interviewed group

## 2 Size (in terms of FTE's)

All tests for size fail to reject the null hypothesis that the to groups are equal. Therefore it is reasonable to assume that both groups are equal on this factor. When controlling for Philips the average size of the interviewed group drops dramatically. This is due to the large size of the non-interviewed companies NXP and Atos Origin. When controlling for service oriented companies the average size of the interviewed group increases significantly indicating that the service oriented companies are relatively small in this group. The same logic goes for when controlling for non-incumbent or non-multinational companies.

| | *Size* | | *Size (controlled for Philips)* | | *Size (controlled for Service)* | | *Size (controlled for non Inc./Mult.)* | |
|---|---|---|---|---|---|---|---|---|
| | *0* | *1* | *0* | *1* | *0* | *1* | *0* | *1* |
| **Mean** | 148.28 | 73.71 | 168.67 | 22.48 | 159.05 | 110.44 | 180.6 | 117.97 |
| **Variance** | 126787.88 | 47070.96 | 198334.81 | 1497.230 | 147586.75 | 69403.25 | 154533.83 | 78659.66 |
| **Observations** | 25 | 26 | 15 | 22 | 21 | 17 | 20 | 15 |
| | | | | | | | | |
| **t Stat** | 0.899 | | 1.2689 | | 0.461 | | 0.550 | |
| **P(T<=t) one-tail** | **0.1879** | | **0.113** | | **0.324** | | **0.293** | |

t-test assuming unequal variances
0 = Non-interviewed group; 1 = Interviewed group

Other control factors could be: age of Mother Company; industry type; growth orientation; entrepreneurial orientation; culture of Mother Company; external investments, but constraints in resources and due to the small sample size these factors could not be taken into account.

# Appendix K: Semi-Structured Interview Scheme

1 *Can you shortly tell something about yourself and your organization?*

2 *What is the added value for your company to be located on the HTCE?*
   i. Image / reputation for your company
   ii. Business (support, etc.)
   iii. Networking (long term business)
   iv. Synergy effects
   v. Infrastructure
   vi. Management support
   vii. Financial support
   viii. IPR support
   ix. Personal (Human resources)

*b. What can be improved, regarding the added value the HTCE has for your company?*

3 *What is your opinion regarding the entrance policy of companies of the HTCE?*
   a. Mix of companies
   b. Focus on technological domains
   c. Entrance rules/regulations

4 *What is your opinion regarding the manner of communication of the HTCE-management with your company and facilitates communication with other companies?*
   a. ICT-network (as medium)
   b. Access to information
   c. Informal networks
   d. How do you relate this with respect to other campus sites on the world? Hoe (How is Innovation management en R&D/Business carried out there?)

5 *With regard to the relationship of the HTCE with your company;*
   *a. Can you describe the current relationship, or what is Campus Site Management doing for your company?*
      i. Only facilities
      ii. Supporting services
      iii. Business support
   *b. What is the desired relationship*

6 *How delivers the Campus Site Management the value? In other words, what kind of activities and resources does the Campus Site Management employ to deliver the value to your company?*

7 *What do you perceive to be the core capabilities of the Campus Site management?*
   *a. What can they improve (is missing)?*

8 *What is the value of the following partners of the HTCE for your company?*
   *a. Universities*
   *b. Government*
   *c. (Knowledge-)institutes*
   *d. Cultural/ creative organizations*

9 *Output data of (the part of) your company on Campus;*
   *a. Growth employees (% per year)*
   *b. New co-operative relationships (no.)*
   c. *Growth external finance (in comparison with. base-year)*

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