

Science Parks as the Facilitators of Sustainability

The Case of IDEON Science Park and its Lightfoot Academy

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Abstract

Science parks are the facilitators of innovation, hosting new high-technology businesses. There are thousands of SMEs in Science Parks all around the world. This thesis is looking at an environmental initiative addressing these firms, IDEON's Lightfoot Academy. The science parks around the world have several approaches addressing sustainability. These approaches are outlined in the thesis, including the providing of environmental services to tenant companies demonstrating it through case studies. SMEs have drivers and barriers to participate in initiatives and implement environmental improvements, these drivers and barriers are summarized here. The thesis is looking at several existing environmental initiatives and environmental management systems to see which would fit science parks especially IDEON Science Park which is at the main focus of the work. IDEON's Lightfoot Academy has been analyzed and a possible implementation of it has been proposed.

Keywords: IDEON, Science Park, SME, Environmental Initiatives, Cleantech

Executive Summary

The thesis gives an overview of science parks and what these parks are doing or could be able to do to contribute to sustainability including environmental initiatives for tenant companies or companies at the vicinity of the park. The paper is a contribution to the preparation of IDEON's Lightfoot Academy, an initiative to involve the tenant companies into environmental work.

Science Parks are the home of thousands of SMEs (Small and Medium sized Enterprises) all around the world and are the facilitators of innovation best described by their position within the triple helix model of innovation systems, where mostly the governmental sphere provides funding and support, the universities are the sources of new knowledge, and the industry provides the market and uses the innovation for making business. The Science Parks are in the middle of the system helping in the interaction of the spheres.

Four possible approaches for science parks have been identified to facilitate sustainability:

- As a real estate developer they build more energy efficient and better buildings to show their commitment and to follow the trend.
- As an operator they are establishing an Environmental Management System at the park or just implementing several programs to improve the environmental performance of the facilities.
- The park dedicates itself to develop a cleantech cluster to attract related companies to benefit from the emergence of the industry and become a center of growth.
- To improve the environmental performance of the tenant companies by providing environmental services or organizing networks and informational events to get them started or help in their progress.

Four short case studies showed some of the above approaches in work. At the Australian Technology Park an environmental management system is in place which incorporates tenant suggestions too; at Hong Kong Science and Technology Parks green buildings are planned to be built for their future more environmentally conscious tenants and for cleantech companies; Lahti Science and Business Park is the center of the Finnish cleantech cluster dedicated only for cleantech businesses and innovation; Kent Science Park is a privately owned science park as IDEON, there is less emphasis on sustainability at the park, still several initiatives are present to improve the park's image on environmental responsibility by sustainable energy sourcing, building greener buildings and helping onsite cleantech companies.

The environmental initiatives for tenant SMEs were investigated, starting with the drivers and the barriers present for SMEs to successfully participate in initiatives and implementation of environmental management systems (EMS). The main internal drivers for environmental work are the cost saving opportunities (energy, resource efficiency), attracting new customers and entering new markets; the main external drivers are pressure from customers and stricter regulations. The real important barriers are the internal barriers which can jeopardize environmental work; external barriers are only slowing down improvements. The most important internal barriers are lack of financial or other resources, high implementation costs, and lack of commitment from management. Main external barriers are information scarcity, no demand from customers.

From a long term perspective and for a continuous improvement, systematic approaches for environmental improvements are preferred. The two main more systematic and long term approach are the implementation of an EMS at the firm or choosing an environmental

business strategy for the firm. The environmental management approach has been further investigated through existing initiatives. These initiatives were:

- ISO-14005, international standard for phased implementation of ISO-14001; expensive, not preferred
- EMAS Easy, EU initiative for EMAS and/or ISO-14001 implementation; less expensive, but still complicated for small firms
- Joint ISO-14001 certification, the Hackefors model; fit for companies at the same location, needs a campaign or project approach, could be too formal
- Step by step Certifications, Acorn Scheme or BS8555 standard; easing the implementation by spreading it in time, could lead to an unfinished and unacknowledged system
- Joint management systems as FR2000; combining quality, environment, and health and safety management systems, could be even more complicated for small firms
- Result oriented systems, Ecoprofit; Aiming for profitable environmental investments, higher impact companies are in focus, system not present in Sweden
- Light EMS, Svensk Miljöbas; Simpler system than ISO-14001, good possibility for upgrade, could fit science park companies

IDEON's Lightfoot Academy is a unique initiative in its form, as no other similar initiatives have been found in science parks. The initiative addresses the tenants of the science park in order to help them improve their environmental performance and help them at the same time realize their potentials benefit from it. The implemented Lightfoot Academy could be shaped according to the following criteria:

- The initiative should have a certificate accepted internationally, or could be used internationally.
- Should help complying with environmental legislation
- Should improve the participants' environmental performance
- Should focus on small and micro companies
- Should use networking
- Should have man on man interaction as a service for participants
- Should be as cost efficient as possible
- Should result in economic benefits for participants
- Should be able to address firms individually
- Should be sustainable on the long run
- Should build out a systematic learning not just an ad-hoc approach
- Should be attractive for non-participants
- Should not be too formal and complicated to implement
- Should not take too much time from participants
- Should rely on the real estate and infrastructure

The first criterion on certification has to be handled as according to the survey conducted on IDEON's tenants, the companies at IDEON are not yet seeing any benefits from certification, therefore having little motivation to implement one. For the success of the initiative, motivation is crucial by showing the business advantages. Building up and using the infrastructure of the science park for environmental management is important considering the size and scarce resources of the firms. Cooperation with Lund University for consulting using cost efficient and motivated student workforce for such initiatives is advised.

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Abbreviations

ATP	Australian Technology Park
BEAM	Building Environmental Assessment Method
BREEAM	Building Research Establishment Environmental Assessment Method
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
HKSTP	Hong Kong Science and Technology Parks
IASP	International Association of Science Parks
ICT	Information and Communications Technology
KSP	Kent Science Park
LCA	Life Cycle Assessment
LEED	Leadership in Energy and Environmental Design
LSBP	Lahti Science and Business Park
LUIS	Lund University's Innovation System
NGO	Non-Governmental Organization
SME	Small and Medium Enterprises

1 Introduction

1.1 Background

Sustainability is a growing issue addressed by highest levels of government, scientists and NGOs, triggered by the emerging alarming evidences of environmental including climate change, biodiversity loss and the depletion of resources. The need for solutions to the problems is getting more urgent forcing governments and other actors to try more drastic measures.

The most common definition of sustainability and sustainable development is from the Brundtland Commission of the United Nations: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (UN, 1987)

A new buzzword “cleantech” is appearing on the agenda of business developers, offering new ways of growth for economies. After the 2008 credit crunch, now there is even more emphasis on sustainability and the acknowledgement of the limits of resources. Governments are putting more effort on green growth, resource efficiency and renewable energy. There is a growing attention on sustainability issues by customers and supply chains. As the Stern review found, when risks and environmental damages and their effects on the economy are accounted and priced, investing into sustainable solutions would pay off in the long run, resulting in much less costs as it seems (Stern, 2006).

Science Parks as parts of innovation systems and centers of entrepreneurship are sensitive for market changes and looking to grasp new business opportunities. After benefiting from the ICT (Information and Communication Technology) revolution and innovations in life sciences, they are ready to benefit from more sustainable businesses such as cleantech products and services. There is a great potential in new start-ups to be more environmentally sustainable from the beginning by designing their business model, products and services with consideration of the triple bottom line which is the combination of economic, environmental and social benefits.

Being environmentally conscious reflects on the reputation of firms from manufacturing companies till science parks. The pro-environmental attitude of companies is starting to be not just an advantage, but a necessity and a minimum standard which is expected by customers and other stakeholders. Environmental legislation is pushing firms, while customer demand is pulling firms towards a more sustainable direction.

Science parks are home for many SMEs (Small and Medium sized Enterprises), having their different environmental impacts, IDEON Science Park in Lund, Sweden is trying to involve its tenant companies with an initiative into improving their environmental performance.

1.2 Problem Definition

SMEs are responsible for 60-70% of the environmental impact of the industry, more than 95% of all companies are classified as SME (EC, 2010a). There are several initiatives addressing the improvement of environmental performance of SMEs. These initiatives make improvements on the participants, but the number of participants is not sufficient. These initiatives are not widespread and have a low number of participants. The most known environmental management systems (EMS) or environmental diplomas within the European Union have only around thousand or a couple of thousands of participants from more than twenty million enterprises in Europe (EC, 2009). It is still an unresolved problem, how SMEs

could be successfully involved to make actions to improve their environmental performance. Considering the huge sector differences and the variety within the SMEs from micro companies with five employees to the international companies having two hundred employees working at multiple sites, a common generic solution is hardly feasible.

As the vast majority of evidence of voluntary initiatives is from central government sponsored initiatives involving large firms, there is a need to scale down the evidence to test the effectiveness and efficiency of local scale voluntary initiatives engaging SMEs (Peters & Turner, 2004).

Since science parks are facilitators of innovation and home of many high-tech and services SMEs, they could be the facilitators of sustainability, several of them around the world is already starting to be proactive, creating, hosting, facilitating initiatives to promote sustainability. However there has been limited amount of research done on science parks regarding what actions they are doing to improve their environmental performance, what roles science parks could have to promote sustainability.

IDEON Science Park is trying to be an actor to help the companies present at the park to be more environmental friendly and benefit from the achievements. A science park to be in this role is unique since it is taking the usual role of the governments or municipalities. The management of the park is acting as a leader of a small community of companies. Would a science park be able to act effectively and become a hub for an initiative addressing SMEs?

IDEON is aiming for an environmental diploma for the participants of its initiative, the Lightfoot Academy. The purpose of the diploma is to be able to use the achievement in environmental performance improvements for marketing purposes to get some business advantages with the efforts.

As science parks are in the center of the innovation system resulting in new businesses and innovations. Considering what capabilities they have, there might be other ways for them to contribute to a sustainable future by promoting sustainable entrepreneurship and helping the greener innovations to thrive. These are rather preventative approaches creating firms with small environmental impact when these are growing, they will need less efforts to keep them having a low environmental impact.

1.3 Research Questions and Objectives

This thesis is seeking to answer few questions on the role of the science parks and SMEs pursuing environmental sustainability.

1. What are science parks doing for sustainability around the world?
2. Could science parks play a bigger role in promoting sustainability by using their resources?

The goal is to get a fair picture of the Science Park world, the tendencies, trends, and drivers to thrive for sustainability, then to map the roles what science parks can take to promote sustainability, finally to see what IDEON could do and what IDEON is capable of to promote sustainability and achieve environmental performance improvements.

3. What kind of environmental initiatives or environmental management systems would fit science park companies?

This thesis will try to find the ways how start-ups and SME-s in IDEON could be motivated and what kind of tools and skills are available and would be the most effective and efficient to acquire to pursue environmental excellence, concentrating on systematic solutions. The findings could be and will be generalized also for other science parks than IDEON.

4. How IDEON Lightfoot Academy could be formed to fit the needs of companies and be beneficial for them?

A concept or implementation of the Lightfoot Academy will be proposed with the recommended environmental diploma or certificate the companies could go for.

1.4 Scope

There are three main focuses of the thesis. At first, it is focusing on science parks and their innovation systems, from worldwide examples to the European and Swedish situation, finally closing up to IDEON Science Park in Lund, Sweden. The study is looking at science parks and their approaches for addressing sustainability.

Then the thesis is looking at first general SMEs mostly within the European context, environmental initiatives and environmental management systems and environmental diplomas developed for SMEs. The diplomas and management systems related to the Swedish context have the main interest.

Finally the focus will be on IDEON Science Park and its Lightfoot Academy, an initiative to better the environmental performance of tenants of the park. The tenants and the stakeholders of the science park will be in focus.

2 Research Methodology

2.1 Theoretical and Analytical Frameworks

2.1.1 Resource Based View

To look at the examined phenomenon of science parks and SMEs two main theoretical frameworks are used. When considering the capabilities of science parks, such as what they can do and what they are doing for sustainability and environmental performance improvement, the resource based view of the firm is used. Also, the latter view is employed for identifying barriers for environmental initiatives at SMEs.

According to Barney, firm resources include assets, capabilities, organizational processes, firm attributes, information, knowledge controlled by a firm that enables the firm to conceive of and implement strategies. The resources can be classified into three categories, physical, human and organizational capital resources. Physical resources are including technology used by the firm, equipment, access to raw materials. Human capital consists of training, experience, intelligence, relationships of individual managers and workers at the firm. Organizational resources are the structure of the firm, formal and informal planning, controlling and coordinating systems, and networks within and outside of the firm. The resource based model provides a model for internal analysis. Its relations to other techniques such as SWOT analysis can be seen on Figure 2-1 (Barney, 1991).

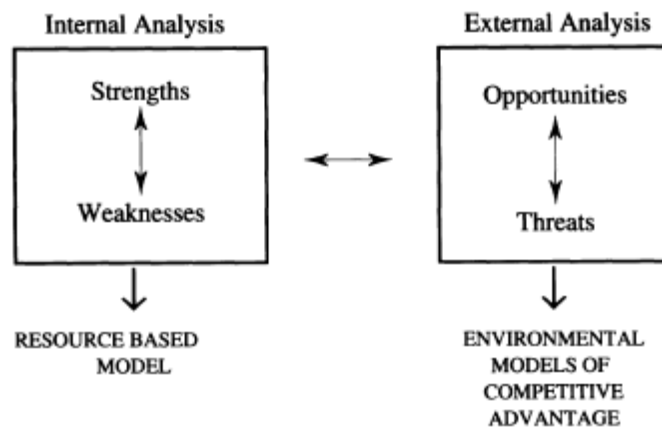


Figure 2-1 The relationship between traditional SWOT analysis, the resource based model and models of industry attractiveness

Source: (Barney, 1991)

Using the resource based view gives an understanding of the firm's internal capabilities. Science Parks can be considered as a firm. When looking at them and what they can do for sustainability, the science parks are the actors using their inner resources to achieve their goals. Identification of these resources is important to see the possible ways how they could contribute.

2.1.2 Stakeholder Theory

When looking at the environment of firms or science parks, stakeholder theory is used as a framework by identifying stakeholders of science parks and their attitudes and actions which could influence the science park's decisions and management. Stakeholders of SMEs influence

their decisions on environmental work, being a source of drivers or creating barriers for SMEs to implement environmental management systems or other initiatives.

The theory is originated from R. Edward Freeman (Freeman, 1984). The definition of the theory is on two aspects: redistribute benefits to stakeholders and redistribute important decision-making power to stakeholders. The first part meaning the firm should benefit and extract costs from stakeholders and share also the benefits achieved by the firm with the stakeholders. The costs and benefits are distributed proportionally. The second part each of the stakeholders should have a say on the future direction of a firm which has an effect on them. The decision making roles should not be distributed equally but the stakeholders affected the most should be allowed to have the most influence (Stieb, 2009).

Stakeholder theory is used to see in the case of IDEON, its stakeholders and their possible standpoint on participating or helping the science park to improve its and its tenants' environmental performance. Stakeholder theory helps understanding the external factors of the implementation of environmental management systems or other initiatives within SMEs.

2.1.3 Triple Helix Model

The triple helix model of innovation is used as an analytical framework to understand how science parks work and to explore IDEON's situation. The model is based on the three main spheres of government, private sector and universities which are interacting with each other, influencing each other and accommodating innovation. Science parks are in the middle of the model, helping in the interaction of the spheres and facilitating the innovation process. For more see the first section in Chapter 3.

Looking at the innovation system in the triple helix way helps understanding the key functions of a science park and reveals the key actors and key attributes of a science park. The stakeholder analysis of science parks is limited to the key actors within the innovation system of the science park. The reason for this limitation is following the stakeholder theory; these actors/stakeholders are the most important from the science park's point of view.

2.1.4 Aspects of Environmental Initiatives

Monkhouse et al. in their study for the European Commission have summarized the factors which have to be considered when creating and implementing an environmental initiative for SMEs. Peters and Turner have provided some additional aspects which were included into the framework. This list of factors is used to assess the possible initiatives which could be developed within IDEON's Lightfoot Academy (Monkhouse, Wilkinson, Herodes, & Hjerp, 2006; Peters & Turner, 2004).

Table 2-1 Key questions and key factors of environmental initiatives

Questions to be answered when creating an initiative:	Key factors for initiatives:
What is the identified need (its objectives) – is there a particular environmental problem that needs to be addressed, eg. poor water or air quality, or noncompliance with certain requirements?	The delivery mechanism – who is responsible for delivery and through which channels? The methods employed for engaging the interest of SMEs

<p>What do SMEs actually want or need?</p> <p>What is the target audience – is this problem the result of a certain sector’s or region’s behavior, or is it a general SME issue?</p> <p>Are there already initiatives in place with this objective and audience?</p> <p>What budget is available for the initiative, and where can funding be obtained?</p> <p>What would be the best way of delivering the objectives, and by whom?</p> <p>How can the services be delivered in a way that makes them accessible to the target community?</p> <p>How can the initiative be developed and improved over time?</p>	<p>The availability, source and duration of public funding, and whether and how much SME beneficiaries should contribute financially to the service they are offered</p> <p>The use of existing or new associations or networks to improve access to SMEs and the promote of shared learning</p> <p>The inclusion within initiatives of systems for monitoring and evaluation, to provide regular feedback on effectiveness.</p> <p>Workable continuation strategy with evidence of on-going effort and improvements.</p> <p>Supporting evidence of success (e.g. receipt of awards, unsolicited praise, and expression of satisfaction from both teams).</p>
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Modified source: (Monkhouse, et al., 2006; Peters & Turner, 2004)

Table 2-1 above is functioning as a framework for guiding the development of an environmental initiative. The developed initiative is more likely to be successful when answering the above questions and looking after the key factors.

2.2 Structure of Research

2.2.1 The Information Gathering

The phenomenon of science parks providing environmental services to tenants in some forms has been approached from two sides, which then joined at the case study of IDEON and its Lightfoot Academy. This thesis is using IDEON Science Park as a case study to examine the possibilities and feasibility of an initiative for tenants of a science park offering environmental services. There are four main sources of information for the analysis and synthesis, see on Figure 2-2.

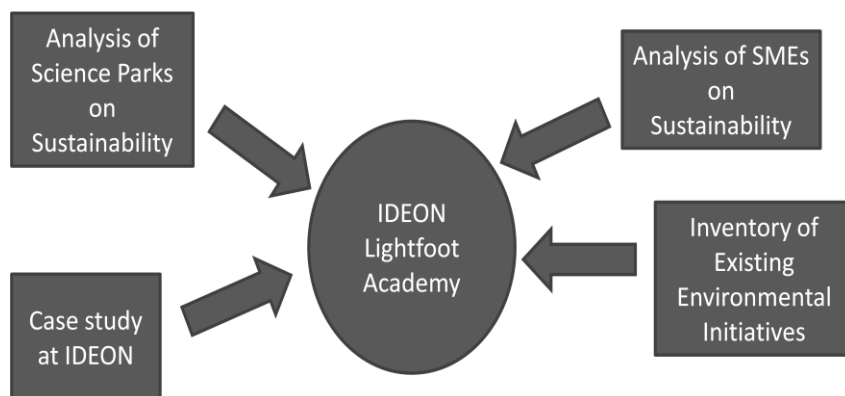


Figure 2-2 The four main sources of information for analysis and synthesis

The first part of the study is focusing on the science parks, examining what science parks are doing for sustainability around the world and in Sweden. The findings are shown through a

couple of small case studies. The different approaches and the capabilities of science parks are summarized. The drivers behind the involvement into environmental work are revealed. The information for the first part was gathered from internet sources, conference materials and literature review of journals and interviews with science park representatives.

The second part of the study focuses on SMEs, looking into their capabilities, general attributes. It examines the drivers and barriers for implementing environmental management systems or other initiatives. The second part is based on literature review. The third part of the research closely linked to the second is looking into environmental initiatives, and environmental management systems developed for SMEs or intended to fit SMEs. This part provides information on the existing solutions which might be useful in a science park context. The third part is based on literature review and interviews with experts.

The fourth part of the study is the case study of IDEON and its Lightfoot Academy, gathering information from the science park itself and from stakeholders of the science park. This part of the study aimed to give more details on the stakeholder relationships around the science park, the attitudes toward possible initiatives for environmental work within the science park based on personal interviews following the triple helix model. A survey has been conducted among the tenants of the park to see their experience and willingness to improve their environmental performance. An online survey has been sent through email to the participants and anonymous answers were gathered. The survey has been designed to be short and easy to answer knowing the limited time resources and short attention span of companies towards survey emails.

2.2.2 The Used Methods for Research

The research on the Science Parks were based on first on internet search for science park and similar words joined with words as sustainability, environmental management, green business, environmental initiatives, green buildings. Similar key words were used to search for literature on the subject. A list of science parks have been gathered from several websites. These science parks have been contacted via email, and some of them has been reviewed through their websites. For the chosen cases, if it was possible, a semi structured phone interview was conducted with a representative of the science park.

Information on SMEs was collected by searching for literature related to SME and sustainability, SME and environmental management, environmental initiatives and SMEs. The found papers were scanned checking their content, the promising ones were read. For the inventory of environmental initiatives a key study has been found through internet search for environmental management systems for SMEs (EC, 2009). The list of initiatives was gathered using internet search and using the found examples from the literature. For the initiatives within the Nordic countries extra information was gathered from representatives of the initiatives, environmental diplomas, unstructured phone interviews were conducted with experts within Sweden.

For the IDEON case study, the scientific literature has been searched for papers on IDEON, an internet search has followed it to get more sources on IDEON. The website of IDEON has been a valuable source for information on the science park. Unstructured interviews have been conducted with stakeholders of the science park gathering more insights on future plans, the current situation and attitudes of stakeholders related to sustainability and environmental initiatives at the park. In order to get more insights from the tenants of the park, an online survey has been conducted on them limited only to six questions focusing on their experiences and attitudes towards sustainability and environmental work.

The list of interviews conducted either by email, phone or personally can be found in the Appendix of the thesis.

2.2.3 The Analysis and Synthesis

During the analysis the gathered information about science parks and SMEs is used in the case study of IDEON. The relevant capabilities of science parks are pointed out looking at the stakeholders and the situation of IDEON. The suitable environmental initiative is found by looking at the situation of the tenant companies of IDEON along with general attributes of SMEs and the existing initiatives. The separate chapters on science parks and SMEs contain some preliminary analysis and summary which then later will be used during the final analysis.

The approaches suitable for science parks in promoting sustainability and their capabilities are taken from the first part of the study, the results are shown in the first chapter. Later during the analysis for the proposal of features of an ideal initiative, the identified capabilities of science parks is used with additional features from information gathered about IDEON and its tenant companies.

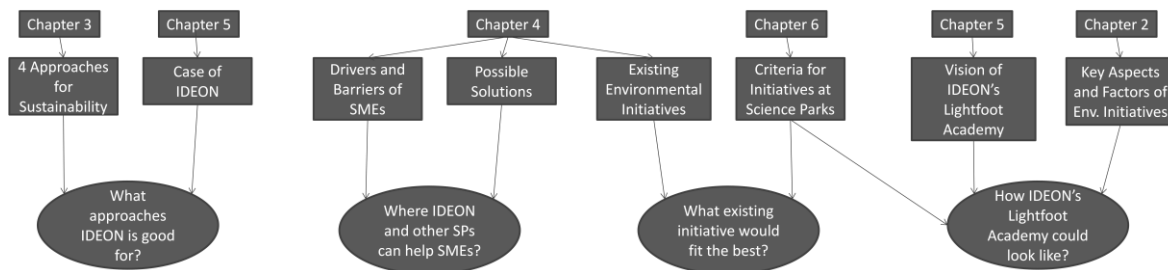


Figure 2-3 The structure of the analysis

The chapter on SMEs and sustainability from the literature review results with a list of important drivers and barriers for implementation of environmental initiatives in SMEs; these are considered during the proposal of features of an ideal initiative for science parks. The inventory of existing initiatives is analyzed against the proposed list and the best fit from them is chosen during the analysis.

Using the information gathered on IDEON in Chapter 5 and the found possible approaches of science parks from Chapter 3, IDEON is matched with these approaches and it is analyzed how IDEON is or would be a fit for the given approach. It is also analyzed how IDEON could help enhancing the found drivers and help SMEs tackle the barriers for implementation of environmental initiatives in them. The structure of the analysis is presented on Figure 2-3.

The analysis is followed by a synthesis proposing a possible system which Lightfoot Academy could aim for. During the analysis and synthesis the aspects of environmental initiatives will be used as part of the analytical framework to address all the key questions and aspects for the development of a successful environmental initiative. Considering the attributes of IDEON and its tenants, and the available tools and existing initiatives, a system for the Lightfoot Academy will be proposed as part of the synthesis.

The scope of the analysis is going from outside, from a global scope towards the inside reaching IDEON's Lightfoot Academy, then within the conclusions it is going from inside from the concrete case towards outside generalizing the findings to be useful in other science park cases or even outside of science parks.

Considering the findings of the study, some recommendations for IDEON Science Park will be given within the conclusions.

2.3 Limitations

The circumstances for a research are never completely ideal, therefore certain limitations are always present during the work. There are three major factors limiting the research, some of them were hard to overcome but an effort has been made to overcome the obstacles.

First, the literature on science parks is limited, even from the available publications most of it was over five years old. The intersection of science parks, and sustainability or environmental management had even less material to offer for analysis, except few conference papers and examples gathered from actual science parks.

Second, as the study has been conducted during the summer, the holiday season was an obstacle for reaching potential interviewees and gather information from firms. The holiday season especially in Sweden is a major obstacle creating a time zone containing July and the beginning of August when most of the people are unavailable. The conducted survey on IDEON companies was suffering from lack of attention. The original survey with 43 questions has been trimmed to six questions to make it possible to fill in within a couple of minutes; the response rate has been around 10% after two rounds of emails. Still the received amount of answers gave some possibility for analysis.

Third, there were language barriers when looking for information on worldwide cases and when looking at the Swedish context. This limited the sources of information or the quality of understanding. These limitations mostly occurred during the science park search and partly during the environmental diploma search.

There were certain limitations originating from the used theoretical and analytical frameworks. Using the triple helix model for innovation systems limited the research on the case of IDEON Science Park, since only the stakeholders present within the innovation system were examined excluding the public, NGOs (non-governmental organizations) and other stakeholders as industry unions.

3 Science Parks and Sustainability

3.1 The Foundations of Science Parks

The first science park which has been established by Stanford University and later evolved into Silicon Valley was a technology cluster where an optimal circumstances were there to be a birthplace for many success stories (Ky & Pretorius, 2007), this park was a model for governments around the world to develop similar growth regions. During the 70's it was followed mostly in the USA, in Europe it became popular during the 80's and in recent decades it has been followed by many other regions (Cook & Joseph, 2001). Currently there are thousands of science parks around the world and their numbers are still growing. There are no concrete numbers available, according to a study made by the European Commission there are around 3500 science parks and incubators worldwide (EC, 2008). It can be assumed, almost every developed city which has a university have at least one science park to facilitate innovation and business development based on the know-how of research at the local university. The number of science parks is growing, during the last decade between 2000 and 2006 the number of science parks grew with more than 30% (IASP, 2007). Right now there are approximately 8800 universities around the globe (Förster, 2011), which gives a good estimate on the magnitude of the number of science parks that could be established.

According to IASP, “a Science Park is an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities.” (IASP, 2002)

Science Parks could be seen as a place for a linear innovation process, which creates business by transforming the knowledge from universities or other research institutes and create innovation to the business world resulting in more jobs and wealth in the region of the Science Park, but this view is limited (Phillimore, 1999). The innovation process is rather non-linear, a continuous interaction between different actors in a network. The three institutional spheres of the network are the universities/academia, the industry/innovative businesses and the government, see Figure 3-1 (Etzkowitz & Leydesdorff, 2000).

The triple helix model contains three basic elements: more prominent role for the university in innovation; movement towards a collaborative relationship of the three spheres where innovation policy is a result of interactions rather than an ordinance from government; the spheres in addition to fulfilling their functions, can take the role of each other's (Dzisah & Etzkowitz, 2008).

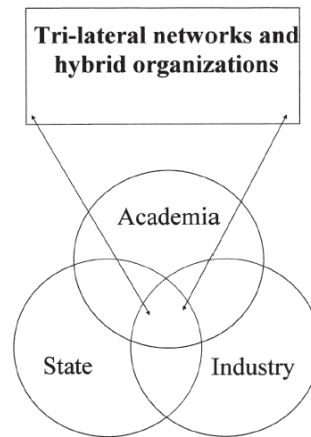


Figure 3-1 The Triple Helix Model of University-Industry-Government Relations

Source: (Etzkowitz & Leydesdorff, 2000)

To make the innovation work, triple helix circulation is essential: people, ideas and innovations have to be shared and circulated amongst institutions. Circulation of people is done by promoting unidirectional movement between spheres, allowing professionals to have a dual life by being employed in more spheres. Such as a professor who is in a high position in a technology firm. Ideas are circulated by having collaborations, physical or virtual communities, innovation networks of universities and industry, innovative regions supported by governments, as the Öresund region which is an international region between Sweden and Denmark. Circulation of innovations on the base of reciprocity and equality of contributions is the third element (Dzisah & Etzkowitz, 2008).

Science Parks are in the center of this process, facilitating the full potentials of the networked model of innovation, they are established with active participation of state or regional level governments, creating an environment for easy interaction between industry and academia, therefore Science Parks can be considered as facilitator of a tri-lateral network.

3.2 Science Park Core Competences

Usually science parks are based on a real estate development, having several buildings for offices and laboratories, some science parks have production facilities too as Hsinchu Science and Industrial Park in Taiwan. The Science Park rents the offices and the use of laboratories for companies and provides additional services for its tenants as accounting, business consultancy, marketing management, financing, human resources management, intellectual property rights. These services are offered by the residing service companies on site or by companies which are part of the network of the science park. Most science parks have a close link to universities nearby to their facilities, trying to rip from the benefits of close proximity (EC, 2008; Vedovello, 1997).

As science parks are facilitators of innovation, an important part of science parks is their business incubator facilities. These incubators are the sources of new firms often spin-offs from universities. An incubator provides the following services to its tenants: pooling resources by organizing staff trainings, exhibitions, conferences and other development activities; sharing resources by sharing laboratories, office equipments, office space, providing testing and administrative support; cheap or free consulting and counseling services like legal advices, accounting, business, technical advices; networking possibilities by accessing the wide network of the science park or its incubator; benefiting from the image of the science park or

its incubator by residing in it; clustering as being part of a group which is surrounded with complementary industry, a pool of skilled labor; geographic proximity to markets, research centers and university facilities; providing rental subsidies, and other subsidies which can reduce costs of the firms; and funding by providing access to venture capital funding, to banking services, to business angel networks (Chan & Lau, 2005).

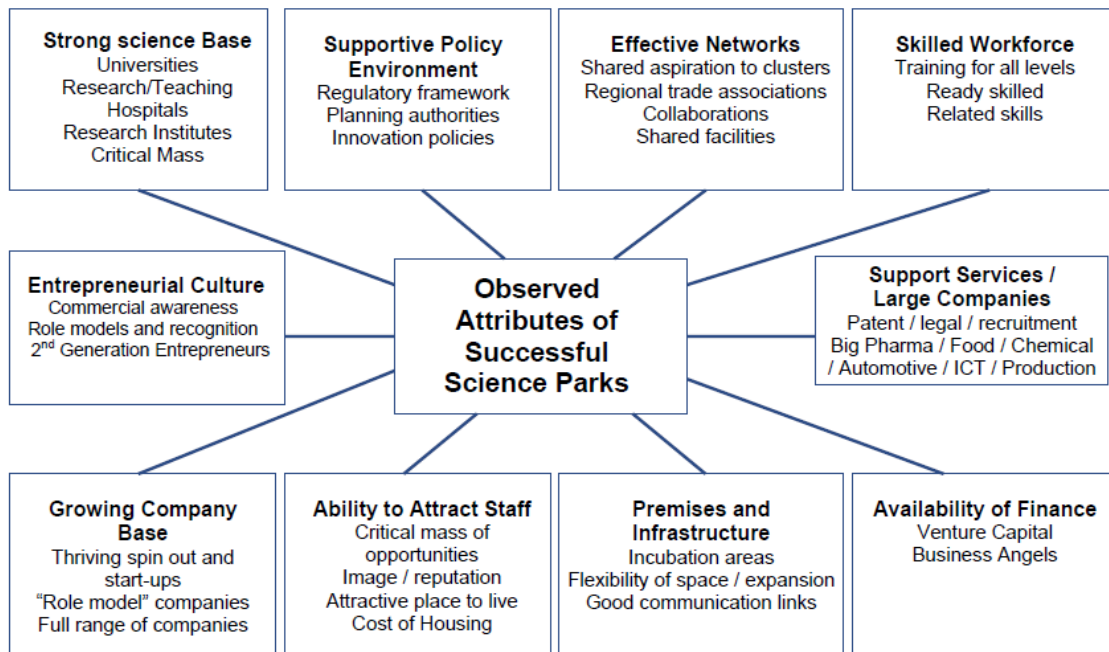


Figure 3-2 What makes a science park successful

Source: (EC, 2008) gathered from UKSPA

There has been no research found on the core competences of science parks, but several attributes can be gathered from literature, on Figure 3-2 above a summary of attributes of a successful science park has been gathered. These attributes cover parts of the triple helix model of innovation as government responsible for good supportive policy environment and mostly for the premises and infrastructure; university brings a strong science base and skilled workforce, industry contributes with support services and large companies. For other attributes the spheres contribute jointly with the help of the science park itself. The following core competences of science parks could be identified:

First of since science parks are based on a real estate project they have capabilities to manage buildings or have a close relation with the management of the buildings (Duro, Sarmiento, Varela, & Maltez, 2005). Continuously it is an aim for science parks to increase the size of the real estate and make more space for innovative companies.

Science parks develop an extensive network, having good relations to universities, industry and financing, facilitating arrangements between actors is one of its core competences (EC, 2008; Ky & Pretorius, 2007).

Thirdly, it is a good facilitator to develop clusters and create an environment for innovation and business development (EC, 2008; Lin & Tzeng, 2009; Ming-Tien & Chung-Lin, 2010).

Fourthly it has general business management and business strategy competence through its incubators, business coaches and business consultants.

Fifth competence is the marketing and strength of the brand of the science park, which tenant companies can use and could benefit sometimes even more than from networks or services the science park can provide (EC, 2008).

3.3 Science Park Initiatives for Sustainability

Science Parks as any other real estate and industrial facilities have to face with their primary environmental impacts in order to maintain the reputation of the park (Shenglin, Hua-mei, & Wenling, 2004). There were no papers published on the issue of environmental sustainability and sustainability initiatives in science parks in scientific journals, but the subject recently got on the agenda at IASP (International Association of Science Parks) and at WTA (World Technopolis Association) where at the workshop and conferences there were presentations and conference papers (IASP, 2010, 2011a; UNESCO-WTA, 2009). Science parks have started to have several initiatives to address sustainability and environmental performance. Having around 3500 science parks and incubators, all initiatives cannot be explored; some typical examples of approaches are given here. Some of the initiatives are shown through several case studies inside and outside of Sweden.

The responsibility of science parks comes from the aim for a triple bottom line approach, to be responsible from environmental, social and economic perspectives. These science parks can be used as instruments helping to achieve green growth, an environmentally sustainable economic growth focusing on green and clean technology and renewable energy. Science parks can be the center of technology innovation and the birth place of new businesses. Additionally, a task of the science park could be during its development to maintain the surrounding and trying to be less polluting, having less negative environmental impacts (Oh, 2009). The facilities of the science park as laboratories are an area where initiatives, as Labs21 an USA governmental voluntary partnership, can improve the environmental performance (Galley & Wirdzek, 2009).

An example is Tainan Science Park from Taiwan where more energy efficient, certified green buildings were built, the surroundings of the buildings were developed and renewable energy firms moved into the park although the initiatives came mostly from outside of the science park (Kung, 2009). Environment Park from Italy is a re-cultivation of an industrial site using eco-efficient solutions and creating a test bed for hydrogen production and has an aim to build a hydrogen cleantech cluster (Da Vià, 2007). A new project in the USA by University of Nebraska-Lincoln is creating Nebraska Innovation Campus on a former industrial site using green building technologies and LEED certification process. The theme of the campus will be food, fuel and water addressing sustainability issues but the main focus of the park is on economic growth and technologies which provide that (Perlman & Jukuri, 2011).

Lleida Science and Technology Park's main building in Spain has a bioclimatic design for energy efficiency, it maintains an arboretum with 400 different tree species used among others as a laboratory (Carbonell & Ticó, 2010). In some science parks there are business incubators which are specialized in creating cleantech ventures and focusing on environmental issues (Lindhult, 2009). Gyeonggi Technopark from South Korea participates in a government initiative to give green certificates to businesses at the park which are either working with cleantech or having projects related to cleantech or selling cleantech solutions with a growing rate (Nam, 2011).

There are initiatives in some science parks addressing the tenants of the park providing information and guidance or even a joint effort on environmental management, for example Kent Science Park from the UK has organized a free online workshop for tenants on Environmental Management (KSP, 2011a). Kista Science City in Sweden organizes the event Kista Green ICT about how ICT can be used to create a better society; is hosting the Stockholm Summit on Innovation in Cities to generate ideas on sustainable cities; and additionally they have events on promoting cleaner transportation by making cycling easier. Manchester Science Park from UK according to its draft Carbon Reduction Plan will try to influence tenants on energy efficiency and inform them and involve them to the execution of the plan which is focusing on the operation of the science park and its direct environmental aspects.

Life-SMIGIN (Sustainable Management by Interactive Governance and Industrial Networking) is a project from the Walloon Business Federation in Belgium financed by the European Commission which aims to improve the environmental management of SME-s located on the same business park. The initiative was welcomed in Créalys Science Park too, where eighteen companies joined to improve their environmental performance together improving on the field of mobility, energy and waste management by participating on seminars and taking actions. They have contributed to the initial environmental study of the park which is aiming to get ISO 14001 certification (UWE, 2011).

As for the science park, its tenant companies are the customers, they can be addressed mostly by information campaigns, voluntary initiatives and price policy. In the literature nothing has been found on science parks and their environmental services for companies or their efforts involving companies into environmental management of their selves.

3.3.1 Australian Technology Park

Australian Technology Park (ATP) has been established in 1996 on a site which was previously the largest railway workshop in Sydney and Australia, see Figure 3-3 (ATP, 2011d). It was established on the initiative of University of New South Wales, University of Sydney and University of Technology with governmental support. The park is currently owned by the local governmental institution the Redfern-Waterloo Authority (RWA) (ATP, 2010).



Figure 3-3 Australian Technology Park

Source: (ATP, 2011d)

The park has approximately 50,000 square meters office area with an occupancy rate of 97.5%. There are around 100 organizations on site employing around 2000 people. The park has an incubator ATP Innovation which has a network of experts and entrepreneurs creating new businesses. It does not specialize for any cluster. The companies are mainly from the life sciences and ICT sector. (ATP, 2010).

The park due to its heritage of a heavy industry area has and had the responsibility to clear and rehabilitate the site. According to Natalie Kikken a representative of ATP, the territory is government owned asset it has to fulfill the mandates on sustainability targets of the government. The park aims even higher, since it sees benefits from cost reductions on waste disposal and energy making the property more competitive. She stated one of the park's key success factors is its commitment to community engagement, this corporate and social responsibility results in leadership in sustainability.

The park's commitment to improve its environmental performance results in employing a project coordinator responsible for sustainability and volunteering. The park has its environmental policy, environmental objectives and targets. It has gathered the environmental legislations related to its operation and reviewed its environmental aspects. The park has an environmental management plan to reach the targets set for water consumption (-25%), energy usage (-30%), waste to landfill (-50%) and environmental harm prevention till 2012 and 2020 using 2010 as a base year. It has sustainable development indicators to show the progress. All required ingredients of an EMS is in place (ATP, 2011b; Brorson & Larsson, 2006). ATP communicates its environmental work and achievements on his website and through its sustainability strategy report (ATP, 2011c).

The company tries to address its stakeholders in the process. A proactive collaborative approach will be used to address tenants of the park. Sustainability and Innovation Committee which includes representatives of various organizations on the park sharing ideas and pursuing beneficial initiatives meets every quarter. This committee's purpose is to be a catalyst for building an effective sustainability culture around the park (ATP, 2011c). According to Natalie Kikken all the tenants are invited to the meetings and it is attended regularly by around 10 tenants.

The park tries to build a cluster for environmental technology but it focuses on at least seven other cluster of business. It filters the new tenants additionally to how beneficial they would be to the park and its tenants, as "prospective tenants should support none or low polluting industry and demonstrate a commitment to ecological sound practices" (ATP, 2011a).

3.3.2 Hong Kong Science and Technology Parks

The park has been established in 2001 in Hong Kong by the government of Hong Kong Special Administrative Region. The park is operated by Hong Kong Science and Technology Parks Corporation (HKSTP) which also operates three industrial sites and InnoCentre, which is aimed to accommodate the cluster of designers and design start-ups. The park is still incomplete, the third phase of development has not been started yet and the second phase has just been finished (HKSTP, 2010). The main site of the park can be seen on Figure 3-4.

The park has approximately 225,000 square meters available space, accommodates around 350 companies employing 8000 people and has an occupancy rate over 90%. The science park has an incubation system where each year dozens of new start-ups graduate. It has five main clusters where it aims to be amongst the best, these are Electronics, Information Technology and Telecommunication, Precision Engineering, Biotechnology and Green Technology (HKSTP, 2011b).



Figure 3-4 Hong Kong Science and Technology Parks

Source: (HKSTP, 2011b)

The park approaches sustainability strategically, it added to its supported clusters green technology and already attracted 29 companies. The focus towards green technology and sustainability in the strategy was gradual first hosting and organizing events as InnoAsia 07 conference on Innovating for Sustainability or 2008 Hong Kong Technology & Renewable Energy Events showing 400 renewable energy inventions. The first handbook on health, safety and environment of the park came out in 2008. Other conferences and events followed during the next years on renewable energies, sustainability (HKSTP, 2011b).

In 2009 Solar Energy Technology Support Centre has been opened to support a cluster on green technology. In 2011 the science park facilitated the set up of electrical vehicle research center at the site and will accommodate tests of the cars (HKSTP, 2011b). Also the phase two development of the park has been finished with the building Green 18, which has earned the platinum rating of BEAM Society and is a showcase and a testing ground (HKSTP, 2011a). The next phase of the development of the park will be for the green technology, energy management and renewable energies cluster. Testing of energy management systems will be facilitated on site (HKSTP, 2011b).

HKSTP has its own environmental, health and safety policy and during the development of earlier phases, it has already used energy efficient solutions following the trend in modern office buildings. There are several conservation measures implemented as regulated lighting schedules, seasonal parameters and sleep mode for heating and cooling systems, replacement of less efficient equipments (HKSTP, 2010).

3.3.3 Lahti Science and Business Park

The case of Lahti Science and Business Park (LSBP), see on Figure 3-5, is special since the park has chosen to be specialized purely on cleantech. It is the leader of the Finnish Cleantech Cluster. It has facilities for renewable energy research at the Energon center, a soil research center and offices to lend to cleantech companies. The predecessor of the park has been founded in 1991 and had been renamed in 2004 to its current name. The park's strategy has been changed in 2005 to concentrate only on cleantech, an extensive network has been built around LSBP. The park is owned by the municipality of Lahti and several other nearby municipalities and universities. Lahti has the biggest share with 74% (LSBP, 2011c).



Figure 3-5 Labti Science and Business Park

Source: (LSBP, 2011c)

The park has 14,000 square meter office and lab space right now with around 50 organizations on site including university departments as University of Helsinki's department of environmental sciences or Aalto University. There are currently around 350 employees and 200 students working at the park. The second phase of the park is going to be in use from 2012 with its additional 24,000 square meters (LSBP, 2011b). In the future the park's plan is to increase the size of the park to 100,000 square meters employing more than 2000 experts. LSBP's profile covers a broad area of cleantech. There are companies working on the field of renewable energy, green buildings, recycling of paper, recycling of energy, water and soil treatments, bio-fuels (LSBP, 2011a).

The management of the park is active outside of the premises and helps more companies achieving their goals. LSBP is the coordinator of the Finnish Cleantech Cluster which has over 500 member companies around Finland, it is active in IASP by coordinating the IASP Enviroparks network (LSBP, 2011b), which is a sub-network of IASP to connect environmental focused science and technology parks to help their companies with knowledge and specialized services. The sub-network has members mostly from Europe (IASP, 2011b). LSBP organizes yearly events as Cleantech Venture Day which attracts cleantech companies, investors from all over the world (LSBP, 2011c).

3.3.4 Kent Science Park

The origin of the park is from the Shell Agro-Chemical research and development facilities opened in 1945 and abandoned in 1996. The park is in the South-East of England in Sittingbourne, see on Figure 3-6. It has been purchased by a pension fund in 2004 and currently managed by LaSalle Investment Management. It has an office area of 46,500 square meters, currently occupied by 65 tenants employing more than thousand people (CSES, 2008; KSP, 2011b).



Figure 3-6 Kent Science Park

Source: (KSP, 2011b)

The science park is not specialized in a niche, has tenants in several sectors: ICT, biotechnology, cleantech firms. Most of the firms are in the field of biotechnology, life sciences and pharmaceuticals (KSP, 2011b). According to Richard Wheeler a representative of Kent Science Park (KSP) the park will aim to have more environmental firms, but there is no exclusivity, firms from any other sectors are welcome.

KSP does not have an environmental management system or a sustainability strategy but has some initiatives to improve its environmental performance. The science park has recently sealed a contract with Scottish and Southern Energy to have all their electricity needs coming from renewable sources. Additionally they are going to purchase a generator to the site which will be operated with bio-fuels, the technology will be from KSP's tenants (KSP, 2011b). The new buildings of the site are planned to be built with technology which will allow them to be certificated at BREEAM rating of Good, which is not the highest rating of the scheme but passes easily the requirements to be BREEAM certified. There are plans for improvement in waste water management by the installation of an anaerobic digester at the site.

There are several events: seminars, workshops for the tenant companies, there is no emphasis on events on environmental issues, still some events have been held on the topic (KSP, 2011a).

3.3.5 Science Parks in Sweden

According to SiSP (Swedish Incubators and Science Parks), the Swedish association of science parks and incubators, there are 32 science parks in Sweden in its 29 regions, all have connection to universities and most of the science parks have an incubator connected to it. Their establishment was done mostly by central and/or regional governments to increase the regions' competitiveness and catalyze economic development of the region (Lundin, 2011).

There are more than 40 business incubators operating in Sweden, of which thirteen are focusing on environmental issues, an incubator which is purely for environmental technology is Sweden Cleantech Incubator which is a virtual incubator not having a site to offer offices to tenants, only helping businesses with expertise. There is a tendency of adding environmental technology to the profiles of incubators (Lindhult, 2009). The Sweden Cleantech Incubator which was based in Skane, after the expiration of the EU funding for the project from 2007-2010 it evolved into Cleantech Inn Sweden a nationwide incubator to support cleantech business ideas. One of the offices of Cleantech Inn Sweden is at IDEON Science Park (CIS, 2011).

Looking into 18 science parks and science cities in Sweden, only two of them, Lindholmen Science Park and Solander Science Park were specialized at least partly into an area of cleantech by providing infrastructure and building a cluster for the area. IDEON Science Park is started to put more efforts on cleantech too, but no cluster has emerged from it.

No services were found which are provided for tenants to improve their environmental performance, only at Västerås Science Park there was an online interface where services offered by tenant companies were listed, amongst of them there were some environmental courses for market prices. Typical initiative of the parks was reducing CO₂ emissions by promoting public transportation and cycling with campaigns or mobility management. The development of the parks follow the tendency to build more sustainable buildings as in case of Johanneberg Science Park trying to develop a livable sustainable city, or IDEON's new building the IDEON Gateway which will be LEED Platinum certified. See the Appendix for the list of the examined science parks in Sweden and the findings.

3.4 Classification of Initiatives

The initiatives or actions of science parks can be classified into three major directions which they follow to become more sustainable or benefit from it, none of them are exclusive all of the three directions can be followed at the same time.

- As a real estate developer they build more energy efficient and better buildings to show their commitment and to follow the trend.
- As an operator they are establishing an Environmental Management System at the park or just implementing several programs to improve the environmental performance of the facilities.
- The park dedicates itself to develop a cleantech cluster to attract related companies to benefit from the emergence of the industry and become a center of growth.

A fourth direction of initiatives could be for which examples could not be found, but was identified:

- To improve the environmental performance of the tenant companies by providing environmental services or organizing networks and informational events to get them started or help in their progress.

The fourth direction needs commitment from the science park itself to become credible and legitimate to be an initiator of environmental performance improvements.

3.5 Drivers and Future Trends

Sustainability as generally in all levels getting into the focus, it is getting more attention of the science park community. This is well represented by the latest IASP conferences, where green growth and cleantech clusters and green buildings became part of the agenda (IASP, 2010, 2011a; UNESCO-WTA, 2009).

The attitudes of governments have changed and new policies put in place to address problems as global warming. Governments take the leading role around the world to transform current business and industrial production into green business and green or cleantech preferring green growth over the previous modes of growth (Becker, 2009). For example in case of the Southern Taiwan Science Park where it was one of the drivers to start doing things differently (Kung, 2009). Science parks try to benefit from the new trend and go with it. Cleantech has become another buzzword after infotech and biotech, creating an environment which attracts

investments into the sector. Some even say this investment flow is a green bubble (Lindhult, 2009).

Table 3-1 Total cleantech venture capital investments

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Investment (billion dollars)	0.9	1.2	1.3	2	4.5	6	8.8	6.1	7.8

Source: (Cleantech Group, 2011)

Table 3-1 above shows the tendency how investment into cleantech companies is rising except during the credit crunch in 2008-2009. Even without governmental policy help, cleantech companies appear in science parks trying to get a slice of the new market.

The drivers for green buildings are the rising energy prices, the changing regulations towards more energy efficient buildings, and the technological developments, which allow building more energy efficient and more sustainable buildings without extra costs as most of the investments pay back in the long run. Generally all new buildings have a better energy performance than older ones, when a science park is extended by building, the new offices will be more sustainable as energy efficiency is part of the requirements of a high standard office building. The third trend is the emergence of corporate responsibility; a science park needs to have a good reputation to attract tenants, being socially and environmentally responsible is starting to be a part of the minimum requirements for an enterprise.

Looking back to the initiatives of the science parks addressing sustainability aligns with the mentioned trends and drivers.

3.6 The roles of Science Parks

Herbert Chen summarized what science parks could do to support green growth. First the science park shall accommodate companies in an environment with sustainable solutions taking advantage from environmental-protection technologies from gardening till energy efficient buildings. The parks should train experts for green growth from academia and from industry to be able to harness the possibilities better. The science parks should facilitate cluster building for cleantech, and help green enterprises to grow by providing business services to them. The science parks should have a good relation with local governments to get policy support for green growth. The international relations of tenant companies could be improved by science park support finding partners abroad (Chen, 2009).

Science parks are in a good position to support tactical deployment of government policy into private sector in order to help to support a different, more sustainable economic development. According to Malcolm Parry the science and technology parks have the following roles supporting sustainability strategies (Parry, 2009):

- Acting as regional leaders in supporting national strategies which are aimed at supporting eco-innovation.
- Helping in the deployment of government policy into businesses successfully reducing the use of resources.
- Supporting businesses to gain access into governmental funding that supports eco-innovation.

- Assisting cleantech companies to develop and become an independent commercial enterprise.
- Providing support for environmental technology networks or clusters to help commercial deployment of environmental technology.
- Co-operating with venture capital and other financing sources to get investments to cleantech.

Science parks are embedded into an environment where they interact with different stakeholders and they can act differently when they are in different roles with these stakeholders. According to the core competences of a science parks found during the literature review and their major attributes the following type of roles could be defined:

- As a landlord, it can improve the environmental performance of the facilities it manages and if new buildings are planned, it can make sure to build them as sustainable as possible. It can improve the performance of research laboratories and test sites. Can create an environmental management system to deal with environmental aspects systematically.
- As a service provider for tenants, it can help creating a cleantech cluster, helping in business development, getting venture capital and help networking. The science park can act as a coordinator of the environmental management of tenants, organizing events addressing environmental issues and raising awareness.
- As a facilitator of knowledge transfer, it can help improving the transfer of knowledge helping to create more sustainable world through its incubators helping cleantech start-ups and spin-offs. The park can help improving the knowledge transfer by organizing events for academia and industry to get the attention towards cleantech and other pro-sustainability ideas.

In the next chapter sustainability will be approached from the tenants' side. These companies are mostly SMEs, therefore the next chapter is dedicated for SMEs and environmental initiatives for them.

4 SME and sustainability

4.1 Attributes of SMEs

SMEs are according to the definition of the European Commission are enterprises with less than 250 employees with additional turnover and balance sheet limitations. Within SMEs the small enterprises have less than fifty employees and micro companies have less than ten employees (EC, 2003). The 20.9 million SME represents 99.8% of all businesses in the European Union, employing 66.7% of the employees and contributing to the GDP with 58.6%. From all the enterprises, micro enterprises which have not more than 10 employees are the largest group representing 92% of all companies. In Sweden micro, small, medium and large companies represent respectively 94.7%, 4.4%, 0.8% and 0.2%, which is above average for the share of small companies. In the European Union the professional, scientific and technical companies, including most of the high-tech companies residing in science parks, represent the second biggest group in number of companies and the fourth in number of persons employed. Within this sector the share of SMEs is the highest from employment, only 7.9% of the professionals employed by large firms. More than 75% of value added is coming from these SMEs (Eurostat, 2010).

Table 4-1 Enterprise size class analysis of key indicators, non-financial business economy, EU-27, 2008

	Number of enterprises	Persons employed	Value added	Apparent labor productivity
	Share in total (%)			Relative to total (%)
All enterprises	100.0	100.0	100.0	100.0
All SMEs	99.8	66.7	58.6	87.8
Micro (-10)	92.0	29.0	21.8	75.3
Small (10-50)	6.7	20.5	18.6	90.5
Medium (50-250)	1.1	17.2	18.2	105.3
Large (250-)	0.2	33.3	41.4	124.5

Source: (Eurostat, 2010)

SMEs have fewer resources as they have fewer employees than large firms, for additional activities they have less income to spare, lacking the economy of scale. Table 4-1 above shows the productivity of SMEs getting worse with the decreasing size, which again makes resources as human and financial capital scarce. Gibb summarized how SMEs look like from a cultural point of view compare to what big corporate and governments are looking for, see Table 4-2 under.

Table 4-2 The business approach to entrepreneurship in the small business, the potential culture clash

Government/Corporate (looking for)	Small Business (as being)
order	untidy
formal	informal
accountability	trusting
information	personal observation
clear demarcation	overlapping
planning	intuitive

corporate strategy	“tactically strategic”
control measures	“I do it my way”
formal standards	personally monitoring
transparency	ambiguous
functional expertise	holistic
systems	“freely”
positional authority	owner-managed
formal performance appraisal	customer/network exposed

Source: (Gibb, 2000)

SMEs have some characteristics which can give them competitive advantage over big firms, as simple capital structure, entrepreneurial orientation of founders and managers, SMEs are flexible to respond to changes in the business environment, possess more innovativeness to respond to competitors’ moves and finally there is a closer interaction between employees (Aragon-Correa, Hurtado-Torres, Sharma, & Garcia-Morales, 2008). For SMEs the influence of some key personnel is much higher than in large firms, the SMEs are less visible and get less attention and exposed less to the media. Business networks are more critical, the firm relies on the managers’ personal network (Loucks, Martens, & Cho, 2010).

The above attributes are a general overview of SMEs; there are significant differences between a factory with two hundred employees and a three person design team. The available resources in most cases grow with the size of the company; a middle sized company can afford extra personnel for tasks out of the main focus of the enterprise as a small company cannot afford it. There is a significant difference between SMEs working in traditional less innovative sectors as a bakery or car repair shop and a high-tech research and development company. The age of the company can determine some attributes too, as older companies could be less flexible and less open for new information if the old ways of doing business seems adequate to them.

4.2 Environmental Performance of SMEs

Across the literature the share of the SMEs from the environmental impact of industries is between 50-70% (Aragon-Correa, et al., 2008; Cassells & Lewis, 2011; Heras & Arana, 2010; Hillary, 2004). A recent study of the European Commission claims 64% of the total environmental impact of businesses is coming from SMEs, using for the calculation of the environmental impact measures with indicators which are similar to the ones used in usual LCA (Life Cycle Assessment) studies, these were for example energy consumption, water use, material use, greenhouse gas emissions, ozone depletion, air quality indicators and the amount of waste. (EC, 2010a).

According to the study 40-45% of SMEs have high impact on the environment; this segment is more likely to invest into environmental tools and solutions since it represents more business opportunity for them by cost reductions and compliance with legislations. The rest of the companies will seldom invest, however simple environmental policies and simple solutions might be used, despite of the limited economic and environmental benefits. In some sectors as the wholesale, the small impact of individual companies adds up via the large number of companies present in the sector and makes the sector to be a high impact sector. In those cases small individual improvements add up to a significant total improvement (EC, 2010a).

From the total average 64% of environmental impact member countries differ, in Sweden only 58% of the impact come from SMEs. From a sector distribution, within the manufacture of chemicals and chemical products sector only 42% of the environmental impact is from SMEs; the share in the manufacture of electrical and optical equipment sector is 48%; in the real estate, renting and business activities sector where research and development and computer related activities belong SMEs have 74% share of the environmental impacts. (EC, 2010a, 2010b).

The green segment has been defined by the European Commission's study as companies which have a certified or non-certified environmental management system or involved in improvements of their environmental performance. According to the study there are approximately 80,000 companies having an EMS representing 0.4% of all the companies, adding the companies which have some energy management system in place around 4% of the companies are part of the green segment. Only 3.6% of micro companies are in the lot compare to the 16.5% of large companies. The study estimated with 20% impact reduction in the green segment the environmental impact of businesses would decrease only with 0.4-0.8% without the large companies which carry the main part of the improvements. In Sweden the core green covers 10% of the businesses, the largest share in the whole European Union. With adding all the companies which have some energy saving measures put in place the so called light green companies, in the EU the share of the green and light green companies is 29.5%, in Sweden the share reaches 66%, the highest in EU (EC, 2010a).

4.3 Possible solutions

There are several ways to improve the environmental performance of a firm including SMEs in general and SMEs at science parks. A good choice needs to take into consideration the capabilities of the firm, its environmental performance and its environment, it has to consider stakeholder views, their pressure, market opportunities and the choice depends on the determination of the firm leaders (Aragon-Correa, et al., 2008). The SMEs need different tools and strategies to support sustainability considering their different resources and attributes compare to large corporations (Loucks, et al., 2010).

There are great differences between the SMEs, micro companies, representing 92% of EU companies with 30% of environmental impact, could be even considered as private households reducing their impact using informational campaigns, energy labels, eco-labels, additionally providing tests and certification of their products (EC, 2010a). SMEs tend to implement environmental measures in an ad hoc way lacking a more strategic focus towards environmental management (Revell, Stokes, & Chen, 2010).

Lucas Marylin classified environmental management practices (EMPs) into four major spheres following the resource based view of the firm (Lucas Marilyn, 2010):

- Physical Capital EMPs containing pollution control investments, pollution prevention focusing on products in use, manufacturing and end-of life phases; pollution prevention focusing on processes using cleaner production techniques.
- Human Capital EMPs as recruitment policy, education and training programs to improve employee environmental knowledge, incentive and reward structure to motivate employees environmental performance and cooperation.
- Social Capital EMPs including eco-design, Design for Environment, Life Cycle Analysis; green supply chain management by selection and involvement into eco-design processes; technology and research alliances and partnerships for environmental preservation.

- Organizational Capital EMPs containing the tracking of environmental information, using environmental management systems; reactive management control mechanisms in production and supply chain (audits); reviewing operations practices using impact assessments; participating in eco-labeling and other certified programs; corporate environmental vision and mission statements, including environmental performance into business plans, trying to benefit from environmental opportunities; communicating externally with stakeholders, environmental reporting, environmental marketing.

To maintain best practices and reach long term commitment for sustainability the SMEs should address their environmental performances with a more strategic or systematic way. Investing into organizational, human and social capital could enhance the efforts to improve the environmental performance of the firm. The efforts could be systematic by implementing an environmental management system in the firm, or just creating processes to ensure improvements. Following the strategic way the company should incorporate sustainability into its business strategy, making the firm dependent for its success on its environmental performance. The strategic way represents a deeper motivation towards sustainability putting more bets on the improvements achieved by the company.

4.3.1 Environmental Management Systems

Systematical environmental management in SMEs can be addressed with EMSs. There are systems with different complexity, general or sector specific, local/national or international, certified or non-certified. Only 3.6% of micro companies, 7.2% of small companies and 6.5% of medium sized companies have a systematic approach to environmental performance improvement, compare to the 16.5% of large companies (EC, 2010a). The EMS systems are not wide spread and their success can be questioned in this sense. It has to be emphasized, that the focus is on the environmental performance improvement of SMEs not on the implementation of a certain EMS or other tools (Ammenberg & Hjelm, 2003).

Environmental Management Systems are voluntary initiatives which could have some potential advantages compare to traditional regulation policy. It has a greater flexibility in reaching targets, increases dialogue between stakeholders, creates a better public image, promotes innovation, it has the potential to let companies achieve beyond regulation compliance, makes companies prepared for future stricter rules, enforcement costs for government decreases (Peters & Turner, 2004).

The EMSs follow the plan-do-check-act circle for improvements, and based on the ISO 14001 international standard. According to Williams et al., eight steps which could be required to implement by an SME are the following:

- Environmental Policy, to show commitment
- Legal Requirements, to know the legislation to be followed
- Environmental Plan, action plan to implement improvements
- Internal Audit, to check the performance of the system
- Emergency preparedness and response, to mitigate risks and damages
- Training and communication, to enable improvement and show them
- Documentation, to make the EMS last
- Certification, to get a proof for the working of the system

During the development of the EMS in order to be successful it has to be simple, inexpensive, needing low maintenance, to need minimal paperwork and not to take significant time away

from other duties of the firm (Williams, van Hooydonk, Dingle, & Annandale, 2000). One more step is present in several EMS-s and in the ISO 14001 standard too (Brorson & Larsson, 2006):

- Environmental Mapping, to assess the environmental aspects and impacts of the firm

Heras and Arana examined an alternative model for environmental management the Ecoscan which is a small EMS from Spain, summarized the advantages which these special environmental systems could offer over the ISO 14001 and EMAS standards. Less work for documentation, better adaptation to local or regional environment even able to provide sector specific requirements, the spreading of the initiative is enhanced through service packages by consultants, if external certification exist the costs are low, there is political and financial support (Heras & Arana, 2010).

There are incremental initiatives implementing similar environmental system as ISO 14001 with small steps certifying each stage of the development (Crognale, 2008; EC, 2009). There are systems focusing on parts of the environmental aspects, systems which do not have external audits or certification. There are companies which cooperate to reach a joint ISO 14001 certification (Ammenberg & Hjelm, 2003; Zobel, 2007). Organizations of different industry sectors can develop sector specific environmental management tools and according to a study around one fifth of them offer such tools (EC, 2010a).

4.3.2 Pursuing Environmental Sustainability by Business Strategy

SMEs could have the means to have proactive rather than reactive environmental strategies. The attributes helping the SMEs to be proactive are its flexibility, entrepreneurial orientation and innovativeness, the driving force of the shared vision related to the owner-founder's vision and the short communication lines within the firm (Aragon-Correa, et al., 2008).



Figure 4-1 Generic competitive environmental strategies

Source: (Orsato, 2006)

Orsato classified four main strategies, which companies can follow to gain competitive advantage and benefit from environmental improvements, see on Figure 4-1. Following a differentiation strategy the companies can pursue beyond compliance leadership to be ahead of competitors in environmental performance of their firm using this advantage in marketing of the company by getting environmental certificates as ISO 14001. A product and service

oriented differentiation strategy is eco-branding, when the firm develops environmentally superior products and services compare to competitors, even entering or creating new markets. The company has eco-labeled products uses the superior environmental performance in marketing. Cleantech companies can follow an Eco-branding strategy providing environmentally better or superior products and services for their customers. Concentrating on lowering the costs, Eco-efficiency as a strategy is aiming to improve the environmental performance of the company and save costs on the operations using cleaner production technologies concentrating on reduction of material, energy and legislative costs. The fourth strategy follows Environmental Cost Leadership gaining a price premium from ecologically oriented products; eco-design and product innovations are needed to be successful in this strategy. Cleantech companies can follow also the Environmental Cost Leadership strategy to gain markets (Orsato, 2006).

Sustainable entrepreneurship represents the highest incorporation of environmental and social issues into the business strategy and the existence of the business. Under on Figure 4-2, the relation between different entrepreneurial approaches towards sustainability is shown in relation on the priority of the environmental and social issues and their effect on markets and society. Sustainable entrepreneurship is aiming for the highest impact on markets incorporating sustainability into the core of the business. Compare to it, Environmental Management represents a medium commitment as an additional, supplementary activity complementing the core business (Schaltegger & Wagner, 2011).

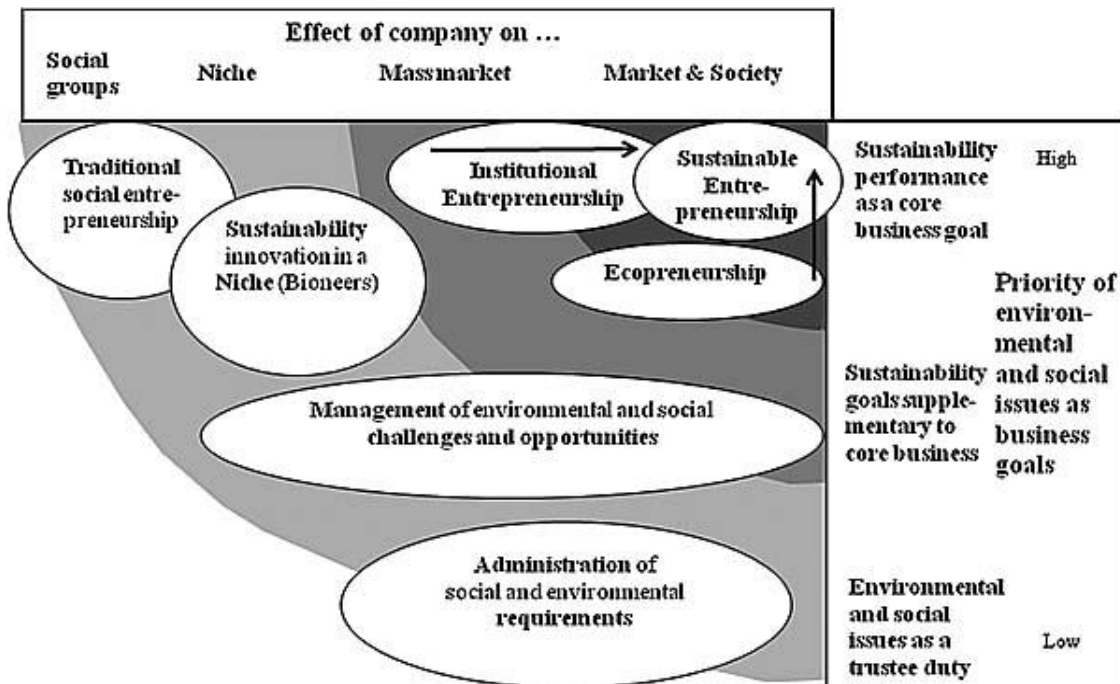


Figure 4-2 Perspectives and development of sustainable entrepreneurship and sustainability innovation

Source: (Schaltegger & Wagner, 2011)

4.4 Drivers and Barriers of Improvements

The use of environmental management tools in SMEs is not wide spread, in the EU only a small portion of companies certified or have some systematic tool in place (EC, 2010a). There are typical drivers which give incentives to act for improving the environmental performance and there are barriers jeopardizing the efforts. According to the data on the SME involvement in environmental performance improvement initiatives the barriers seem stronger than the

drivers in most cases. The balance is not static; it is continuously changing and might turn in favor of the drivers. Incentives for SMEs should be different than the ones for larger corporations, since SMEs differ in their attributes from large firms (Studer, Tsang, Welford, & Hills, 2008).

The major determinants of drivers and barriers are the legislative environment, cost structure, company capabilities and the state of the market. On the stakeholder perspective the drivers and barriers are defined by the government, the company, the customers and the suppliers (Gadenne, Kennedy, & McKeiver, 2009).

4.4.1 Pull or Push

The drivers of environmental improvements in SMEs, mostly concentrating on environmental management could be classified into two main groups the internal push drivers and the external pull drivers.

Hillary states that stakeholders are important drivers for EMS adaptation; the most important are customers, local government, local community, regulators and employees. She identified internal (organizational, financial and people) and external (commercial, environmental, communication) benefits which could driver the implementation of an EMS (Hillary, 2004).

According to Rasi et al. stakeholders as drivers the most influential the internal stakeholders as employees, management of the firm, then external stakeholders as authorities, customers, suppliers, the least important are the secondary stakeholders as industry and trade associations, NGOs, labor unions (Rasi, Abdekhodae, & Nagarajah, 2010).

Focusing on ISO 14001 implementation the European Commission's report identifies four drivers the demand from customers as a pull driver, developing a competitive edge for new customers and resulting in a good brand for exporting is a push driver as well as the EMS being a good management tool for saving costs and to be able to comply with legislation (EC, 2010a).

SMEs are driven by financial motives to reduce costs, compliance pressure avoiding penalties, personal motives the values of the owner/manager is key in determining the firm's attitude towards environmental issues. Still the study by Cassells and Lewis did not find a link between the attitudes and actions, cost reducing practices are the dominant driver (Cassells & Lewis, 2011).

Revell et al., who examined the importance of environmental drivers, have found out, the more important drivers are cost savings on energy or by resource efficiency, government regulations, market based instruments, attracting new customers, good publicity, good reputation to attract and retain staff, and potential to enter into new markets. Other drivers which were mentioned are local promotion of the business, pressure from existing customers, ability to attract public sector contracts, encouragement from landlord, information from network association, and joint initiatives with other tenants in the building. The recognized least important drivers are the pressure from business stakeholders, encouragement from trade bodies and pressure from suppliers (Revell, et al., 2010).

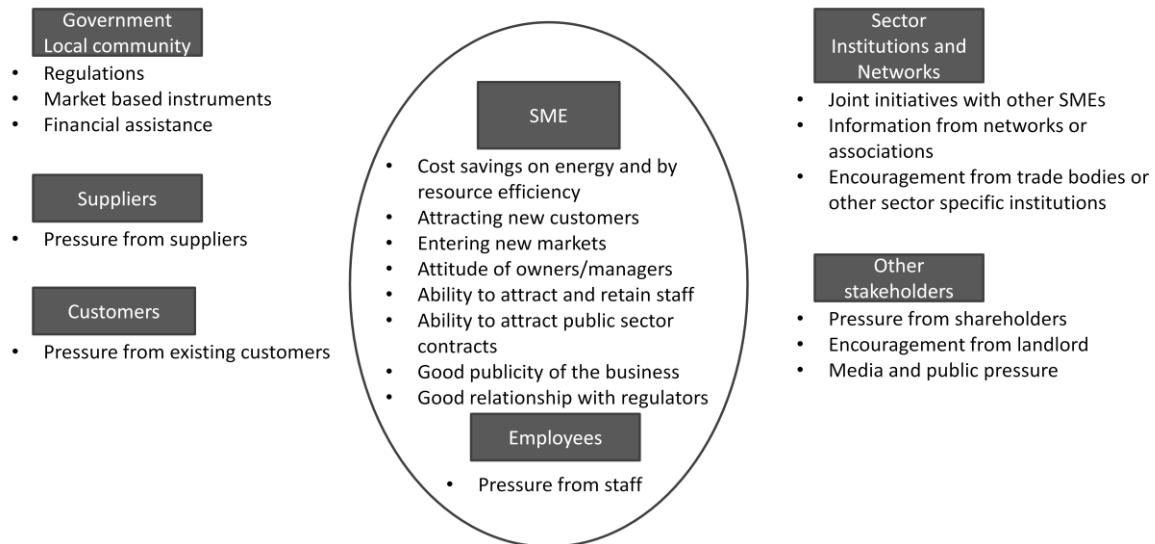


Figure 4-3 Stakeholders and internal/external drivers for environmental improvement of SMEs

A study on SMEs in Hong Kong found, the most effective incentives are supply chain pressure from customers by imposed conditions on the SME, consumer preferences demanding green products, fiscal incentives or market based instruments, financial assistance for improvements by governmental agencies, media/public pressure by organized campaigns against bad practices, strict legislation. Non-monetary incentives scored low in terms of effectiveness in the study (Studer, et al., 2008). Several studies confirmed that in micro firms, environmental concern of owners/managers was one of the most important drivers for environmental work. Smallest firms are most likely to be motivated with it (Revell, et al., 2010).

A survey in Poland showed the main drivers behind pro-environmental activities were reduction of operating expenses, the desire to improve the surrounding environment, improve the corporate image, the need of technology upgrade resulting from legislation. Some believed they can improve their market position by being pro-environmental (EC, 2010a). A survey on SMEs from the same industrial area showed, more than 60% of them agreed on to encourage environmental change their landlord could help in the process, businesses should act together in a network to tackle environmental issues, trade associations and networks should play a bigger role helping them to be more environmentally friendly (Revell, et al., 2010).

The external and internal drivers have been gathered and associated with different stakeholders surrounding the SMEs trying to implement environmental systems or participate in environmental initiatives, see above on Figure 4-3.

4.4.2 External and Internal Barriers

The drivers of environmental improvements face with the internal and external barriers of the firm, which are responsible for the problems with spreading initiatives for environmental management and environmental improvements among SMEs. The factors determining the awareness of the firm are access to information, time and costs, owner/manager personal characteristics, some firms are not even sure on the understanding of the legislation (Gadenne, et al., 2009). Possible drawbacks of implementing an EMS which can become barriers are resource problems as cost, time and skills. Higher than expected staff costs, unexpected capital expenditures, high certification fees, and too much time and cost required. The implementation of environmental measures could face with lack of rewards from the market. The EMS could have overcomplicated documentation providing rather more paperwork than

environmental improvements; in case of some EMSs the needed external communication could be underestimated, meeting different stakeholder demands could be cumbersome. It could be difficult to link the EMS to other systems as quality system. Short audit cycles needing attention (Hillary, 2004).

The barriers for implementing certified environmental management systems especially ISO 14001 are according to the study published by the European Commission are the lack of information about how to obtain a certificate making the SMEs depend on external advisors. SMEs often do not see their selves as having an impact on the environment giving no motives for improvement. The certification process could need long time to proceed with it. The implementation costs and running costs are high; external auditing could be costly therefore some SMEs decide to have an EMS without certification. If there is no demand from legislators or customers to implement a system, then often the implementation is perceived as extra cost and burden. Other sector specific standards might be more important for the SME than an environmental management system occupying the resources of the firm. SMEs are less concern about their image since their public exposure is much lower than large international corporations. There could be skills issues in the firm lacking management, legal or technical skills The most serious barriers for companies for using eco-innovation are the lack of financial resources and the very high implementation costs (EC, 2010a).

According to Hillary the internal barriers of the firm are connected to resources, understanding and perception, implementation, attitudes and company culture. The external barriers can come from certifiers/verifiers, economics, from institutional weaknesses, and support and guidance (Hillary, 2004). Murillo-Luna et al. classified the barriers for environmental improvements. Internal barriers are as lack of organizational capabilities such as limited motivation and preparation of employees, not enough top management leadership, poor communication, operational inertia. Lacking strategic capabilities as no management commitment, lack of research and development, conflict with personal goals, short term planning. Problems with financial capabilities, there is no resources available, there are high opportunity costs and the investment would replace a technology which is still profitable for the company. External barriers are high costs of technologies and services, higher priority of other external requirements, inadequate regulation by pressing other issues, scarcity of information, bureaucratic obstacles. Insufficient supply of equipment and information, lack of information on best available technology, uncertainty on the environmental and economic benefits of implementation (Murillo-Luna, Garcés-Ayerbe, & Rivera-Torres, 2011).

Barriers mentioned by Revell et al. are lack of consumer demand or no supply chain pressure, loss of competitiveness in the market, increased costs, lack of staff time to introduce measures, very low impact on the environment, insufficient information, poor infrastructure present to support activity and lack of interest from suppliers. The most important barriers from these identified by UK SMEs were the increase of costs, the lack of time to introduce measures and poor infrastructure to support activities such as recycling (Revell, et al., 2010).

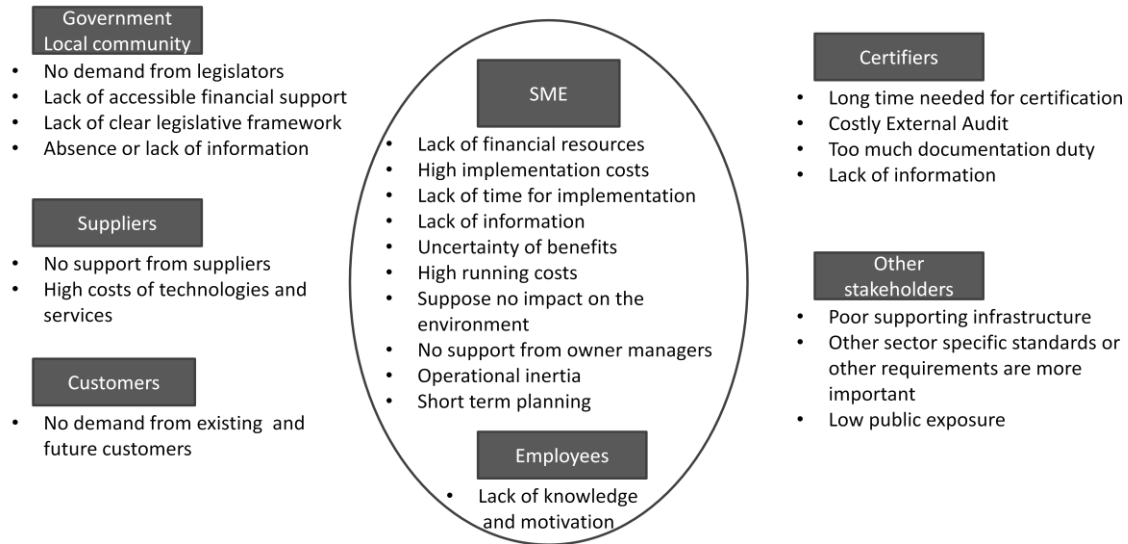


Figure 4-4 Stakeholders and internal/external barriers of environmental improvement in SMEs

Among the different obstacles of environmental improvements only budgetary and organizational limitations and aversion from innovation and change prevents firms from advancements. The external barriers are described as initial barriers not preventing the adoption of proactive environmental strategy. Only internal barriers are what prevent improvements (Murillo-Luna, et al., 2011). The owner values drive the organization; if SME's owner/manager prioritize sustainability, the most likely the business itself will prioritize sustainability too (Loucks, et al., 2010). There are signs of the end of the dominance of the push over pull drivers, ranking the internal drivers as cost savings from energy and resource efficiency, customer attraction, good publicity, getting new markets, and having motivated staff ranking almost as high as external drivers as legislative control and fiscal incentives (Revell, et al., 2010). Still, a gap appears to exist between what owner/managers say is needed, action beyond regulation and what is actually done. The gap is the biggest in micro enterprises, which are the least likely to improve without regulatory intervention. For example in the study of Cassells and Lewis, two third of the examined SMEs from New Zealand were skeptical about cost savings. (Cassells & Lewis, 2011)

The external and internal barriers of environmental improvement of SMEs are gathered above on Figure 4-4. On the figure the barriers has been associated with stakeholders interacting with the SMEs.

4.4.3 Benefits and Business Advantages

From systematic continuous learning and from implemented environmental management practices the SMEs could gain several benefits and business advantages. The mention internal drivers are originating from possible benefits for the business, making the business more resilient, reliable, responsible and respectable. SMEs are able to follow the legislation more easily making the business less vulnerable, the seeking for continuous improvement helps the company to cut costs, to save on energy and resources. Checking on the supply chain safeguard the company from possible scandals and secure the supply and the brand. Being environmentally conscious helps the company to have a good reputation which helps finding new customers and motivating and attracting talented workforce to the company.

Including sustainability as an aspect into the business activities, it could strengthen the products and brands of the company, could help finding new markets and business opportunities which would be unavailable without the incorporation of sustainability. A

competitive advantage can be gained if the organization is using the EMS to learn, this learning is hard to copy and paste. A credible business conduct creates a trust in investors, for a more sustainable business new financial sources could open up by finding a way to green investors.

Learning to manage operations in a more systematic way could result in more order at the firm, since EMS follows the structure of quality systems.

4.5 Environmental Initiatives with Certificates Addressing SMEs

There are several initiatives and systems for environmental management present. On the top of the initiatives, there are the international and general environmental management system standards as ISO 14001 and EMAS. Their focus is on large companies, but some believe in their use for SMEs too. There are guidance for their implementation in SMEs, the ISO 14005 and the EMAS Easy providing a phased implementation till reaching the certification (EC, 2011a; ISO, 2010). Some easier ways to develop a working environmental management system is to share the implementation work with other firms as it is done when a joint certification is reached or developing a recognized partial system which later step by step can be improved to get a more well known and accepted system certification as the ISO 14001 or EMAS (IEMA, 2011; Zobel, 2007). For the previous solutions the ultimate goal is to reach ISO 14001 or EMAS certification with fewer loads on the business by either sharing the burden or by prolonging the implementation time and easing the load on the firm.

There are diplomas and certificates designed for small companies, the aim of these schemes not to reach the international standards but to reach a level of environmental management in an SME which is feasible for it taking into consideration its resources and motivations. There are numerous of these schemes as EcoCompass, Environmental Diploma Göteborg, Green Dragon Environmental Standard (EC, 2009). After reaching the level of environmental management needed for these certificates to step up to an international standard is easier and later on possible to reach. Sector specific diplomas are helping the SMEs of the sector to concentrate on the main issues of the sector, giving guidelines for improvements, for example there are several diplomas developed for the tourism sector (EC, 2009). If a company does not want to have a certified system there are tools available only to assess its environmental impact, or develop its own management system. There are environmental awards schemes available to have some proof of environmental excellence, these awards are often not well publicized and lack credibility as their requirements are too easy to fulfill or the providing institution is not well recognized (Studer, et al., 2008).

Dalhammar recognized four main approaches towards facilitation of EMS in small firms; these are the incremental approaches using a step by step implementation with acknowledgement on every step; the joint EMS or group certifications when companies join to implement a system cost efficiently; mentorship outside or inside the supply chain by a larger corporation or other organization which has advantages for both sides; the fourth approach is standardized solutions for implementation, focusing on a special sector EMS or an EMS fit for certain companies, which can save time and costs for the implementation in the focus sector (Dalhammar, 2000).

There are six main types of support and services which can help SMEs to be able to comply with regulations and improve their environmental performance (Monkhouse, et al., 2006):

- Passive information and advice tools available mostly through websites and some campaigns to advertise these tools.

- Active or direct support and advice can be given to SMEs, providing it for free or very cheap.
- Arranging training sessions for SMEs to build their knowledge and capabilities.
- Networking approaches, creating a knowledge hub helping the exchange of experience and information, creating a critical mass to reach economy of scale.
- Economic and market incentives, providing financing or having reward systems for best practices, creation of certificates which are used for promoting the excelling companies
- Voluntary agreements going beyond the requirements of regulations, needing commitment but offering incentives for participants.

According to Monkhouse et al. the most effective initiatives for influencing the behavior of SMEs are on the regional level. Providing specialized services targeted for SMEs to address their need and face with the special barriers they have. Special support tailored to individual SMEs is more effective. Longer term relationships between the participating companies and the initiative can achieve greater benefits after building out trust and good relationship to be able to influence successfully. Marketing of the initiative should not be underestimated and efforts needed to succeed. The SMEs can be contacted more easily through already existing familiar channels (Monkhouse, et al., 2006).

The problem with small SME specific management systems could be their poor acceptance by the customers of SMEs, by big corporations, ISO 14001 has a wider acceptance, it is well known and there is a bigger demand for it. Too many different certificates increases the information asymmetry between suppliers and buyers (Heras & Arana, 2010). On the other hand, small scale local initiatives can be used as seed beds for regional improvements when implementing environmental management systems in different locations attracting the attention of local SMEs (Peters & Turner, 2004).

The relevance of the implementation of a certified environmental system is higher for high impact SMEs, for low impact SMEs the benefits might be inferior. Sector specific schemes are more relevant for the companies, but since their focus is on a certain sector, the impact of a scheme is more limited (EC, 2010a).

4.5.1 ISO 14005

ISO 14005 is an international standard helping the implementation of the ISO 14001 certified environmental management systems for SMEs and gives some guidance to achieve an EMAS certification. The International Organization for Standardization has published for the first time in 2010 this guidance. As ISO 14001 and EMAS is originated from the British EMS standard BS 7750 (Hillary, 2004), the ISO 14005 standard is originated from the British guideline for phased implementation of an EMS for SMEs, the BS8555.

There is no other support given to the SMEs, the standard has to be acquired and followed. It gives a five and a three phased implementation example. The document is compact and hard to follow; most SMEs would need external help from consultants to be able to use it. There is no additional information available on best practices or other concrete practices which the SMEs could rely on. The document describes what should be done, but do not help in the how. The ISO 14005 guidance is rather a good information source for consultants not for the companies. The described system seems complicated which needs substantial resources from the adopting firm. Still, the ISO 14001 standard is implemented in more than 200,000 organizations all around the world, making it the most widespread system (ISO, 2011).

4.5.2 EMAS Easy

The project of EMAS Easy is aiming to promote for manufacturing and services SMEs the international standard of Eco-management and Audit Scheme (EMAS) of the European Union. It has a two phase implementation in the first phase the trainers are trained at the international level, which then followed with local implementation projects with the help of the trained experts (Monkhouse, et al., 2006). The European Commission has a website for information to share with the SMEs, toolkit and examples are available there (EC, 2011b). The program claims it delivers an EMAS compliant system in 10 days with 10 people on 10 pages in 30 steps (EC, 2011a). This might seem less costly but if calculating with 10 workdays with 8 hours of work costing 60 Euros for a man-hour would result in 4800 Euros without the consultation costs which could be even more costly.

The guidance has a general scope, still concentrating more on SMEs which have material flows and have a workshop, despite of this it could be used for offices as well as service providers. The guide turns the implementation to a very operational process where the links are showed and less thinking is needed. If EMAS certification is reached with an EMS, as EMAS is adopting the ISO 14001 requirements, to reach the ISO 14001 certification the firm does not need much extra efforts (EC, 2011a). There are around 4600 certified organizations from which 81% are SMEs mostly within the European Union (EC, 2011c).

4.5.3 Joint Certification of an EMS

The joint certification of an environmental management system known as Hackefors model from Sweden is aiming to bring ISO 14001 certification with less efforts for individual companies by cooperation with other firms. In Sweden, in 2004 approximately 20% of the ISO 14001 certificated companies reached the certificate with the model. The most practical implementation of a joint EMS with a group of companies is within a limited area as an industrial estate or a science park. At the end of the process each company has its own EMS and its own certificate. The unique elements of the joint EMS system are: joint environmental organization, joint system administration and documentation, extensive environmental training, joint environmental policy and objectives, joint internal environmental audits, joint third party audits (Zobel, 2007). There are more than 400 companies certified within 24 networks inside Sweden (EC, 2009).

The certification process needs consultant assistance; it builds up central expertise for the running of the EMS which makes the SMEs more vulnerable, depending on the central knowledge base. The joint implementation costs are less than the individual implementations, the work needed for the implementation in one case varied between 100 and 200 man-hours followed by 1 to 5 man hours of maintenance each week, allowing most of the companies to run the EMS without extra recruitment (Ammenberg & Hjelm, 2003).

4.5.4 Acorn and Other Phased Systems

Building on the BS8555 standard, it is a scheme to achieve a full operational ISO 14001 certified EMS with six steps. The first step is to get commitment and establishment of the baseline, step two to identify and ensure compliance with legal and other requirements, third step is to develop objectives, targets and programs, in the fourth the implementation and operation of the EMS has to be done, the fifth step builds up the checking, audit and review parts. The final sixth step is to acquire the ISO or EMAS certificate for the EMS (IEMA, 2011).

The benefit of the scheme for SMEs is they can get a certification and acknowledgement after each step giving them the freedom to reach only a certain level and be able to be transparent.

When a firm reached phase two, it is certain the firm follows all the regulations present in the UK, when reaching phase three the company shows it put efforts into the reduction of environmental impacts and risks (Crognale, 2008). The development process is guided by the purchased documentation of the scheme and consultants. In 2009 there were five hundred companies certified, the costs of the certification are high (EC, 2009). Each step needs external certification, if the company goes through all the steps will reach ISO 14001 with its full complexity.

Other similar national stepwise systems in Europe are e+5 from Spain, Green Dragon Environmental Standard from Wales, Eco-dynamic Enterprise label from Belgium, 1. 2. 3. Environment from France. The number of the schemes' participants does not reach even the thousand companies (EC, 2009).

4.5.5 Svensk Miljöbas and Other Simple Diplomas

There are environmental diplomas offering an EMS, which is following the backbone of the ISO 14001 but results in a slimmer EMS system. This is a good starting point when the company wants to implement the international standard and gives acknowledgement on their environmental commitments. According to Christian Owe from Ekocentrum, Gothenburg Environment Diploma is one of the simple EMSs which started in 1995 by the municipality of Gothenburg. The format of the diploma was adopted in circa 40 municipalities around Sweden. The diploma has joined to a national wise standard and label Svensk Miljöbas. From the autumn of 2011 no other diplomas and labels only the Svensk Miljöbas certificate will be given to companies fulfilling the requirements. The developed techniques for adaptation with support and consultancy in different municipalities will remain. The scheme has around 800 certified companies. There are certified organizations which provide the full certification package with materials and education to successfully reach certification.

The Gothenburg Environment Diploma has more requirements than the Svensk Miljöbas, the companies have to go through a checklist with 58 points from which most of them has to be fulfilled in order to get the diploma. The checklist is concentrating on simple solutions for transportation, energy and waste management. The checklist is helping by advising concrete measures as the changing of light bulbs or purchasing eco-labeled products (City of Gothenburg, 2010). In order to keep the diploma an external audit has to be done yearly, during the audit the implementation of the environmental plan is assessed in addition to the content of the checklist. According to Ingrid Bohlin from Gothenburg Environment Diploma the costs for certification are around 20 to 25 thousand SEK excluding the compulsory half day education of all employees on basic environmental knowledge. Most of the certified companies are in the service sector operating an office.

The Gothenburg Environment Diploma is joined together with three other environmental diplomas in the Nordic countries by Nordic Environment Network. This is an initiative which started as a project and became a permanent network for cooperation, the members of the network are the Green Network from Denmark which is a regional initiative, the Eco-Lighthouse from Norway and the EcoCompass from Finland's metropolitan area (NEN, 2011). The aim of the network is to enhance cooperation between the schemes and maybe in a later stage to develop a common standard accepted in all the member countries.

In order to achieve the certification of Svensk Miljöbas, the implementation of the EMS has to be done with the help of an authorized issuer organization. The company needs to appoint a management representative for the EMS. The environmental review, identification of environmental impacts and significant aspects is needed. The relevant environmental legislation has to be collected; training has to be provided for employees of the company. The

documentation has to cover the policy goals, action plan of the company, relevant legislation, chemicals used, it has to show a training plan, emergency preparedness and a short environmental report is needed. The management review of progress has to be included into the system too. For the first three years auditing has to be done yearly. The implementation is aided by checklists, templates and other materials (Svenskmiljöbas, 2010).

4.5.6 Other Initiatives

There are initiatives which in exchange of the certification and the marketing benefits expect concrete results and improvements from the firms. Examples of these are Ecoscan from the Basque part of Spain and Ecoprofit which has started from the city of Graz and spread mostly within the German speaking regions.

Ecoscan certificate is given to a company which established an environmental improvement plan, which after delivered results. The management system has to have the commitment from the company, the environmental aspects of the firm has to be assessed and prioritized. Environmental objectives have to be defined following the drawing up of the environmental improvement plan after analyzing the possible actions, technologies and practices. The environmental improvements have to be monitored; a review of the environmental management by the management of the firm is needed. There are few hundred companies participating in the scheme, the average time required to reach the standard is four and a half months, the companies need more than 50 hours of consultancy costing around 4000 Euros to implement the system which is lower than an ISO 14001 certification (EC, 2009; Heras & Arana, 2010).

Ecoprofit is a local government scheme building a public-private-partnership of local authorities, companies and experts/consultants. The aim is to make environmental improvements while cutting operational costs of the companies (Lintz, 2011). It originates from Austria and has become an international initiative present in 19 countries. Most of the certificated companies (around 3000) are in Germany (EC, 2009). For Ecoprofit certification the companies have to participate in a series of workshops which help them among others in defining improvement possibilities and assessing their environmental impacts, finding the relevant legislations, addressing organizational and management issues. The implementation is aided by consultants working with worksheets for developing a system with a program of environmental measures, the consultants help in the implementation of the measures and prepare the firm for the examination and certification process (Lintz, 2011). For a successful certification the company has to make improvements and have to prove the compliance with relevant legislation. The funding of the project is by governmental and participating company contributions. The certificate has to be renewed each year. (Monkhouse, et al., 2006).

Ecoprofit Micro might be more relevant for science park initiatives, which is tailored for companies under 20 employees. The program is in Graz subsidized by funding from the European Union therefore it is free of charge for participants. The program is 5 months long consisting of five workshops on several subjects. Additionally to operations the program focuses on a more strategic approach addressing the services and products of companies, trying to build a sustainable corporate philosophy. Personalized consultation is included in the program (Graz, 2010).

The SMEs and generally all firms need extra resources to keep up multiple management systems, when there is a quality management system, a health and safety management system and an environmental management system implemented in a company. A joint system saves energies and results in more transparency. FR2000 from Sweden is one example of joint systems as it is together a quality, environment, and health and safety system. This system is

designed for SMEs and large companies covering a wide spectrum. There is a general certificate which has been tailored so far for thirteen different sectors where the tailored certificate is used. The certificate is based on ISO 9001 the international quality management standard and on ISO 14001. The FR2000 contains 16 sections for description of activities and 53 sections for management of activities gathered in ten chapters based on a flow- and process-oriented approach which makes it different from ISO standards. The flow is from customer enquiry through the company towards delivery. The information package for FR2000 costs 6050 SEK. There are 368 companies certified within the scheme (FR2000, 2008, 2011).

There are other simple initiatives for example the EnviroStep from New-Zealand which is a self-assessment method for SMEs with a questionnaire, EcoCert from Ireland concentrating on cost savings or Hong Kong Q-Mark concentrating on the monitoring of the environmental performance of the companies.

4.6 Networking for economy of scale

Establishing networks for SMEs to improve their environmental performance could overcome some of the barriers they face as lack of resources, lack of accessing information and isolation. In a network the members jointly formulate problems and issues and use each other's experiences and resources to solve these problems (Halila, 2007). A collective innovation group of SMEs can identify potential improvements and have beneficial outcomes within a scope of a voluntary initiative at a local scale industrial estate (Peters & Turner, 2004).

The cluster approach can help to identify and assess similar environmental aspects and find technological and operational solutions that can be applied to similar production processes, products or services. Physical proximity can facilitate the cooperation; there are synergies by having the same local ecosystem, sharing the environmental impact, the cluster can help in interacting and communicating the common stakeholders. Information exchange can be fostered by networks sharing experiences and applying common solutions (Daddi, Testa, & Iraldo, 2010). A good example for networked approach is the earlier mentioned joint implementation process for ISO 14001 by SMEs (Ammenberg & Hjelm, 2003).

César has studied the effect of a virtual public network for SMEs with results showing, the firms within the virtual network providing information performed better environmentally and economically. The network provided information on environmental technologies, best practices, legislations, helped developing green competences in firms. The aim of the project was to avoid duplication in the development of environmental content by consultancy firms and institutions. Following the one stop shop idea, the more preprocessed the information for final application, is more valuable for the firms (César, 2008). According to a study from the European Commission one fifth of the sector organizations offer environmental management tools and offer guidance for member companies. These services including other services offered by the sector organizations are used by around one fifth of the SMEs (EC, 2010a).

Revell recommends building local business and environmental networks which are positively approached by SMEs. These networks can help building a relationship between SMEs, government and other stakeholders, based on cooperation and trust collective actions can be done to solve environmental problems. The networks concentration on certain aspects which interest more the owner/managers of SMEs will more likely involve the firms into active membership. Using the existing networks for addressing environmental issues than setting new ones could be beneficial (Revell, et al., 2010).

4.7 The Science Park and SME connection

Science Parks are homes for thousands of SMEs all over the world. These companies can be classified into three major groups: the tenants, the companies in incubators, and service providers. The tenants are innovative companies with growth potential with flexibility and changing company culture, most probably without strict formal processes concentrating on making business and developing competitive products and services; the average number of employees working at these companies are around ten, some of them reaching couple of hundred employees. The companies in the incubator are all micro enterprises with one to five employees; they are having resource problems and are aided by the incubator. These companies have minimal spare resources concentrating on finding markets, business models and developing their products and services, the companies are very innovative and capable to change fast. The service companies are providing help, assistance and other services to the tenants and incubator companies enjoying a close proximity to these companies. The service companies cover all fields where employees and firms would need services, from the restaurants and barbers to the banks and business consultants. These firms are either SMEs or a branch of a large corporation.

Science parks can be a seed bed for environmental improvement as they are a source of innovation helping in the knowledge transfer from universities to the business world. “Infecting” its networks with the idea of sustainability, sustainable entrepreneurship, cleantech innovations and environmental management the science parks can contribute to improve the environmental performance of economies and societies. A science park in relation to the SMEs can be a driver for environmental improvements, can take a facilitator role, helping the tenants and other nearby companies with information and advices, since the science park has the highest influence on its premises, science parks can help building up an infrastructure for an effective environmental management for example helping in waste management or energy management.

There are certain differences between the typical science park firms and between the SMEs which were mainly in focus of the literature. The literature was focusing mostly on SMEs with high impact or SMEs which have a stable business in a settled business segment as construction, maintenance, furniture production or textile manufacturing. Science park firms on the other hand are mostly high-tech companies active in new business segments which are volatile, probably growing. These businesses are not in a stable and settled business segment have to react much faster to changes and has to continuously innovate to stay in business. The environmental impact of these firms differs from companies which are having heavy machinery using substantial amount of chemicals. Still their environmental impact depends on the technologies the science park tenants are using.

The next chapter gives an insight into IDEON Science Park and its Lightfoot Academy initiative for the SMEs residing at the park. The chapter covers the attributes of the science park, some background information and details on the tenants of the science park.

5 The case of IDEON Lightfoot Academy

5.1 Introduction to the Science Park

IDEON Science Park (see on Figure 5-1) is one of the oldest science parks in Sweden; not like most of the science parks in Sweden, it was established by private funding in 1983. The park was part of the answer to the problem of the decline of heavy industry and traditional industries as ship building and textile manufacturing in the region in the 70's. IDEON Science Park was built to boost high-tech SMEs to change the regional industry structure from traditional to a modern industrial structure with IT and biotechnology (Park, 2002).



Figure 5-1 IDEON Science Park

Source: (IDEON, 2011)

The science park has been developed into one of the biggest science parks in Sweden with 110,000 square meter office and laboratory space occupied by around 240 companies employing circa 2,000 people. The site has two owners, IKANO and Wihlborgs real estate developers, which are key actors in the science park. Within the science park and its vicinity there are four business incubators to help new start-ups in their starting phase of commercialization.

The Lund University premises are in the neighborhood of IDEON, some buildings at the park are occupied by the university. In the initial stages of the park it was a prerequisite for a company to have ties to the university in order to be accepted to the park. It has changed, now being in a high-technology sector and having a good growth potential is enough to be part of the science park. Still there is a close relation between the university and science park companies. According to Linus Wiebe deputy director of innovation at LUIS, the innovation system of Lund University, most of the start-ups from Lund end up at IDEON in some stages at their life, either as incubator companies or as tenants.

The companies which have been tenants of IDEON have a very high survival rate, more than 70% of all the companies ever been at the science park is still operating in some form. Maria

Sätherström the marketing manager of IDEON Center mentioned: one of the success factors of the science park is that it is privately financed and the tenants have to pay market prices for their rent, this prepares the tenant companies for the outside world, not like in some bad examples where government subsidies resulted in unviable companies. Through IDEON Business which is a network for services the tenants can receive help for all sides of their business operations as legal advices, accounting, marketing, human resources, education.

The advantages of being at IDEON does not originate only from the possibilities to collaborate with other firms on site, but the prestigious milieu present at IDEON gives a positive image for the tenants in the eyes of the outside world (Jonsson, 2002).

The science park does not have production capacities, only some research laboratories are on site for life science research. The park consists of mainly offices with all the ICT infrastructure for computer aided research, development and design.

5.2 Stakeholder relations and motivations for Sustainability

5.2.1 IDEON and the Triple Helix Model

All three sectors in the triple helix model have influence on the leadership of IDEON Science Park. The private sector has the ownership, the regional government and the municipality is represented in the board of IDEON Center which is the central organization of IDEON responsible for marketing and providing services for tenants through built up networks. The governmental funds help tenants and incubator companies to develop their business giving an additional possibility for governmental influence. The main governmental actors are Innovationsbron the national organization to promote innovation and commercialization of ideas with good potentials, ALMI which is another state owned company helping SMEs and new businesses for economic growth, VINNOVA the governmental agency for innovation is helping innovation systems in tackling barriers and benefiting from opportunities, Tillväxtverket is the Swedish agency for economic and regional growth managing structural funds (Torounidis, 2010). Lund University is the main source of new ideas, knowledge and technology which is transferred to the business world sourcing the innovation system, LUIS is facilitating the process by helping researchers to bring their ideas into feasible business ideas, according to Linus Wiebe yearly from 6000 researchers nearly 100 ideas are valorized by checking its feasibility for viability on the market, at the end around 10 start ups are assisted for set up. Lund University is represented in the board of IDEON Center to have an influence on the science park.

There are four incubators within the park or in its vicinity. IDEON Innovation used to be owned and managed by IDEON Center, now it is an independent company; some influence from IDEON Center is still kept through its board. The Incubator is not specialized in any sectors, most of the companies are within the IT and bio-technology sectors. The aim of the incubator is to be an ideal place for innovation. According to Rickard Mosell the CEO of IDEON Innovation, the goal is to create a great soup influencing not just the incubator companies but anyone who get in contact with the incubator. The second incubator is VentureLab founded to help the students of Lund University in case having a great idea to be able to make it reality. VentureLab is rather a pre-incubator, the founded companies move mostly into IDEON Innovation from there. LIFT Incubator is concentrating on service companies or companies with a non patentable idea, the entry criterion is to be at least one or two years in business before entry and having an idea which is new. According to Per Garvell from LIFT Incubator the main focus in the incubator is on teaching the companies how to sell their products, the companies have to survive without external funding by the income from customers buying their services. Lund Life Science Incubator is a specialized incubator

in life-sciences; this incubator is not at the science park but operates in a nearby building. The incubator companies pay subsidized rent prices and share laboratories which make the early stage operation and research & development work cheaper. A virtual incubator called Cleantech Inn Sweden is residing at IDEON. A virtual incubator offers similar services as a general incubator except it does not have offices for renting to tenants. Cleantech Inn Sweden is specialized in cleantech companies. It is in a changing state at the moment yet without formal cooperation with IDEON Center. As Per Garvell explained, cooperation between incubators is only in a starting phase, on the way to become no competitors to each other. The innovation system surrounding IDEON can be seen under on Figure 5-2.

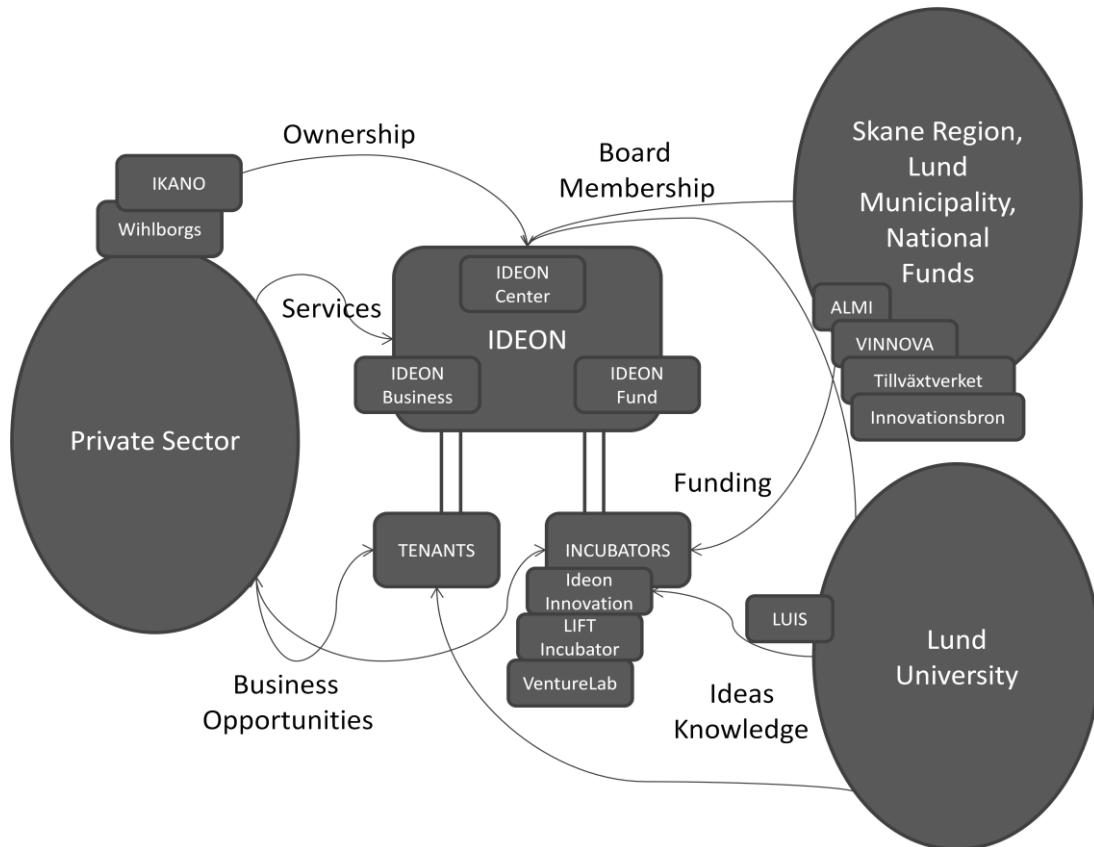


Figure 5-2 IDEON and the triple helix

Source: (IDEON, 2011; Torounidis, 2010)

5.2.2 Motivations for Sustainability

Some of the stakeholders of IDEON are interested in making the science park to be more sustainable including the tenants of the park. The real estate developers (IKANO, Wihlborgs) are planning for long term, which gives them the opportunity to invest into buildings considering a longer time period allowing more expensive investments which later will pay off. The real estate owner is interested in less energy use, longer wear-down of the buildings and full occupancy which is a common interest with IDEON Center.

IDEON Center is interested in to make the science park to be an attractive place with high occupancy rates. To follow the trends of innovations and new business opportunities, the park would like to specialize more in cleantech, adding as its third pillar following ICT and Life-sciences. IDEON Center is interested to promote itself to be more environmentally conscious to attract cleantech companies. According to Maria S  therstr  m environmental consciousness

is getting to be part of the minimum level what tenants and businesses expect from a science park.

The Skane region and Lund municipality are interested in promoting sustainability, and helping initiatives to make the region and the city more sustainable, they take responsibility for the environmental problems and try to be proactive tackling them. Carbon neutral transportation system and sustainable urban development among others are in the focus of the region and the city (Skane Region, 2009). Skane region is a sponsor of IDEON's Lightfoot Academy.

At Lund University sustainability is not in the main focus of research. According to Linus Wiebe there are rarely any ideas on the field of cleantech coming from researchers. LUIS and the University is trying to put more effort on it, during 2012 an investment fund called LU Cleantech is going to be set up to help cleantech ideas commercialize. The researchers could be motivated with dedicated research funding addressing sustainability issues or adding sustainability into the criterion for acceptance.

The incubators related to IDEON do not put much effort on sustainability, at IDEON Innovation some of the business advisors have more interest in sustainability but it is not a criterion for a start-up to be green. The main focus of incubators is on helping creating working and successful businesses in sectors where there is a good potential for growth. As one of the sectors of good potential is cleantech, Cleantech Inn Sweden is concentrating on that sector only, making it a special virtual incubator at IDEON from sustainability point of view. According to Per Garvel as there are going to be new opportunities for business on the sustainability field, there will be more new companies appearing at an incubator which are entering into that sector.

5.3 Tenants of IDEON

5.3.1 Size and Sector

There are three main groups of the companies at IDEON: the tenants, the incubator companies and the service companies. Currently 139 companies are listed as tenants, 45 as incubator companies and 48 as service companies (IDEON, 2011). The incubator companies are the smallest of all having only some professionals employed; mostly the owners of the company are the only employers of them, all of the incubator companies are micro companies. The tenants of the science park are mainly micro companies, but there are some small and medium sized companies at the park and some large companies have representatives in the park as Texas Instruments, Intel, Foxconn. Ericsson was renting whole buildings at the science park for its research and development work, currently moving out from the premises. The representative companies are either offer supply chain services for production or parts of the products of tenant companies, or increasing the presence of these large companies to have a good insight on innovation processes. The service companies are either smaller consulting companies as Ekonomi Konsult CLW or branches of large firms as banks (Nordea, Handelsbanken), consulting firms (Ernst & Young, KPMG) or other firms offering services (Sodexo, ISS).

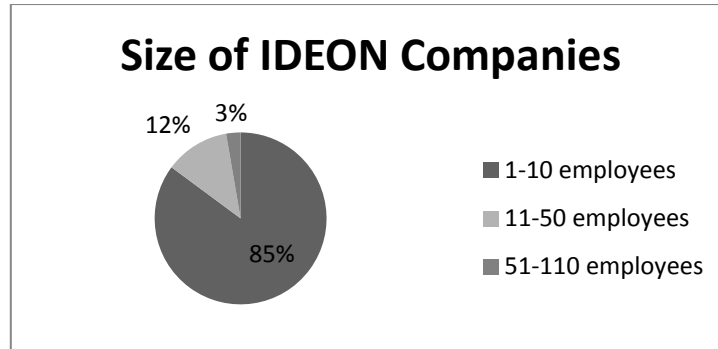


Figure 5-3 The relative proportion of size among IDEON companies

Source: IDEON

Most of the companies present at IDEON are micro companies having not more than 10 employees, see Figure 5-3. The ICT sector has its biggest share with 26% among all the companies at the park. The other two pillars, Life Science and Cleantech, represent respectively 20% and 7% of all companies. The share of cleantech companies yet to be low compare to the other two pillars. According to Figure 5-4 under, around third of the companies are supporting service companies providing for the rest of the tenant.

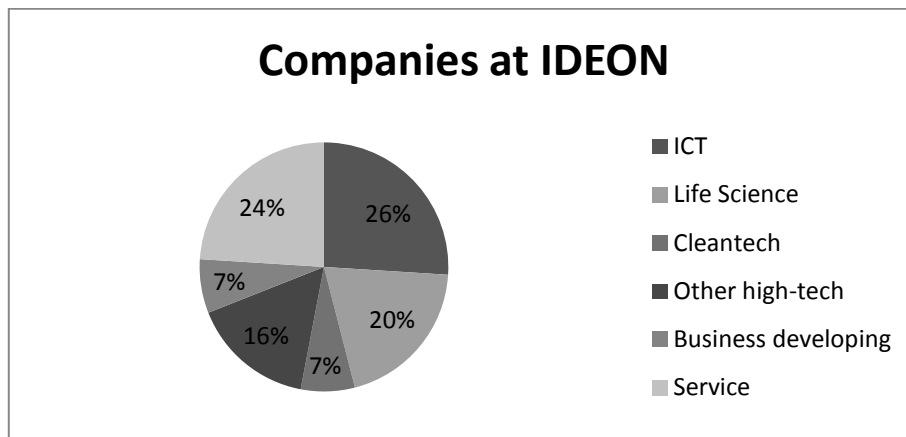


Figure 5-4 The distribution of companies at IDEON by sector type

Source: IDEON

5.3.2 Environmental Experiences and Attitudes of Tenants

An online survey has been conducted on the tenants of IDEON Science Park, from the asked circa 230 firms only 24 answered the online survey. Most of the answers came from micro companies, but there were some branches of large companies answering the survey too, for the distribution of companies in size answering the survey, see under Figure 5-5.

The summary of results including all sizes of firms is shown on the following figures. According to the survey, the companies seemed neutral or a bit proactive towards environmental sustainability, see Figure 5-6. The results shows, just around one fourth of the companies have faced customer pressure to show their environmental performance, and a small fraction has already an EMS or conducted an LCA, see on Figure 5-7. According to the

answers to the survey most of the companies do not see an environmental certificate showing their environmental commitment beneficial, see the distribution of answers on Figure 5-8.

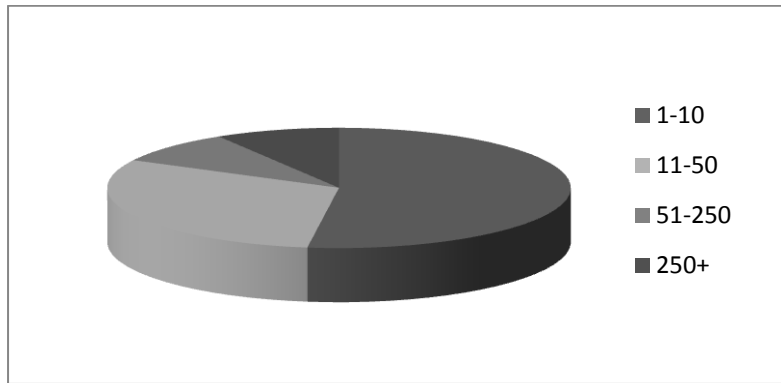


Figure 5-5 Distribution of size of the surveyed companies in number of employees

The results show that the larger the firm the more likely the firm has already been working with environmental issues, even having an environmental management system. The micro firms did not see much pressure from customers to show environmental work, only one company faced with it. Except one answer where an LCA has been made by the company; the micro companies did not have any EMS and has not conducted an LCA. The micro companies rather do not see any benefits from having an environmental certification, and are rather neutral on the environment and on willing to make improvements.



Figure 5-6 The distribution of answers for question on pro-activity

The small companies having 11-50 employees are rather willing to make environmental improvements a bit more than micro firms do, their attitude towards the benefits of an environmental certificate is neutral. The small companies had minimal experience with EMS and LCA, only one of the firms has an EMS. Almost half of them have already faced environmental questions coming from customers.

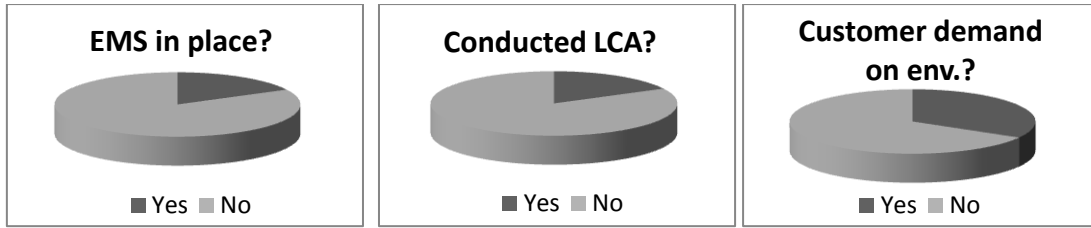


Figure 5-7 Distribution of answers on environmental work and customer demand

The medium and large firms show the best environmental profile through the questionnaire. As most of them have an EMS and made LCA-s, all of them faced with customer demands on environmental work and performance. These firms were committed the most to improve their environmental performance voluntarily showing the highest rate of pro-activity.

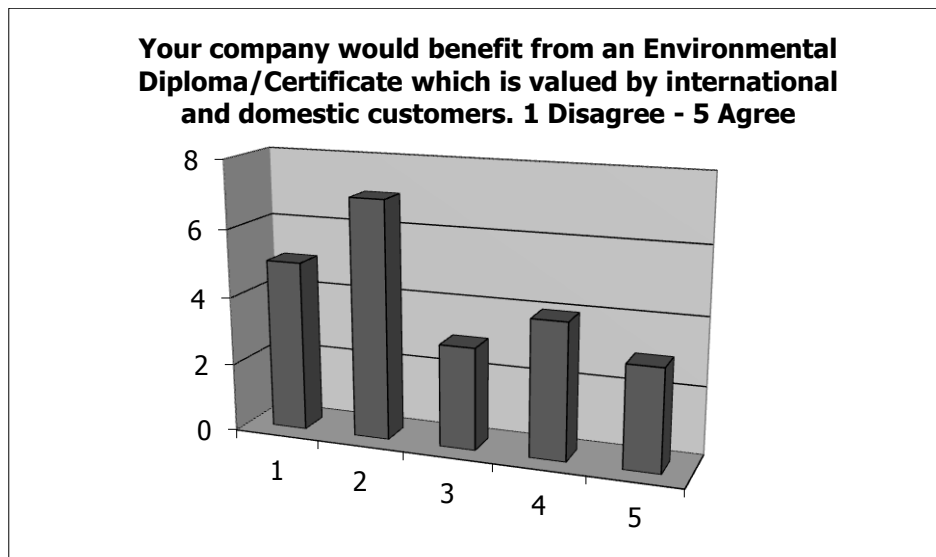


Figure 5-8 The distribution of answers on benefit of an environmental certificate

Despite the size of the sample it can be said, that the micro and small companies do not have a positive attitude towards environmental work, being rather neutral on doing things pro-actively, and having a minimal pressure from customers. The study did not look into pressure from other stakeholders like the government or the public.

5.4 The Lightfoot Academy concept

Within the IDEON Lightfoot project, which started in 2009, there have been steps towards reducing the environmental impact of the park and its tenants by mobility management tools. IDEON opened a bicycle renting service for employees at IDEON promoting cycling to nearby locations instead of using cars. The use of mass transportation was promoted and a parking fee has been introduced for employees to motivate them using mass transportation instead of driving.

Lightfoot Academy is an initiative trying to help tenants to reduce their environmental impact and help them to be involved into sustainability issues. It has to be considered, most of the companies at the park are focusing on how to make business rather how to avoid harm on the environment. According to Karl-Erik Grevendahl the project leader of IDEON's Lightfoot Academy the plan is to focus on small companies with less than 25 people, companies focusing on international markets where not just the product but the whole company has to

be more sustainable, companies in dirty businesses with high environmental impact, companies trying to keep up with regulation. Goal is to connect the companies with people many years of experience on their fields, focusing on issues which are the most relevant for participants. There is no solution which would fit all the participants, tailored solutions have to be offered. The initiative could be imagined as a network of companies interested in similar things and connected to experts concentrating on man on man interactions in addition to some internet based concepts.

5.5 Future Expansion Plans

The science park is going to have two major developments in the near future. After the moving out till 2012, the old AstraZeneca site next to the park will become IDEON Medicion Village, a hub for life sciences. The addition of the AstraZeneca site would almost double the office and laboratory space available at the science park with its 80,000 square meters office and laboratory space. It has been bought by a foundation with the major contribution of Mats Paulsson, this will add a third real estate owner at IDEON Science Park. The park will be the home of a cancer research cluster (LU, 2011a, 2011b). The final form of cooperation within the IDEON Science Park has not been established yet.

IKANO is building a new nineteen story building called IDEON Gateway on the north end of the Science Park on a previous parking lot. The building will contain 20,000 square meters extra office space. The building will reach the highest levels of green certificates as within LEED it will reach the platinum level. It is claimed to be the greenest building in Sweden, according to Fredrik Åkesson the main goal was not to create the most sustainable building. The main driver behind the design was long term thinking for 50 or more years. The building has the latest technologies, solar cells, geothermal heating, automatization resulting in high energy efficiency.

The mentioned expansions will significantly increase the number of companies at the park, creating an even larger network of companies.

6 Analysis

The previous chapters addressed the researched problem from different angles and scope. During the analysis the information presented and the findings summarized in those chapters is put together to synthesize and present a system which could be the aim to be developed under the IDEON Lightfoot Academy initiative.

6.1 IDEON and Sustainability

The third chapter summarized four ways how science parks can contribute to environmental sustainability. These were to be an environmentally responsible real estate developer; implementing an EMS for the science park and having programs for environmental improvements; being a host of a cleantech cluster, supporting sustainable businesses and businesses for sustainability; and acting as a service provider for tenant companies assisting them for environmental performance improvements.

6.1.1 IDEON and Real Estate Development

IDEON Science Park is going through an expansion right now, where a new building is built by IKANO one of the owners of the science park. IDEON Gateway is designed to have a high environmental performance. IDEON can be seen as a responsible real estate developer.

On the other hand the expansion of the science park with the existing buildings of the former site of AstraZeneca, since these are older buildings with worse environmental performance and there is less freedom on influencing their environmental performance. The development of the park cannot be said to be strategic on having green buildings. Still it can be said with new buildings the science park follows the more sustainable real estate developments. When considering the long term, during the design of new buildings or refurbishment of old ones, the future developments of the park most probably will be following the footsteps of IDEON Gateway.

6.1.2 IDEON and EMS

IDEON does not have an environmental management system and it is not in the plans of the park to have one. The individual owners of buildings (IKANO, Wihlborgs) have freedom to invest into the infrastructure to have more energy efficient insulation or to manage the waste collection and they are already investing or planning to invest in the future into the improvements of the existing infrastructure.

The management of the park does not gather the environmental aspects of the park under one management, since the individual owners of buildings are responsible for the management of those buildings. For example Wihlborgs has its own environmental management and reporting for all their buildings including buildings at IDEON. IDEON Center is only responsible for the marketing of the park and the services. To be able to implement an environmental management system at the park, the management of the environmental aspects of the park, as energy consumption, waste management, purchasing, transportations should be under one organization. There is an uncertainty whether the park would follow this way of contributing for sustainability.

6.1.3 IDEON and Cleantech

IDEON has not been able to develop a certain branch of cleantech cluster. The park does not have special infrastructure for any cleantech research and development or special offers which would attract more of these firms. Still 7% of the companies residing at the park are cleantech companies from several fields.

IDEON's goal is to increase the presence of cleantech companies; therefore in the future this way of contribution for sustainability would be pursued at the park. For increasing the attractiveness of the park, some services for cleantech companies could be developed as test sites. : Showing more environmental responsibility as a marketing strategy, already used in other science parks, IDEON could be more attractive for cleantech companies. For this strategy the previous ways of contribution for sustainability should be followed too.

6.1.4 IDEON and Environmental Services

IDEON has taken some steps towards offering environmental services for tenants and assisting them to improve their environmental performance by initiating IDEON Lightfoot Academy. At the moment there are no environmental services offered to tenants of IDEON. There are no service companies residing at the park which have environmental services in their portfolio.

According to the gathered information, being an active initiator of providing environmental services for tenants is unprecedented. There are information services, or initiatives originating from outside of the park, from governments but not from the science park itself.

6.2 IDEON, SMEs and Sustainability

The fourth chapter gave an overview on what kind of barriers the SMEs face when implementing environmental management systems or introducing some environmental improvements in the firm. There are drivers which motivate, help the companies to continue or start such work. A science park could have the abilities to influence the barriers and drivers making the environmental improvements more likely to happen.

6.2.1 Enabling Environmental Improvements

The science park can drive environmental improvements by encouraging as a landlord for more efficient resource use with rental agreements where the electricity and water consumption of the companies are measured and paid separately. At IDEON the new tenant agreements not like the previous ones does not cover the electricity costs, the tenant has to pay them in addition to the base price. The science park is a key facilitator by improving the supporting infrastructure of environmental management as poor supporting infrastructure is one of the barriers SMEs have to face. This includes recycling and other waste management, providing energy efficiency tools to the tenants, as controlling temperature and ventilation.

The driver of good publicity can be enhanced by IDEON as a marketing tool for the tenants, helping them to reach wider public with their results. IDEON can help promoting networks from where useful information can reach the tenants. Joint initiatives of SMEs can be facilitated by science parks. IDEON using its networking capabilities and public image can help SMEs with their environmental work. Implementation barriers as lack of information can be tackled by science parks providing information for tenants or helping them finding the needed information. Lack of financial resources is one of the most important barriers for investments for environmental improvements. Science parks can develop a good relation with funding agencies to help tenants win the needed capital for the investments.

According to the survey made on the IDEON tenants, the barrier of no support from owner managers as a barrier for environmental initiatives does exist in some extent. The answers showed only around an average agreement on pro-activity, therefore a considerable amount of firms at the park are not supporting voluntary actions for environmental improvements. From the survey, uncertainty of benefits as a barrier for SMEs could be present at IDEON companies, since most of them do not see an environmental certification as beneficial for

them. To see a certificate unbeneficial does not mean the company sees no benefits from cost reductions, less material use or other aspects of the operation when implementing environmental improvements. Due to the rather negative attitude within IDEON tenants towards environmental certificates, and the low experience with environmental management systems and conducting LCAs, IDEON could promote the benefits of environmental improvements for tenants to reach higher acceptance for initiatives as IDEON Lightfoot Academy.

The results of the survey conducted on IDEON companies could show even too positive picture of the companies, as it is most likely the companies caring the less about the subject did not answered the survey, therefore among the answers the more environmentally conscious firms are over represented.

6.2.2 Sustainability through Innovation

The European Commission's study has stated: supported by the academic literature, eco-design is not seen as relevant for the majority of SMEs. Some of the firms have eco-design in some individual projects for example for demonstration, but this rarely leads to implementation of eco-design in product development processes. Eco design is not a management issue in SMEs and strategic goals for an environmental product policy are very rare. When eco-design is practiced, it is mostly on redesign of products than development of new product concepts which is eco-innovation (EC, 2010a).

The SMEs in science parks are different from the ordinary average SMEs. These are mostly high technology and innovative firms. The science park is in the middle of an innovation system, facilitating innovation. Therefore eco-innovation for SMEs at science parks could be more relevant than for average firms. These companies have the capabilities to develop new products, have the channels to get new knowledge and new perspectives outside of the firm. The science park can help by introducing and assisting the SMEs to work with eco-innovation.

IDEON does not have a dedicated business incubator, or business advisors for eco-innovation, but it has the means to have one. At the site of the park a virtual cleantech incubator is present, Cleantech Inn Sweden. Working together with the incubator, the science park could develop a system for promoting eco-innovation and development of new businesses based on green products and services. With the enlargement of the science park there will be more free space for extra incubators and cleantech and green companies.

6.3 IDEON and Environmental Management Systems for Tenants

6.3.1 Criteria

An initiative which would be suitable for IDEON Lightfoot Academy has to comply with several criteria; these are compiled from the vision of the project leaders of the Lightfoot Academy, the capabilities of science parks and the capabilities of IDEON, the barriers and drivers of SMEs on implementation of EMS and other environmental initiatives should be considered (see Figure 4-3 and Figure 4-4), general attributes of SMEs along the gathered information on IDEON companies is used.

- The initiative should have a certificate accepted internationally, or could be used internationally.
- Should help complying with environmental legislation
- Should improve the participants' environmental performance

- Should focus on small and micro companies
- Should use networking
- Should have man on man interaction as a service for participants
- Should be as cost efficient as possible
- Should result in economic benefits for participants
- Should be able to address firms individually
- Should be sustainable on the long run
- Should build out a systematic learning not just an ad-hoc approach
- Should be attractive for non-participants
- Should not be too formal and complicated to implement
- Should not take too much time from participants
- Should rely on the real estate and infrastructure

The above list of criteria has some contradicting criteria where a good compromise could be reached after their consideration of importance. For example, when implementing something systematic which is then has to be less formal needs a compromise. To have something cost efficient, less costly is usually contradicting with the effectiveness of an initiative, real improvements usually cost more. Adding an extra aspect to the business as environmental protection usually adds to the costs, but it could be a driver for innovation and improved efficiency of the firm adding to the values of it.

From the implementation point of view, it is easier to follow or join some existing programs rather than to create a completely new one. Learning from the existing programs is advised too. In the following paragraphs, the found existing systematic initiatives are examined. The comparison of these initiatives is based on qualitative assumptions and the use of the above criteria, the deep analysis of each certificate or initiative is over the scope of the thesis.

6.3.2 ISO 14005

It leads to ISO-14001, the most recognized EMS system, which is really international and can be used around the world. But it is expensive compare to others. Too much documentation, it is absolutely out of the scope of micro companies and even small companies. The barriers it faces are financial resources, costly external audits. Its benefit would be the international recognition. ISO-14001 does not need real improvements from the companies but the implementation of programs usually leads to them. Its implementation takes more time and probably needs extensive consultancy support.

6.3.3 EMAS Easy

It leads to EMAS or ISO-14001 certifications. The implementation of it is still costly but probably cheaper than following ISO-14005. It needs an EMAS Easy certified consultant to help the company. This is tailored for SMEs with rather high environmental impact, but can be scaled for smaller enterprises, offices. EMAS is international but not wide spread and might have a problem of acknowledgement outside of Europe; the certified companies can get ISO-14001 certification right away without extra efforts, only paying for the certification and having the external audit.

6.3.4 Joint Certification

This leads to ISO-14001 certification. It is cheaper than an individual ISO-14001. It is internationally recognized. Negative aspect is, the organizations are depending more on the central management of the scheme and freedom of the companies is a bit limited with it. There is always a possibility to become independent when company is moving out from

premises. It uses a network for implementation; an outsider consultant is still in need for implementation. Can ease the barrier of high costs, economy of scale can be reached with it. Implementation of documentation and other templates is needed. If a new firm would like to join the network, the whole certification process for that individual firm has to be done. This work is always easier by using the materials and knowledge of the existing system. A joint certification needs the participants to implement the system with the same pace in order to reach the certification together.

6.3.5 Step by Step Certification

Based on the BS8555 standard, the step by step certifications lead to ISO-14001 certification at the end. The companies can stop on half way reaching a certain level which suits them. This means less costs, but no international recognition only recognition from a local scheme. It gives more time for implementation, distributing the costs in time. The final amount of work and investments are the same as in case of a simple ISO-14001 certification process. If a company stops half way, it will have a recognized half ready system with some improvements for the environment. This scheme helps with the barrier of high costs by distributing them in time. A step by step implementation can be jeopardized by the focus shift of the management of the firm, being satisfied with a half ready system. Still this half ready system could be sufficient for micro firms realizing their environmental aspects and developing some improvement programs.

6.3.6 Joint Management Systems

As the case of FR2000, these systems are helping companies to implement a system covering more areas than environmental management. FR2000 can lead to ISO-14001 certification. This gives the benefit of saving resources. But the implemented system is even more complicated than a simple ISO-14001 implementation, therefore for micro and small companies this system might be too much. The implementation costs are around the same as a simple ISO-14001 system. The certification for ISO-14001 result in additional costs to make the system recognized internationally. For most of the micro and small companies there is no need to have systematic approaches for several aspects of a business. From the point of view of an environmental initiative such systems are over the scope of the goals of these initiatives. Still for individual companies such management system could be useful.

6.3.7 Ecoprofit and Ecoprofit Micro

Ecoprofit is a result oriented initiative aiming for concrete environmental performance improvements to be reached. The certificate is only given to companies if they achieved the planned improvements and comply with environmental legislation. The Ecoprofit gives a good founding for an ISO 14001 or EMAS certification, but its aim is not to build an environmental system for the company. The scheme is international but known mostly in Austria and Germany; it is bounded mostly to municipalities or regional governments. Networks of companies have been built around the initiative to help the participants sharing information and to find the right actors who could help them in the implementation of their environmental improvement program, only the successful companies are rewarded which were able to reach improvements in energy efficiency or in other environmental aspects of their operations. Ecoprofit is addressing companies with high environmental impact, since those companies gain the most on improvements.

Ecoprofit Micro is aiming companies fewer than 20 employees is less result oriented but fits better these companies than Ecoprofit. It is closer to an informative tool, demanding less from the participants only their time and attention. If the participants are committed, the free of charge consultancy and workshops can improve their environmental performance in the

future, even leading to some competitive advantage. The Ecoprofit Micro is using the reputation of Ecoprofit to get acceptance.

6.3.8 Svensk Miljöbas

It is an environmental diploma used only in Sweden. The diploma follows the structure of the international standard ISO-14001 but needing less documentation and being cheaper when implemented. This certificate embraces several municipal or regional schemes into a nationwide standard. It is known mostly in Sweden and in Scandinavia. The implementation has to be done by certified consultants who give education for employees and provide materials and other services for implementation. The implementation can be done in a group of companies when providing the necessary education for all the companies together. The benefits of the certificate depend on the implementation of the environmental program developed. The environmental diploma gives a systematic background for environmental improvements with fewer costs as an ISO-14001 certified system would need. The time for implementation is within half a year.

6.3.9 EMS Light May Fit

None of the mentioned certificates covers an international slim environmental management system developed for SMEs. In all cases the conformance with current legislation is a minimum criteria, the firms usually helped to have an understanding of the environmental legislation concerning their operations. The companies at science parks are mostly SMEs therefore the lighter, less complicated systems are better fit.

One of the major barriers for involving into environmental work is the occurring costs which have to be financed by the company, by other organizations or by the benefits of the initiative itself. The above mentioned initiatives vary on the costs; the most expensive ones are those which result in ISO-14001 certification. The costs are reduced by joint efforts sharing resources or adding together the resources for a common effort. Lowering the demands on the companies and offering free informational or even consultancy services can reduce the costs of the companies. Using cheaper resources as students and trainees for helping the implementation can reduce costs further.

Science parks have a high potential helping with their networking capabilities, building an information system for participants. Using their networks their tenants can have more access to funding for investments and for implementation costs. To enable to take actions science parks have the capability to provide the infrastructure for environmental work, having individual measurements for each company on energy, water consumption, on waste. Science parks can provide the means for waste collection, joint recycling system and chemical management to reach economy of scale for cost efficiency.

From this list of initiatives ISO-14005 seems too expensive and inadequate for SMEs in science parks. A step by step approach can lead to an unfinished system and the certificate for a half ready system might not be acknowledged. A joined management system is over the scope of improving the environmental performance of SMEs, it is a more complex system. A joint certification binds the companies and makes them to be dependent on an external actor, the group coordinator; this could be less attractive and still results in a more rigid ISO-14001 system which is a better fit for companies acting in less innovative sectors. EMAS Easy is claimed to be easy to implement but the resulted system could be still too formal for companies under 25 employees. Svensk Miljöbas and Ecoprofit initiatives and certificates could fit SMEs and science park companies.

6.4 The Working Lightfoot Academy

In the following, a picture of a working Lightfoot Academy will be presented, using the specific information on IDEON Science Park and the generic findings on SMEs and science parks answering key questions and examining key factors of environmental initiatives mentioned in the methodology in Chapter 2.

6.4.1 Key Questions and Factors

There is no particular environmental problem which is needed to be addressed with IDEON Lightfoot Academy. The main objective of the initiative is to help participating companies to improve their environmental performance, preferably with systematic, long lasting solutions. The concrete problems which will be addressed, has to be investigated in workshops and meetings with participant companies.

What SMEs need is going to be found out during the running of the academy to address issues which the participants are most interested in. The ideal approach would be to address companies individually, then solving, fulfilling similar problems and needs jointly.

The target audience of the initiative is small and micro companies with less than 25 employees, the primary targets are the companies residing at IDEON but other companies from the vicinity are welcome too. There are no sector specific criteria for participants; therefore the initiative is addressing generally SMEs.

During the study no similar initiatives have been found, which are addressing science park companies, Ecoprofit Micro shows some similarities, but it stops before being systematic and remains an educational initiative demanding no improvements for certification. The initiative at Créalys Science Park shows some similarities too, which helped the participating 18 companies to improve some of their environmental aspects with an ultimate goal to reach ISO-14001 certification. The initiative did not provide a certificate at the end. No science park specific initiative has been found similar to IDEON's Lightfoot Academy.

The funding of the Lightfoot Academy is coming from the fee paid by the participants, governmental funding from Skane region, private sponsorship by the local energy company and by a bank. Ideally the initiative should be able to be run by the participants and IDEON after the set up.

The academy needs external expertise for creating the services and providing them. For this the science park has to build up a network which contains the participants of the academy, experts from different fields in order to be ready to give information, conduct workshops, and provide help. The academy is going to have online presence which opens an extra channel for information. To make the initiative cost efficient, the resources of Lund University could be used. There are interdisciplinary Master's programs on the field of environmental management, sustainability. The students of these programs could be used as experts when supervised within a course project by their professors. The participant companies could be asked to organize workshops or case presentations in exchange of reducing their membership fees.

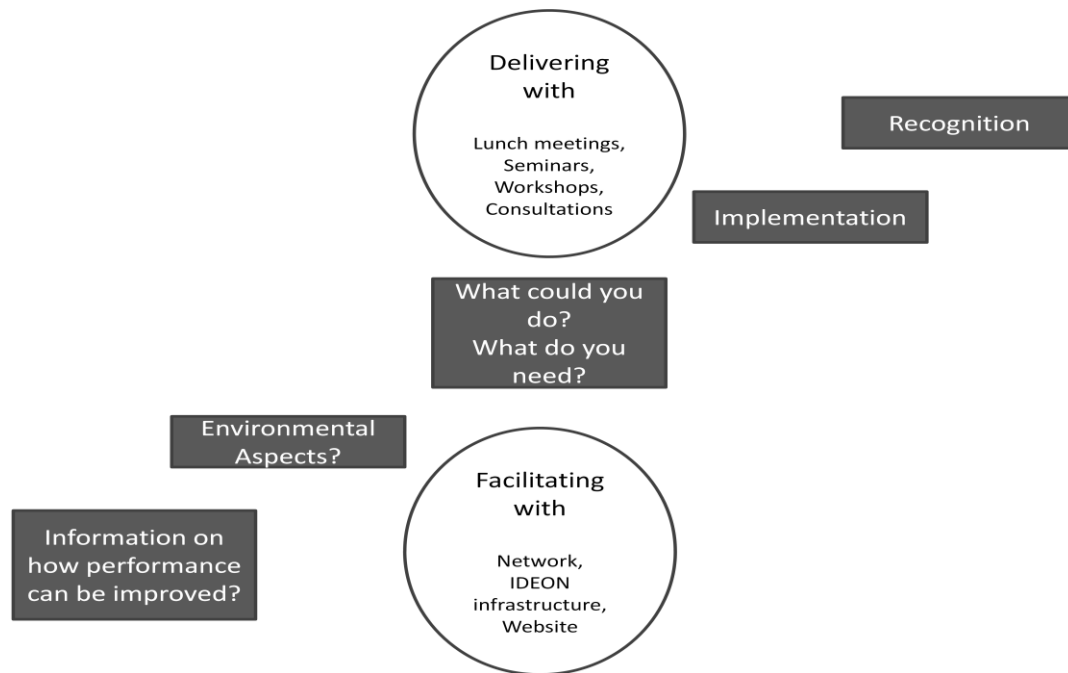


Figure 6-1 Parts of IDEON Lightfoot Academy

The services of the initiative would be delivered by the above mentioned consultants and other actors using the website, the lunch meetings, the workshops and the seminars providing one on one discussions. The Academy has to provide onsite help for the companies by experts spending time dealing with individual needs of the participants.

IDEON Lightfoot Academy could reach a self-sustaining status only minimally depending on external funding, or building out sustained funding channels. The Academy should have an “open door” policy, some of other initiatives have an initial part where participants are gathered and then a path is followed with them towards a goal as ISO-14001 certification. IDEON Lightfoot Academy should be opened for new participants at any given time, as being rather a service than a fix term program.

The results of participants should be marketed externally through the website and other channels and internally by asking the companies with a success story to share it with interested participants. Feedback mechanisms have to be developed in order to monitor the need of the participants and to be able to improve the Academy continuously.

Systematic approach can be reached by implementing a small EMS into the companies to create a circle for continuous improvement in a plan-do-check-act manner, or the Lightfoot Academy could have this systematic approach in it by repeating the above process on companies. The systematic approach is implementing a learning process which can make sure to result in improvements in the long run. The recognition contains certification or some other acknowledgement and evaluation of the implemented measures. The place of the systematic approach depends on the capabilities of individual companies, which company made to be able to handle it alone, would handle it alone, which company would not be able, would be helped. The parts of IDEON’s Lightfoot Academy are summarized above on Figure 6-1.

6.4.2 Ladder of Sustainability Excellence

The participating companies could be classified according to the level they are involved in sustainability. Using the analogy with refuse-reduce-reuse-recycle, the companies which have some environmental work in place mitigating their environmental impact could be at the recycle level, the companies focusing more on services with products than on products reducing their impacts and consumption of resources could be on the reuse level. Companies such as cleantech, which try to address concrete environmental problems with their products could be at the reduce level. Companies which are trying to change the current economical, consumption systems, trying to make radical changes could be at the refuse level.

The companies are getting higher on the ladder according to on what level they address sustainability. For example going from reactive approach towards proactive approaches, having sustainability within the strategy of the company would put them on higher levels. Companies could be on the higher levels, which would have a vision on their place in a completely sustainable world, considering not just profitability but each part of the triple bottom line at the same level.

6.5 Perspectives of International Use

Currently there is no international standard for a slim environmental management system aiming for SMEs; therefore the international acceptance of a systematic environmental work through a certification process is not yet straight forward. When choosing a local certification, the use of that certification abroad is depending on other circumstances. For example the reputation of the nation where the certificate is from can influence its acceptance. As Sweden has a good reputation being environmentally responsible, a local certificate could be accepted even word wide if it is from Sweden.

If the science park is able to create a reputation to be environmentally responsible, even a certificate given by the park could be enough to be accepted. Although to build up the reputation takes a long time. If the science park would have an internationally recognized ISO-14001 certificated EMS which would incorporate the Academy members in some ways, the member companies could refer to the science park and its ISO-14001 certificate, when they need to show their environmental work, additionally to the actual progress the company made.

7 Conclusions

It has been shown in the first chapter, that science parks can play and some of them are playing a bigger role in promoting sustainability. The four main approaches are:

- Acting as a real estate developer
- Managing the environmental impacts of the park itself
- The park is specialized in cleantech or other more sustainable businesses
- The park is using its networking and service providing capabilities to develop environmental services for tenants

As the small case studies gave an example, the science parks mostly follow the first three approaches, when trying to be more sustainable. The major drivers for the efforts are new business opportunities and the improvement of the image of the park by showing more responsibility.

A list of available environmental management systems, certificates and initiatives has been examined. For science park companies the lighter, less complicated systems are a better fit. Since most of the science park companies are SMEs the systems and initiatives developed for them is a better fit. From the available certificates, the Ecoprofit and the Svensk Miljöbas could be considered. Looking at the two, the Svensk Miljöbas is preferred at IDEON Science Park since it is a Swedish certificate, all the auditing and certification has an already developed and tried process. The Ecoprofit has not been in Sweden before.

The companies at a science park are innovative mostly high-tech companies which have a potential to grow bigger in the future. Concentrating on the products and services of these firms could be where the highest impact can be achieved, since these firms' main activity is to create viable business models, creating these models considering sustainability could have a significant positive impact in the future.

IDEON is adding cleantech as one of its core cluster following the third approach mentioned earlier. To help in the establishment of the cluster, the science park should make a closer relation with Cleantech Inn Sweden and start a cleantech incubator at the park. The life science companies will move to IDEON Medicon Village, the freed space could be the place for cleantech labs and companies. Creating an incubator portfolio for IDEON would be beneficial synchronizing the separate incubators to cooperate rather compete with each other. Cooperation could be established with LUIS at Lund University creating a working innovation system which is going through IDEON Science Park creating a line of companies following sustainable entrepreneurship.

IDEON's Lightfoot Academy could follow the criteria listed in chapter six:

- The initiative should have a certificate accepted internationally, or could be used internationally.
- Should help complying with environmental legislation
- Should improve the participants' environmental performance
- Should focus on small and micro companies
- Should use networking
- Should have man on man interaction as a service for participants
- Should be as cost efficient as possible
- Should result in economic benefits for participants

- Should be able to address firms individually
- Should be sustainable on the long run
- Should build out a systematic learning not just an ad-hoc approach
- Should be attractive for non-participants
- Should not be too formal and complicated to implement
- Should not take too much time from participants
- Should rely on the real estate and infrastructure

The initiative has to use the capabilities of the science park and the surrounding institutions it is in relation with, cooperation with Lund University could lead to cost efficiency. To have a systematic approach for continuous environmental performance improvements, for the firms which have more resources, an environmental management system could be implemented, which later could reach a certification as Svensk Miljöbas. For smaller and more resource scarce companies, the Academy could provide the systematic approach by providing regular assistance to the companies.

According to the online survey conducted on companies residing at IDEON, there is no need in most of the companies present for improving their environmental performance. In order to reach higher participation levels for the Lightfoot Academy, efforts have to be taken to promote the initiative, and help the companies realize their needs and the benefits of participation. For motivation, the business advantages of environmental work could be emphasized. Some show cases could be developed at the park to give close examples to tenants.

Certification should not be the primary goal for the Lightfoot Academy, as it is not desired yet by the companies. When the companies get involved and see some benefits from the initiative and realize or experience a need for a certification, then a certification process could be started with the interested parties.

The ownership of the park is shared currently between two later three owners. The maintenance and the management of the premises of the park are completely separate. The income streams from rents are going straight to separate companies. The common around the science park is the service agreement with IDEON Center, and the signs and some design around the park are similar. The separation within the park could be a source of weaknesses as the environmental work cannot be coordinated under one management, or has several practical barriers when the park would make some environmental work by itself providing the infrastructure for the companies.

Looking into a broader perspective, into science parks around the world, these parks have the capabilities and the opportunity to become the facilitators of sustainability along facilitating innovation. Providing environmental services to tenants could become a standard as providing business consulting and accounting services. Initiatives and networks as IDEON's Lightfoot Academy could become usual way of dealing with the environmental aspects of tenant companies. The science parks as seedbeds could reach other SMEs outside of the parks, involving them into the networks. New companies with a better environmental performance could be the showcases for other SMEs, showing how environmental aspects can be incorporated into a business successfully, leaving the business still or even more viable and prospering on the long run.

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Appendix I: Benchmarking of Swedish Science Parks

The following table has been filled with information from websites and related news of the examined science parks and email conversations with representatives of some of the parks.

Name	Founded	Number of Firms	Size in m ²	Location	University nearby	Incubator	Spec.	Fields/Type of firms	Env. Initiatives on Science Park	Env. Services for Firms	General Attitude
Aurorum Science Park	1989	69	20000	Lulea, Sweden	Lulea University of Technology	Y	Y	ICT / Media	Nothing has been found	Nothing has been found	No mentioning of sustainability and environmental performance. Some firms work at the Science Park consulting on such issues
Munktell Science Park	2005	88	3600	Eskilstuna, Sweden	Mälardalen University	Y	N		Nothing has been found	Nothing has been found	No mentioning of sustainability, not in focus
Ideon Science Park	1983	235	110000	Lund, Sweden	Lund University	Y	Y	Mobile technology, ICT, Life science and Cleantech	Bicycle renting, Promotion of mass transportation, Energy efficiency investments, Green Buildings, Lightfoot Academy for tenants	Lightfoot Academy for improving the environmental performance of tenants	There is an increasing awareness for sustainability. Strategic approach

Johanneberg Science Park	2009	60	40000	Göteborg, Sweden	Chalmers University of Technology Foundation, University of Gothenburg	Y	Y	Energy, Material Sciences and Built Environment	The park is aiming to be a cluster of sustainable society. Built environment is one of its specializations. Chalmers University is pushing for excellence in Sustainable Future	No environmental services only networking possibilities which can be with environmental firms	Sustainable development is mentioned, some eco firms or organizations are present at the park.
Lindholmen Science Park	2000	262	300000	Göteborg, Sweden	Chalmers University of Technology Foundation, University of Gothenburg	Y	Y	Sustainable Transfer Systems, Modern media and design, Mobile internet	Commute greener initiative to get to work in a more sustainable way	No environmental services only networking possibilities which can be with environmental firms, Test Site Sweden is the place for sustainable transportation tests	Aimed to some clusters which bring sustainable transportation, the park is a facilitator.
Medeon Science Park	1985	23	25000	Malmö, Sweden	Malmö University and Skånes University Hospital	Y	Y	Medical technology, Biotechnology Pharmaceuticals or Health care, Cluster of Biotech	Nothing has been found	Nothing has been found	No mentioning of sustainability, not in focus
Mjärdevi Science Park	1984	220	190000	Linköping, Sweden	Linköping University	Y	N		Nothing has been found	Nothing has been found	No mentioning of environment or sustainability, not in the scope

Norrköping Science Park	1987	95	50000	Norrköping, Sweden	Linköping University	Y	Y	Visualization, Printed Electronics and Interactive services	Nothing has been found	Nothing has been found	No mentioning of the environmental field, not in focus
Science Park Jönköping	2001	110	18000	Jönköping, Sweden	Jönköping University	Y	N		Company on the premises offered some workshops for companies to get EU funding for Eco Innovation.	Nothing has been found	No mention of sustainability, not in focus
Solander Science Park	2008	7	3000	Pitea, Sweden	Lulea University of Technology	N	Y	Biomass, Forestry, Bio-Energy, Bio-fuels	Developing the forest based bio-refinery concept, it is building new more energy efficient buildings replacing the existing	Nothing has been found	The existence of the park is to address the issue of sustainability itself
UMINOVA Science Park	1984	94	25000	Umea, Sweden	Umea University Swedish University of Agricultural Sciences	Y	Y	InfoTech and Biotech, Life science	Nothing has been found	Nothing has been found	There is no direct attention for pursuing more sustainable businesses, but the inventors have some business ideas which make some difference. Not in focus

Västerås Science Park	1998	172	200000	Västerås, Sweden	Mälardalen University	Y	Y	Automation, Energy, IT and Creative industries	Nothing has been found	The Science Park has a surface for the companies on site to show their available courses. There are environmental courses available for market prices	It is not in the main focus, but some tenants are working on the environmental field, it is communicated
Silverdal Science Park	2005	Few	65000	Sollentuna, Sweden		N	Y	Biotechnology Pharmaceuticals and Chemical tests	Nothing has been found	Nothing has been found	No mention of sustainability, not in focus
Stockholm Science City			250000	Stockholm, Sweden	KTH Royal Institute of Technology, Karolinska Institutet, Stockholm University, Stockholm School of Economics	N	Y	Life science	Nothing has been found	Nothing has been found	Not in focus, even printing possibility for website. Not a traditional science park concept
Elektrum/ Kista Science City	1970's	8500		Kista (Stockholm), Sweden	KTH ICT and the Department of Computer and Systems Sciences	Y	Y	ICT cluster	Riding to work initiative, there are some conferences on some environmental aspects	Nothing has been found	It is concentrating on ICT, there are green companies in the incubator and some programs addressing aspects. Not a traditional science park

Uppsala Science Park	1985	140	57000	Uppsala, Sweden	Uppsala University	N	Y	Life Science	Nothing has been found	Nothing has been found	There are some conferences on the matter in the park, not in focus of the park. The park functions rather as a firm hotel
Science Park Halmstad	1990	77	5000	Halmstad, Sweden	Halmstad University	Y	N		Nothing has been found	Nothing has been found	Environmental aspects are not in the focus of the science park
Karolinska Institute Science Park	2006	56	3300	Stockholm, Sweden	Royal Institute of Technology (KTH) and Södertörn University (Södertörns Högskola)	Y	Y	Life Science	Nothing has been found	Nothing has been found	No mention of sustainability, not in focus

Appendix II: List of EMSs and certificates for SMEs

Name of certificate or initiative and its origin	
ISO14005	International
EMAS Easy	International
1.2.3. Environnement	France
Bayerisches Umweltsiegel	Germany
Acorn method, BS 8555	United Kingdom
e+5	Spain
ECOCAMPING	International
EcoCompass	Finland
Ecodynamic Enterprise label	Belgium
Eco-Lighthouse	Norway
ECOPROFIT	International
EcoStart	Finland
EcoStep	Germany
Ekoscan	Spain
Environmental Diploma Göteborg	Sweden
Green Dragon Environmental Standard	United Kingdom and Ireland
Green Key	International
Green Office	Finland
Green Network/Key2Green	Denmark
Grüner Gockel	Germany
Hackefors Model	Sweden
QuB	Germany
Ecomapping	New Zealand
Ecostage	Japan
PIUS	Germany
PREMA	Germany
Miljöstegen	Sweden
FR2000	Sweden
Ecobusinessplan	Austria
Svensk Miljöbas	Sweden
EcoCert	Ireland
Hong Kong Q-Mark	China
Enviro-Mark	New Zealand
EnviroStep	New Zealand

Appendix III: The survey on tenants of IDEON

The following survey has been sent to tenants of IDEON Science Park:

General

1. The size of the Company in number of employees:

1-5	6-10	11-50	50-250	250+

Indicate it with an [X]

Environmental Experiences

2. Does your company have an Environmental Management System in place?

(ISO 14001, EMAS, a not certified system etc.)

YES	NO

3. Has your company ever made a Life Cycle Assessment study?

(Environmental impacts from cradle to grave)

YES	NO

4. Have your company ever been asked by customers to provide information on its environmental performance/work?

(Environmental Reports, Energy and water use, Product Declaration etc.)

YES	NO

5. **Your company feels sustainability has to be addressed and taken into consideration during operations even if it's not needed by any stakeholders.**

0: Don't know 1: Disagree 5: Agree	
--	--

Give a number from 5 to 1

6. **Your company would benefit from an Environmental Diploma/Certificate which is valued by international and domestic customers.**

0: Don't know 1: Disagree 5: Agree	
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Give a number from 5 to 1

Appendix IV: List of Interviews

Name	Represents	Type of interview	Date
Per Garvell	LIFT Incubator	In person	09.08.2011
Rickard Mosell	IDEON Innovation	In person	08.07.2011
Ingrid Bohlin	Gothenburg Environment Diploma	On phone	05.08.2011
Linus Wiebe	LU Innovation	In person	03.08.2011
Karl-Erik Grevendahl	IDEON Lightfoot Academy	In person	01.08.2011
Richard Wheeler	Kent Science Park	On phone	21.07.2011
Fredrik Åkesson	IKANO	In person	11.07.2011
Cecilia Larsson	Wihlborgs	In person	31.08.2011
Natalie Kikken	Australian Technology Park	Via email	07.07.2011
Joakim Iliste	Miljöstegen	Via email	04.07.2011
Maria Säterström	IDEON Center	In person	04.07.2011
Christian Owe	Ekocentrum	On phone	30.06.2011
Aino Sipilä	Lahti Science and Business Park	Via email	25.07.2011