

Bachelor thesis

An analysis of the extent to which sustainability projects in the Netherlands can serve as inspiration for a Cradle to Cradle project in Bielefeld

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Declaration of own work

Herewith I assure, that I wrote this bachelor dissertation independently. I did not copy from other work and I only used the sources and references indicated in the text. This dissertation is my own original work and has not been submitted or published before.

Jan-Philipp Jansen

08th June 2014

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Abstract

Implementing the *Cradle to Cradle* principles in the design of an industrial park is a challenging and complex task and requires a great amount of dedication of all parties involved. Due to the fact that *Cradle to Cradle* is a relatively new concept, only few experiences have been made with the design of buildings or industrial sites. This study was therefore set out to elaborate the extent to which existing sustainability projects in the Netherlands can serve as inspiration for a *Cradle to Cradle* project in Bielefeld. In order to do so, this study identified common obstacles and success factors of existing projects and applied them to the project in Bielefeld. In a first step, literature covering *Cradle to Cradle* in the built environment, industrial ecology, eco-industrial parks (EIP) and the design of these parks has been reviewed and analysed. By comparing the approach of *Cradle to Cradle* and the principles for the design of an EIP, overlaps were identified. The degree to which both approaches overlapped, confirmed the assumption that findings regarding drivers, limitations and success factors of EIP's can also be applied to *Cradle to Cradle* projects. Primary data were gathered through the conduction of in-depth interviews with experts on the field of sustainable industrial parks in the Netherlands. The interviewees were asked about their experience in the development of EIP's and the obstacles and success factors they came across. The analysis revealed that most projects faced *economic* or *technological uncertainties* and *time* restrictions as most challenging obstacles. The interviewees provided a range of success factors, such as good *communication*, accurate *economic predictions*, an *inventory* of the present situation, as well as continuous *evaluation*. On the basis of these findings the framework conditions of the project in Bielefeld were analysed and potential strengths, weaknesses, threats and opportunities identified. These findings were used to formulate recommendations and strategies to implement them. It was recommended to promote the overall positive framework conditions and to use the development of the sustainability strategy of the provincial government to provide the required incentives and subsidies. Further, the city should elaborate a letter of intent with involved companies to emphasise its long-term ambitions. Additional recommendations, like the early involvement of stakeholders and the development of a communication plan, were derived from the findings of the interviews and their contribution to the success of the project in Bielefeld was discussed. In conclusion, this research has proven that the present conditions are beneficial for the realisation of a *Cradle to Cradle* industrial park and that the city should be able to successfully realise this project.

Keywords: Cradle to Cradle, Eco-industrial Park, project management, success factors, sustainable urban spatial development, the Netherlands, North Rhine-Westphalia, Germany

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List of abbreviations

C2C	Cradle to Cradle
C2C-BIZZ	<i>Cradle to Cradle</i> Business Innovation & Improvement Zones (Project of EU)
CO ₂	Carbon dioxide
EIP	Eco-industrial park
ESCo	Energy Service Company
EU	European Union
INTERREG	Community initiative, which aims to stimulate interregional cooperation
LCM	Lifecycle management
NGO	Non-government organization
NRW	North Rhine-Westphalia
WCED	World Commission on Environment and Development

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1. Introduction

The *Cradle to Cradle* principles were developed in 1992 by Michael Braungart and William McDonough (Mulhall & McDonough, 2010). The awareness of these principles and the range of application continuously increase and more and more companies have entered the market with products designed according to the *Cradle to Cradle* principles. Several successful pilot projects have been realised (e.g. Ford motors, Rouge Car Plant, Michigan) and new projects have been launched worldwide.

1.1. Reason for investigation

In 2011 the European Union launched the project “*Cradle to Cradle* Business Innovation & Improvement Zones” (C2C-BIZZ), which is a part of the “INTERREG North-West Europe (NWE)” program. The C2C-BIZZ project aims at accelerating the application of C2C principles in business sites and the broader built environment throughout North-West Europe (Bielefeld, 2014). Since many authorities for regional planning and economics are not familiar with the principles of *Cradle to Cradle*, a transnational approach with a series of pilot projects, situated in a wide range of geographical, institutional and cultural conditions has been chosen (Bielefeld, 2014).

The city Bielefeld, located in the northeast of the province North Rhine-Westphalia, Germany, is one of nine partners joining in the C2C-BIZZ project from 6 north-western European countries. From 2011 to 31st December 2014 the project partners strive to implement a new form of commercial or business premises management and to develop financial, entrepreneurial and technical tools for planning, building and maintaining industrial site according to the *Cradle to Cradle* principles (Bielefeld, 2014).

Bielefeld decided to analyse and evaluate a sustainability-oriented commercial or business premises management and has set up a team of experts from local authorities, energy suppliers and economics. Among others, the environmental engineering company GERTEC, located in Essen, Germany, was hired to analyse a wide range of criteria for the application of *Cradle to Cradle* in industrial architecture and urban space management. Furthermore, the applicability of these principles and directives, regarding the industrial built environment, were analysed by GERTEC. The findings of that study will be summarised in a comprehensive guideline for the built environment in Bielefeld.

Additionally to the analysis carried out by GERTEC, the company wanted to gain an insight into potential risks and benefits that can occur during the design and realisation phase of an

industrial park. Since the park in Bielefeld can be build from scratch (greenfield), all measures that increase the efficiency of the project can be taken into account during the design phase. GERTEC therefore launched this study to investigate into the opportunities and risks that can derive from incorporating the implementation of circular energy, material streams and the formation of clusters in the overall *Cradle to Cradle* design.

1.2. Problem definition

The successful realisation of projects based on the *Cradle to Cradle* principles can be a crucial step in the development of resilient urban areas with a variety of functionalities. In the conducted research, GERTEC elaborated detailed guidelines for the implementation of *Cradle to Cradle* in the built environment for the project in Bielefeld.

On the field of architecture and mainly large-scale projects, as the one in Bielefeld, progress has been made by increasing energy efficiency or water and resource consumption. In Germany however, little recognition was paid to the implementation of closed circular systems within companies and especially across company boundaries. As the headline of an interview with Michael Braungart, published in 2012 by the German news channel “n-tv”, stated: “The concept of Cradle to Cradle could lead to the next industrial revolution, but Germany has its difficulties” (Poprawa, 2012). During the interview, Braungart explained that the principles of *Cradle to Cradle* were, in contrast to Germany, adapted much faster in the Netherlands and Belgium. According to Braungart, Germany is too involved in linear “take-make-waste” systems, which contributes to a continuous loss of resources. In contrast to the German conservative thinking, the Dutch are stated to have a more direct view on the needs of the future (Poprawa, 2012). Braungart and McDonough (2002), as well as the Ellen MacArthur Foundation (2014) proposed, that circular material and energy streams withhold a promising alternative to linear production systems. In the Netherlands, the *Cradle to Cradle* principles have been applied in a small number of projects. Other sustainability approaches, such as industrial ecology and the corresponding design of eco-industrial parks, have been known in the Netherlands for almost two decades and were implemented several times. In the Netherlands the framework conditions for the implementation of new sustainable concepts thus seem to be advantageous if compared to the situation in Germany.

The following research question narrows down the overall problem into one problem statement:

- To which extent can sustainability projects in the Netherlands serve as inspiration for a *Cradle to Cradle* project in Bielefeld?

The three following sets of research questions were derived from this problem statement:

1. What are common success factors of eco-industrial parks in the Netherlands?
 - 1.1. Which obstacles do these projects have to face?
 - 1.2. Are there common starting points of these projects, e.g. with regard to the initiator, involved parties and the framework conditions?
 - 1.3. What are common strengths, weaknesses, opportunities and threats of these projects?
2. Do the identified common problems and obstacles apply to the situation in Bielefeld?
 - 2.1. What are the framework conditions in Bielefeld?
 - 2.2. What are strengths, weaknesses, opportunities and threats of the project?
 - 2.3. Which of the identified success factors and obstacles are present?
3. How can the identified success factors be established in the project in Bielefeld?
 - 3.1. How were the obstacles overcome in the analysed projects?
 - 3.2. Can the driving forces for the solution be applied in Bielefeld?
 - 3.3. How can findings from eco-industrial parks be implemented in the design in Bielefeld?

1.3. Main topic areas, aims and objectives

The topics that were dealt with in this research are related to the disciplines of circular economies, architectural design and sustainable spatial design. Investigations have been made regarding the existing framework conditions in Bielefeld and findings of sustainability projects in the Netherlands. These disciplines share common grounds when combined in the design and realisation of *Cradle to Cradle* buildings and parks.

The main aims of this research therefore were:

- To analyse the existing framework conditions of the project in Bielefeld.
- To explore a series of eco-industrial parks in the Netherlands and identify common grounds of the design practices.
- To analyse existing paradigms of eco-industrial parks and *Cradle to Cradle* areas in the Netherlands and elaborate common obstacles and factors for their success.
- To identify which of the obstacles are likely to occur during the realisation of the project in Bielefeld and elaborate possible solutions to overcome them.

- To elaborate an overview of success factors of the project in Bielefeld, potential threats and recommendations to improve the framework conditions of the project.
- To elaborate ways to implement clusters in the design of the park in Bielefeld
- To draw a conclusion on the strengths and weaknesses of the project in Bielefeld and present recommendations to increase the success of the project.

1.4. Structure of research

The following research paper is divided into five parts. In chapter 2, the literature review will focus on the principles of *Cradle to Cradle*, existing directives for the built environment, the concept of industrial ecology and eco-industrial parks. It will further highlight common grounds of both approaches. Chapter 3 will then introduce the chosen research strategy of this study. Chapter 4 presents the results of the primary research, which will be evaluated and discussed in chapter 5. Chapter 6 draws the conclusion and provides recommendations for Bielefeld for further research.

2. Methodology

2.1. Research questions

The previously introduced problem statement of this research project will be answered with the help of the following three sets of research questions:

1. What are common success factors of eco-industrial parks in the Netherlands?
 - 1.1. Which obstacles do these projects have to face?
 - 1.2. Are there common starting points of these projects, e.g. with regard to the initiator, involved parties and the framework conditions?
 - 1.3. What are common strengths, weaknesses, opportunities and threats of these projects?

The first research question and the corresponding sub-questions aimed to gain an insight into the current situation of eco-industrial parks in the Netherlands. By elaborating factors influencing the progress of these projects and identifying factors for success the author gained an insight in the framework conditions of the projects and their influence.

2. Do the identified problems and obstacles apply to the situation in Bielefeld?
 - 2.1. What are the framework conditions in Bielefeld?
 - 2.2. What are strengths, weaknesses, opportunities and threats of the project?
 - 2.3. Which of the identified success factors and obstacles are present?

After having investigated the current situation of eco-industrial parks in the Netherlands and their success factors, the second research question aimed to elaborate the current framework conditions of the project in Bielefeld and their influence on the progress.

3. How can the identified success factors be established in the project in Bielefeld?
 - 3.1. How were the obstacles overcome in the analysed projects?
 - 3.2. Can the driving forces for the solution be applied in Bielefeld?
 - 3.3. How can findings from eco-industrial parks be implemented in the design in Bielefeld?

In order to be able to answer the problem statement of this research, the findings revealed through the first two research questions needed to be applied to the situation in Bielefeld. The third research question of this study therefore focused on identifying strategies used to overcome faced obstacles as well as the driving forces and stakeholders involved in the strategies. Moreover, these questions aimed to elaborate ways to combine the findings of the analysis of the framework conditions in Bielefeld and the analysed projects.

2.2. Research strategy

This research was based on both, desk and qualitative field research. Secondary data were gathered, analysed and evaluated in a literature review that covered books, journal articles, research papers and theses. Primary data were gathered by conducting interviews, which contained a range of questions regarding:

- The interviewee's experience in the development process of a project
- The obstacles and success factors realisation of the project
- The collaboration of companies and authorities

2.3. Selection of methods

2.3.1. *Research process*

As stated before, the first phase of this study was a literature review, covering books, theses, journal articles, reports and information gathered on websites like that of the C2C-centre. Following the first phase of this study, qualitative primary data were gathered through interviews, analysing common factors for success and obstacles faced by eco-industrial parks in the Netherlands.

2.3.2. *Research method*

Kumar (2013) presented a range of different qualitative research methods for the collection of primary data, such as case studies, focus groups or group interviews, participant observation, oral history and reflective journal log (p.155-158). For this research, the method of unstructured interviews was chosen as the most appropriate (Kumar, 2013, p. 177-178). This method can be subdivided into four types of unstructured interviews, such as in-depth interviewing, focus group interviews, narratives and oral history (Kumar, 2013, p. 192-193). In contrast to a structured interview, where the structure and content are set, an unstructured interview provides the opportunity to ask additional in-depth questions, specify aspects of interest and focus on identified findings. Therefore this method was chosen to be most appropriate. A number of key questions were prepared in advance, though the interview will be conversational. An overview of the interview questions can be found in the appendix of this research. Additionally, open-ended questions were used, giving the interviewees the chance and freedom to answer the questions in a way they thought was appropriated (Kumar, 2013, p. 184-186).

2.3.3. *Research strategy*

The researcher personally held the interviews and they were conducted on site or via telephone, depending on the interviewee's availability and preferences. The interviewees were chosen by the characteristics of the project they are or have been involved in. All interviews were recorded, if the respondents allowed it, or otherwise answers were written down manually.

2.3.4. *Population and sample*

The population of this research was based on experts from the field of management and project design, who have gained experience either in projects with a *Cradle to Cradle* background or who were involved in the design and realisation of an eco-industrial park. The interviews were conducted in the Netherlands and the research population was thus limited by the boundaries of the country. In qualitative research, information is gathered until the researcher reaches a point of saturation (Kumar, 2013, p.247-248). This applies to situations where data are collected on a one-to-one basis and, hence, applied to the strategy of this research. The number of interviewees was thus determined by the expertise and the amount of information provided by each one of them. Kumar (2013) has identified four sampling methods for qualitative research, namely purposive, expert, accidental and snowball sampling (p.247). This research made use of a combination of purposive sampling and snowball sampling. In judgemental or purposive sampling, the sampling group is determined by characteristics defined by the researcher. The range of interview partners focused on a group of experts, such as managers, designers and other decision-maker. Due to the high level of responsibility for the project, these experts were expected to have gained a high degree of hands-on experience throughout the development of their project. In snowball sampling a first group of interviewees is chosen, which are asked to identify potentially interesting people in their professional or private network (Kumar, 2013, p.245). The combination of purposive and snowball sampling provided the opportunity to create a new network of experts and reach an in-depth knowledge base. In order to find appropriate interviewees a desktop research was carried out, that analysed existing eco-industrial parks in the Netherlands. The interviewees were then chosen by their degree of experience and the researcher contacted them via their company email, to allow time to think whether or not they want to participate. With the email the interviewees were provided with a short introduction of the research, the estimated duration and the main interview questions that were discussed. At the end of each interview, the interviewees were asked to suggest a new interview partner from their network.

2.3.5. Data analysis

The interviews provided essential insights into the planning and realisation process of projects. Moreover, they delivered valuable information that contributed to answering the research questions and therewith the problem statement. As it became evident that most interviewees did not read the previously provided information or were not able to recall at the time they were interviewed, each interview began with a short introduction of the research and was followed by a conversational interview. During the interviews the researcher used the prepared interview questions as a checklist. Afterwards, the researcher transcribed the interviews and sent a copy to the interviewees to confirm their accuracy. The findings of the interviews were analysed according to the methodology introduced by Kruse (2008) and Kumar (2013). From the available methodology, a content analysis, divided into three steps, was chosen to be most appropriate. This analysis was carried out manually and included the following steps.

Firstly, the main themes that emerged from the transcribed interviews were identified. As this research aimed to identify common obstacles and problems, it was important to analyse the interviews to determine frequently occurring aspects as well as possible similarities in the chosen strategies. In this study, themes therefore were quantified by frequency of occurrence (Kumar, 2013).

The second step in the process was the classification of the responses. As discussed by Kruse (2008) the identified main themes of the given answers must be condensed into a smaller range of subjects and this step focused on subsuming them. For example: All answers that referred to time related obstacles were summarised in the main theme *time*.

The third step was the integration of the classified themes and responses in the research report (Kumar, 2013, p. 318). The most frequent answers and themes were discussed and strategies and success factors were introduced.

After having analysed and discussed the findings, a PESTEL analysis of the project in Bielefeld was carried out. As described by Johnson, Scholes and Whittington (2008), a PESTEL analysis is designed to analyse the macro-environment of a company. In this study the PESTEL analysis was used to analyse the framework conditions and determine factors that could have an impact on the development of the project in Bielefeld.

On the basis of this broader analysis of the macro-environment, a SWOT analysis was carried out. A SWOT analysis, as defined by Johnson et al. (2008), summarises the strengths, weaknesses, opportunities and threats of a company and was used in this research to identify strengths, weaknesses, threats and opportunities of the project.

In a last step, the findings of the PESTEL and SWOT analysis were condensed in a TOWS matrix. As defined by Johnson et al. (2008), a TOWS matrix is derived from the results of the SWOT analysis and highlights the strategic options of a company, taking into account internal and external developments. On the basis of the TOWS matrix and the findings of the interviews, a list of recommendations for the project in Bielefeld was elaborated.

3. Literature review

This research is divided into several consecutive phases, of which the first phase consists of a literature review. During this phase, relevant findings on the field of sustainable architecture and urban landscape design according to the Cradle to Cradle principles were gathered and summarised. Furthermore, the principles of an eco-industrial park were elaborated, methods for the design introduced and common grounds with Cradle to Cradle identified.

3.1. Cradle to Cradle

The World Conservation Strategy, published in 1987 by the World Commission on Environment and Development (WCED) and commonly known as the Brundtland report, first defined the term sustainability as to “meet the needs of the present without compromising the ability of future generations to meet their own needs”. This report called for a more considered use of resources and shifted the focus towards making companies accountable for their environmental costs (Roberts, 1994). In 1992, only five years after the report of the WCED was published, Braungart and McDonough proposed the basics for the development of the *Cradle to Cradle* principles (Westerlo, Halman & Durmisevic, 2012).

As stated in the report published by the World Resource Institute in Washington D.C. (WRI) in 2000, energy and material use is expected to threefold over the next 50 years, due to an increase of the world's population by 50% and sustained economic growth (Matthews et al., 2000). Unless the predicted economic growth can be substantially decoupled from resource use and waste generation, environmental pressures are stated to increase rapidly (Matthews et al., 2000). An increased efficiency in material use could contribute to a sustained economic growth. Though many European countries have achieved significant reduction in waste production, sustainability has only just been reached (Braungart & McDonough, 2003). Additionally, Kumar and Putman (2008) stated that “as third world countries develop and consumption increases, raw materials will be in short supply” (as cited in Kumar & Putman, 2008). In their recently published report, the Ellen MacArthur Foundation (2014) acknowledged the topicality of these findings and stated that the desired continuous generation of wealth will require new industrial models, such as the implementation of circular material or energy streams, which are less dependent on primary energy and material supply. The positive agenda of the *Cradle to Cradle* approach focuses on the design of these circular streams (“Waste=Food”) and thus provides a potential solution to the outlined problems (Braungart & McDonough, 2002).

3.1.1. *The principles of Cradle to Cradle*

The two pioneers Michael Braungart and William McDonough proposed the positive agenda of *Cradle to Cradle* in the 1990s. The underlying principles can be narrowed down to three defining principles. Inspired by nature's nutrition cycles, Braungart and McDonough (2002) defined the first principle: "Waste = Food". All human made materials, products or buildings should be designed in a way that, after their use, all parts can re-enter one of the two defined metabolisms. Each product or material will cycle either in the *biological metabolism* or the *technical metabolism* (Mulhall & Braungart, 2010). A product designed as part of the *biological metabolism* must therefore be biodegradable and can return in nature's cycles to provide nutrients for plants and organisms or restore soil fertility (Braungart and McDonough, 2002). The second metabolism is the *technical metabolism*, which mirrors the biological metabolism and aims to create a cycling material stream of high quality technological products, which provide a source for new products after their service life (Mulhall & Braungart, 2010).

The second principle of *Cradle to Cradle* is "Use current solar income" (Braungart & McDonough, 2002). A building designed according to this principle thus uses the current solar income to cover its energy demand and, if possible, even generates more energy than it requires (Braungart & McDonough, 2002). Other forms of renewable energy, such as wind, geothermal, hydropower and bioenergy are also applicable, as long as no adverse effects occur (Mulhall & Brangart, 2010).

The third basic principle is "Celebrate diversity" (Braungart & McDonough, 2002). Inspired by nature's healthy and highly complex ecosystems, the *Cradle to Cradle* principles strive to respect, celebrate and thereby stimulate the cultural and ecological diversity. This should be reflected in the design of products as well as urban development and architecture.

Additionally to the three basic principles of *Cradle to Cradle*, the approach consists of the "positive agenda" and introduced the idea of an eco-effective system (Braungart & McDonough, 2002). The positive agenda of *Cradle to Cradle* aims at focusing on the increase of positive characteristics of products and buildings and thereby decreasing their negative impact. In this context, the design of an eco-effective system is introduced. In contrast to eco-efficiency, where the main goal is to reach the highest possible level in for example waste prevention, the eco-effective approach aims to eliminate the idea of waste and to implement circulating streams of materials.

3.1.2. Definition of a Cradle to Cradle building

In the context of the principles of *Cradle to Cradle* and with regard to the Hannover Principles, the Floriade Venlo Principles and more recently the Almere Principles, Mulhall and Braungart (2010) gave a definition of a Cradle to Cradle building:

“A Cradle to Cradle building contains measurable elements that add value and celebrates innovation and enjoyment by: measurably enhancing the quality of materials, biodiversity, air and water; using current solar income; being deconstructable and recyclable and performing diverse practical and life-enhancing functions for its stakeholders” (as cited in Mullhall and Braungart, 2010).

3.1.3. Principles for the built environment

Already in 2000, McDonough wrote the Hannover Principles in order to provide guidance and advice for the construction and design of the world expo2000. Several years later, this guideline was used as an inspiration for the development of a series of projects, such as the principles defined by the city Almere in 2008 and later by the city IJburg (2009), the developments in Venlo (2009), as well as the area development projects for the Floriade2012 and the Four-Leaf Clover in the province of Limburg (2008). In 2010 Out, Haane, Levels, Albering & Ouwehand analysed the influence of the *Cradle to Cradle* principles on these projects and concluded that the first (“waste=food”) and second principle (“use current solar income”) were mainly translated into general goals and measures. Two examples are the implementation of closed material or water flows within the area in order to create cycling streams and the use of renewable energy (Out et al., 2010). The third principle (“celebrate diversity”) was used to incorporate specific local conditions in the design and development of the project.

Following the analysis of Out et al. (2010), Westerlo et al. (2012) translated the three basic principles of *Cradle to Cradle* into a series of guidelines for the built environment. Aiming at a simplification of the implementation process, Westerlo et al. (2012) elaborated aspects that should be considered for the application of the *Cradle to Cradle* principles. According to Westerlo et al. (2012), each product needs to be analysed according to the *Cradle to Cradle* Design Protocol and have a defined quality throughout use and recovery. The use of renewable or recycled materials is thus only desirable if the product has been analysed and the impact on user and environment is known (Westerlo et al., 2012). Furthermore, a building should measurably enhance air and water quality of its surrounding environment. With regard to the second principle of *Cradle to Cradle*, the elaborated aspects state that several forms of renewable energy should be considered to meet the building’s energy demands. In cases where the local conditions in combination with the available technologies cannot sufficiently

meet these demands, the opportunity should remain to integrate them in the future (Westerlo et al., 2012). Furthermore, the building should be designed in a way that supports an increased diversity of species and demonstrates conceptual diversity by focussing on the beneficial effects and features of a building and by integrating innovative elements. A building should thus measurably increase the quality of its surroundings.

Next to the desired aspects derived from one of the three principles of *Cradle to Cradle*, Westerlo et al. (2012) identified additional aspects that are important for the realisation process. First of all, reverse logistics should be taken into account, which has been analysed and described by Kumar and Putman in 2008. Furthermore, a material pool should be developed with diverse industries involved. The last aspect identified by Westerlo et al. (2012) is a “design for disassembly” that should be applied to the building to make it adaptable during its use-time and the materials reusable afterwards.

Concluding, the principles of *Cradle to Cradle* provide an approach to eliminate waste in all of human’s production processes, stimulate the use of renewable energy, as well as to integrate diversification of for example society and production. Since the principles of *Cradle to Cradle* were proposed, a wide range of research has been carried out, analysing and further developing ways of application. With regard to the building industry, many theoretical steps have been taken to implement *Cradle to Cradle* and attempts have been made to design a *Cradle to Cradle* building. However, as stated by Mulhall and Braungart (2011), a building fully designed according to the principles of *Cradle to Cradle* does not exist yet.

3.2. Sustainable industrial parks

Apart from the *Cradle to Cradle* principles, a series of approaches has been introduced, which focus on the design of sustainable industrial parks that measurably decrease the impact on their surrounding environment. In this chapter, a number of definitions will be discussed and their applicability for this study will be elaborated. Furthermore, design approaches will be introduced and common grounds of an EIP and the principles of *Cradle to Cradle* will be explained.

3.2.1. Definition of industrial ecology

The concept of industrial ecology was first discussed by Frosch and Gallopoulos in 1989. They defined an industrial ecosystem as a system where:

“...the consumption of energy and materials is optimized, waste generation is minimized and the effluents of one process (...) serve as the raw material of another process” (Frosch & Gallopoulos, 1989; as cited in Heeres et al., 2004).

A system designed according to this definition thus stimulates a more efficient use of energy and resources and the implementation of closed material cycles. Roberts (2004) stated that industrial ecology seeks to improve the overall quality of the environment, while satisfying economic demand. The principles of industrial ecology as stated by Roberts (2004) comprise eight steps. Firstly, the engagement in partnerships should be promoted. Consequently, industries should be located strategically in order to concentrate by-products and waste streams. Industries that can benefit from these products should be co-located accordingly. By creating opportunities to recover energy and material flows and to achieve cleaner production technologies, value can be added and synergies can evolve. Infrastructure is recognised as an essential element of industrial parks and therefore the implementation of “smart infrastructure” that provides the opportunity for the park to grow, should be applied. Innovation should be encouraged by supporting industrial policies and incentives, as well as collaborations between companies for the design of new and improved products. Lastly, enterprises that are involved should demonstrate commitment to their sustainable development (Roberts, 2004).

3.2.2. Life cycle management

As stated by Heers, Vermeulen and Walle (2004), lifecycle management (LCM), which is also known as integrated chain management, is a concept comparable to the concept of industrial ecology and has been introduced simultaneously. By promoting the closing of material cycles and by taking responsibility for the environment beyond company boundaries, LCM proposes that measures are taken in cooperation with multiple companies (Heers, et al., 2004). The definition used in this study was proposed by the Dutch Environment Ministry, which defined lifecycle management as:

“... the management of material flows, in chains caused by social activities, with respect to the environmental space boundaries” (Vermeulen, et al., 1995).

Additionally, Vermeulen, Kok and Cramer (1995) put forward three principles that the management of material streams should meet to comply with the definition above. Firstly, the use of non-renewable resources should be reduced and the use of renewable energy be stimulated. Secondly, a balance should be held of one resources used and the amount of

that resource being produced in a year. Thirdly, all material should be kept in material cycles as long as possible, unless adverse and undesired environmental impacts are caused.

3.2.3. Definition of an eco-industrial park

The concept of an eco-industrial park evolved from industrial ecology and the design of industrial eco-systems. The concept is also referred to as an eco-park or a sustainable business site (Pellenbarg, 2002). An industrial park can be defined as:

“...a large tract of land, sub-divided and developed for the use of several firms simultaneously, distinguished by its shareable infrastructure and close proximity of firms” (Peddle, 1993; as cited in Côté and Rosenthal, 1998).

An eco-industrial park is the application of the system-oriented approach of industrial ecology on a meso- or macro-level. This means that an EIP can be designed on a local and regional level (Roberts, 2004). Literature provides a range of definitions of an EIP and therefore only the most commonly used ones will be discussed. Martin et al. (1996) suggested a definition of an EIP in 1996, which defines an EIP as:

“A community of businesses that cooperate with each other and with the local community to efficiently share resources (information, materials, water, energy, infrastructure and natural habitat), leading to economic and environmental quality gains, and equitable enhancement of human resources for the business and local community” (as cited in Martin, et al., 1996).

In their *“Fieldbook for the Development of Eco-Industrial Parks”*, Lowe, Moran and Holmes put forward a definition of an EIP as:

“...a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in the management of environmental and resources issues including energy, water and materials. By working together, the community of businesses seeks a collective benefit that is greater than the sum of the individual benefit each company would have realised if it optimised its individual interests” (as cited in Lowe et al., 1996).

Côté and Cohen-Rosenthal (1998) proposed another commonly used definition of an EIP. They defined an EIP as:

“...an industrial system, which conserves the natural and economic resources; reduces production, material energy, insurances and treatments costs and liabilities; improves operating efficiency, quality, worker health and public image; and provides opportunities for income generation from use and sale of wasted materials” (as cited in Cote & Cohen-Rosenthal, 1998).

All three definitions have in common, that an EIP is based on the collaboration of businesses in order to minimise environmental harm, to increase the efficiency of resource consumption, and increasing economical benefits for the park and its surroundings. In this study the researchers defined an EIP as:

...a community of manufacturing and service businesses, which strives to minimize its impact on the environment by efficiently sharing resources, such as renewable energy, infrastructure, information and (waste-)materials. By collaborating, the community of businesses seeks a collective environmental and economical benefit that is greater than the individual benefit each company could have realized by following individual interests.

3.2.4. Designing an eco-industrial park

The concept of an eco-industrial park has been defined for almost two decades of research and pilot projects. Roberts (2004) stated that a primary aim of an EIP is to encourage collaborations. Heeres et al. (2004) identified a series of stakeholders of whom active participation is required:

- “Public sector stakeholders from local, regional and national government agencies;
- Representatives of local companies and potential future tenants in the EIP;
- Leaders in the industrial and financial community;
- Local chamber of commerce;
- Labour representatives;
- Educational institutions;
- Practitioners with the full complement of capabilities needed in the project: architecture, engineering, ecology, environmental management, and education and training; and
- Community and environmental organizations.”

In their research Heeres et al. (2004) emphasised that, after participation is assured, the first essential task is to gather information about the located or desired companies, regarding resource consumption, products and future plans. In the following design phase of an EIP the formation of clusters can lead to a series of benefits for the participating companies. The formation of clusters describes a concept focussing on functional linkages and interdependencies of companies (Roberts, 2004). Implementing clusters can lead to a range of economical benefits as identified by Gevaert (2005).

As stated by Gevaert (2005), the overall economical benefits, a beneficial market position compared to competitors, the creation of a positive image and better working conditions as major driving forces behind the implementation of clusters.

In order to design clusters, Liwarska-Bizukojca, Bizukojcb, Marcinkowskic and Doniec (2009) proposed a classification of businesses for the design of an eco-industrial park. Inspired by the principles of industrial ecosystem, members of an EIP are seen as living organisms that need “food” (organic or inorganic material), energy and have industrial metabolisms (Liwarska-Bizukojca et al., 2009). Industrial enterprises are divided into groups of producers, consumers, decomposers and eury- and steno-enterprises with different material and energy flows. In this concept, a producer is characterised by producing goods of market value, which are necessary to satisfy the demands of the market. The desired products made from raw- or recycled materials, energy and water. Nevertheless, additional by-products can be produced as well. Depending on the degree to which processed materials are needed in the industrial metabolism, producers are categorised as primary, secondary or tertiary producers. Liwarska-Bizukojca et al. (2009) also introduced a second type of producer, the power plant. The production of energy is a crucial step in the balancing of an EIP as most producers depend on it. The second group of introduced by Liwarska-Bizukojca et al. (2009) is the group of industrial consumers. In contrast to natural ecosystems, an industrial consumer not only receives component for further processing, but also requires energy to do so. To this group belong trade and service enterprises and do not produce any material goods, apart from waste. Industrial decomposers are the third group proposed and are characterised by

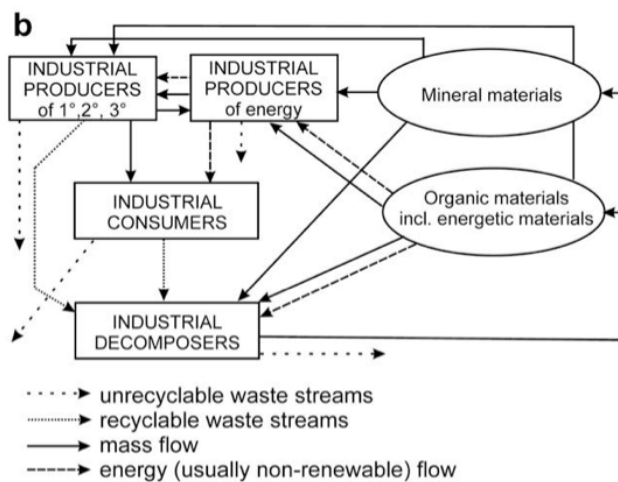


Figure 1 – Basic flows of mass and energy in an industrial ecosystem (Liwarska-Bizukojca et al., 2009)

transforming, recycling and neutralising by-products formed by producers and consumers in the industrial ecosystem. The last group of eury- and steno-enterprises, are enterprises that manufacture goods required by a wide (*eurus*) or narrow (*stenos*) range of companies. Hence, a eury-enterprise manufactures a product required by many or all companies of the EIP. This type of enterprises is also referred to as Anchor Company. In contrast, a steno-

enterprise is highly specialised and its products are therefore used by a limited number of companies.

Applying this theoretical allocation to a series of existing eco-industrial parks, Liwarska-Bizukojca et al. (2009) determined the minimal conditions for the design of an EIP as the necessity to have at least one producer or decomposer involved in an EIP to be able to create synergies.

It can be concluded that the design of an eco-industrial park requires active participation of a range of stakeholders. Additionally, the collection of information regarding the participating companies is an important step in the design phase. For the design of an eco-industrial park, a methodology derived from nature's ecosystems has been introduced. Moreover, the minimal conditions for the design of synergies were defined.

3.2.5. Drivers and limitations of eco-industrial parks

In 2002 Pellenburg carried out an extensive field study in the Netherlands, analysing factors of success and failure of eco-industrial parks. The most crucial success factor that became evident is the collaboration between companies and their cooperation with local government. As an eco-industrial park can be considered as a form of cooperation, the quality and intensity of this cooperation is identified to determine the results of a project (Pellenburg, 2002). Moreover, Pellenburg stated that the initiative for the design of an EIP should start from the companies involved and not from government. However, Gevaert (2005) stated that governmental support through subsidies and knowledge transfer are of great importance. Another aspect determined by Heeres et al. (2004) is, that a central company or anchor company should lead the cooperation process and coordinate the cooperation. Nevertheless, Dekker (1997) stated that no direct competition between involved companies should occur.

Tudor, Adam and Bates (2007) identified financial benefits as the primary driver for eco-industrial parks. Firstly, the overall costs for waste treatment and disposal can be reduced and companies processing these residues can gain access to cheaper energy and material supplies. Secondly, as the international market is under continuous change, an increase in competition and growing consumer demands are crucial driver for the design of an EIP and the collaboration of companies. Among Dutch SME's (small and medium sized enterprises) innovation opportunities, the ability to increase product quality and opportunities to enter new markets were additional drivers for the design of eco-industrial parks.

Besides common drives and benefits of EIP's, literature revealed a range of limitations and problems that need to be overcome. Pellenburg (2002) stated that the absence of a series of the identified success factors, such as the creation of trust, stakeholder involvement governmental support and good monitoring, could be considered as critical limitation and

hamper the success of a project. Additionally, a fluctuation in material, water and energy supplies exchanged between companies, as fundamental element of an EIP, is identified as a crucial risk (Pellenbarg, 2002). Heeres et al. (2004) brought forward further limitations. Firstly, the exchange of resources could technically or economically be unfeasible. Secondly, a lack of information and legal regulations can hamper the design of synergies. Lastly, the intended change or cooperation between companies might not comply with the current organisational structure.

3.2.6. *Common grounds*

As stated by Braungart and McDonough (2002), the *Cradle to Cradle* approach tries to reach true sustainability by eliminating waste. Through the design of intelligent products and by carefully choosing raw materials with beneficial characteristics, circular material streams can be designed, supporting either a biological or technological metabolism (Braungart & McDonough, 2002). According to Braungart and McDonough (2002), striving to increase eco-efficiency is a fundamentally wrong approach, since it aims to decrease the negative environmental impact instead of increasing the positive aspects. Westerlo et al. (2012), however, acknowledged the eco-effective approach as an essential step in the transition towards the design of an eco-effective system as described by Braungart and McDonough (2002). Eco-industrial parks, as defined above, strive to minimise the environmental impact of the park and can thus be seen as a first step in the transition process. By matching energy and/or material needs of companies located within the area, authorities and private enterprises aimed to reduce energy and material cost. Additionally, the implementation of circular energy and material streams is a fundamental principle of an eco-industrial park. In the following, common grounds of the approach of eco-industrial parks and the *Cradle to Cradle* principles will be identified.

Comparing the first principle of *Cradle to Cradle* ("Waste=Food") with the defined aims of an eco-industrial park, it can be concluded that both approaches strive to minimise and ideally eliminate the production of waste. By closing cycles along the production chain and keeping all non-hazardous materials in the system as long as possible, the overall environmental impact of an industrial park is aimed to be reduced (Vermeulen et al. 1996; Braungart & McDonough, 2002). When designing an industrial park according to the *Cradle to Cradle* principles, however, two additional aspects need to be taken into account. Firstly, the positive agenda of *Cradle to Cradle* aims to define as many positive characteristics as possible instead of focussing on the minimisation of negative aspects. Secondly, all materials used need to comply with the *Cradle to Cradle* Design Protocol and can thus re-enter either the

biological or *technological metabolism*. Waste is therefore not only minimised but fully eliminated.

As the development of EIP's evolved, the implementation of renewable energy was recognised in the design. With regard to the *Cradle to Cradle* criteria for the built environment elaborated by Mulhall and Braungart (2010), it can be concluded that both approaches seek to implement renewable energy supply. The literature reviewed on the design of EIPs, however, indicated that the implementation of renewable energy is not an essential element. Energy can be derived from waste incineration or other non-renewable sources as well (Heeres et al., 2004; Liwarska-Bizukojca et al., 2009)

The third principle of *Cradle to Cradle* strives to incorporate cultural and ecological diversity in the design of an industrial park. This specific aspect has not yet been implemented in any of the found approaches of an EIP. However, through the process of designing businesses cluster and the need to prevent internal competition within an EIP (Dekker, 1997) diversity of companies can be achieved. With regard to the design of an EIP as proposed by Liwarska-Bizukojca et al. (2009), this diversity becomes necessary due to possible, competitive needs of businesses.

The comparison of the principles of *Cradle to Cradle* and the principles for the design of an EIP lead to a series of overlaps. Firstly, both approaches aim to decrease the production of waste by integrating circular material and energy streams. Secondly, both approaches aim to implement renewable energy in their design, however, in the design of an EIP this is less emphasised. Lastly, the implementation of diversity can be found in both approaches, even though it is not directly addressed in the principles of eco-industrial parks.

In conclusion, the design of an EIP has been developed through exhaustive research in the past two decades. A range of guidelines was provided by several studies (Côté and Rosenthal, 1998; Heeres, et al., 2004; Tudor et al., 2007; Liwarska-Bizukojca et al., 2009) and primary data were gathered through pilot projects all over the world (Pellenbarg, 2002; Roberts, 2004; Heeres et al., 2004). Important elements of an EIP are clusters of companies that contribute to the formation of synergies. Dividing located or desired companies into groups of producers, consumers and decomposers, can contribute to an effective design of an industrial ecosystem. By comparing the approach of *Cradle to Cradle* and the principles for the design of an EIP, many overlaps were identified. It can thus be assumed that findings, regarding drivers, limitations and success factors of EIP's, can contribute to increase the effectiveness of the design and realisation of *Cradle to Cradle* industrial parks.

4. Research results

The results of the interviews revealed a series of factors that influenced the development of sustainable industrial parks in the Netherlands. In the following, the results of the conducted research will be presented in detail. Moreover, the current framework conditions of the project in Bielefeld will be analysed and recommendations for the project design will be outlined.

4.1. Evaluation of interviews

The interviews revealed a series of obstacles that occurred during the design and realisation phase of sustainable industrial parks in the Netherlands. Moreover, success factors and strategies were identified, that were applied to overcome these obstacles and led to a successful realisation. In the following, the findings will be introduced and in a second step, success factors and recommendations will be discussed.

4.1.1. Initiatives

The interviews revealed a range of starting points for the design of an eco-industrial park, which can be categorised into two groups. A first starting point is characterised by an *anchor company* that wants to expand and therefore initiates the development of a new and sustainable industrial park. The newly developed premise can be planned individually and aligned to the needs of the company. This approach, however, often requires the availability of a *greenfield* area, where the park can be designed and build from scratch. The second and more common starting point is an EIP that evolved from existing local cooperation between companies. As stated in the interviews, municipalities often strive to decrease their CO₂-footprint and support sustainable development. Local initiatives become increasingly interesting to work with and the municipalities mostly facilitate the development and expansion of the small-scale synergies. The initiatives for the design of eco-industrial parks can thus come from different parties. Regarding the area, two starting points, *greenfield* and *existing park*, have been identified. However, all analysed projects showed modifications of these starting points and hence are future projects expected to develop individual initiatives, depending on the given situation.

Analysing the initiation of eco-industrial parks and their development, a range of stakeholders was identified, of whom active participation is required throughout the process:

- *Municipalities*, which initiate and/or coordinate the project and the communication among involved parties
- *Provincial governments*, which often have a high level of expertise and can provide legal support as well financial support through subsidies
- *Experts* (e.g. architects, manager, NGO's), which provide knowledge and can coordinate or facilitate the communication and development of the project
- *Universities and research institutes*, which can provide or generate knowledge
- *Located companies*, which are the core of each industrial park and a necessity for success.

The elaborated list of participating stakeholders provides an overview of the most important stakeholders that had a vital impact on all analysed projects. As the findings regarding the initiation of an eco-industrial park already revealed, all analysed parks were developed from individual starting points and have chosen their own strategies. Therefore, new projects may require additional participation from other parties as well.

4.1.2. Common obstacles

One common aspect that was mentioned throughout all interviews was that the implementation of new technologies comes with a certain degree of uncertainties. These can be categorised in *economic* and *technological uncertainties*.

As the development of an EIP requires the collaboration of different companies, which focus on individual profits, *economic uncertainties* can be important limiting factors and obstacles. As stated by Mr Rentrop, a program manager of *Port Moerdijk* in Brabant, many companies expect a rate of return of up to 16% on their investments, which can often not be guaranteed in these projects. As stated by Mrs Demandt, a project manager at *Beatrixhaven* and head of the NGO *Parkmanagement BV*, other potential obstacles can derive in projects where the necessary data for calculating expected benefits and the feasibility of technologies are not available or only insufficiently. In these situations companies are likely to decide against the modernisation. However, *economic uncertainties* can also derive from external factors, such as the economic crisis of 2008 and 2009. According to Mrs Demandt the crisis led to a low willingness to invest in modernisations and thereby reduced the achievable scale of the projects. Another obstacle faced by projects is the missing possibility to pre-finance the development of a project concept and contracts. As stated by Mr de Bruijn, a waste-stream agent of the province Brabant, financial institutions are only willing to finance the actual building process of a project.

As the experience with many sustainable technologies, such as the creation of synergies and the re-use of waste streams, are still limited, *technological uncertainties* are another obstacle faced. Not only can this affect the duration of the actual construction time of an EIP, but also lead to unexpected difficulties and delays. One example was put forward by the coordinator of the project *De Meerpal* in Utrecht, where geothermal heat pumps were built to supply an area of approximately 17 hectare. He said that: “...na het aanleggen van de 3 leidingen waren tijdens aanvang van het systeem al twee buiten werking (after the pipelines for the heat pumps had been built, two of the three were not working at commissioning).” As this technology has not been applied at this scale before, the implementation proved to be difficult. Moreover, a lack of alternative heat supplies led to a partial failure of this project.

Additionally to the obstacles mentioned before, *time* was identified as an important factor. The reason for this is that the planning and design phase of eco-industrial parks often require several years of preparation. B. Krikke, manager of *Ecomunitypark*, gave the following example: The development of an Energy Service Company (ESCO) proved to be more difficult than expected (*technological uncertainty*) and it was therefore decided to postpone the implementation. The coordinating party decided that the available amount of time was insufficient and therefore the projects did not reach all of the anticipated goals. The factor *time* can consequently be an obstacle, if not scheduled correctly.

4.1.3. Success factors

After having identified common obstacles and problems, promising strategies and success factors will be introduced. The interviewees were asked several questions about perceived success factors of their projects and strategies chosen to overcome obstacles.

Firstly, *communication* was identified as an essential factor for success. As stated by Mr Geerstes, project manager of *Biopark Terneuzen*, all directly or indirectly involved stakeholders should be approached in an early stage and kept involved throughout the progress of the project. As local authorities have to approve e.g. future building projects, an early communication of intentions can be an advantage. As said by Mrs Demandt and confirmed by Mr Geertse, the communication should be organised by the project coordinator and regularly involve the participating companies.

Additionally to good communication, *economic factors* have an important influence on the development of an EIP. Located companies investing in a more sustainable production system take a financial risk (Mrs Demandt & Mr Rentrop). As stated by Mr Zwart, project coordinator of *De Meerpaal*, it is therefore important to provide *accurate predictions* of the

expected feasibility and rates of return. If the necessary knowledge is not yet available, a small-scale pilot project can be launched, implementing the new technology in one company of the park. Additionally, Mr Rentrop proposed, that the coordinating parties can create incentives and decrease the individual financial risk of the participating company by *providing guarantees* for the made investments. This, however, is only practical for small-scale projects, as it is often not the core business of the coordinator. Moreover, as stated by Mr Geertse, project manager of *Biopark Terneuzen*, companies should primarily make the investments in modernisations. Available subsidies or sureties should only be used to create additional *incentives*.

The success of a project can be influenced even before it was launched. As said by J. Rentrop, a project should *start with an inventory* of the participating companies and the present situation. Since the interdependence of participating companies is obligatory over a long period, it is vital to assure certain standards before developing a project concept. In order to prevent the project from losing track, the *continuous evaluation* of the progress is an essential success factor. As stated by Mr Geertse, the goals of large-scale projects tend to change during the development process and often need to be adapted to the given situation. It is therefore important to continuously evaluate this progress and thereby identify potential problems in an early stage (Mrs Demandt).

As said by Mr Rentrop, a project manager of *Port Moerdijk*, explicit agreements and *legal coverage* for created synergies and cooperations are of great importance, as companies are interdependent for a long period. A well-structured *legal framework* is thus an important success factor for a long-term cooperation.

The last mentioned success factor was the availability of *knowledge* and experience. Mr Zwart proposed, that parties planning on launching a project should always first analyse existing projects. If the required knowledge is not available at the coordinating party, external experts should be hired or nearby universities or research institutes consulted to provide this knowledge (Mrs Demandt).

4.1.4. Additional results

As the project in Bielefeld is part of an INTERREG project of the European Union, the interviewees were asked additional questions about their experience with INTERREG projects and their recommendations for future participants. All interviewees stated that their experience was both positive and negative. Ms Demandt said, that her participation in an INTERREG project resulted in a large number of unpaid hours, which were caused by the

limitation of the project itself. As many partners from various countries participate in these projects, the EU has set a limit to the number of declarations that may contain mistakes. Declarations are revised by approving authorities and the funding for all projects is stopped if a certain percentage of false declarations is reached. Mr Geertse, a project manager of Biopark Terneuzen, put another negative aspect forward. According to him, the required administrative effort to receive payments from INTERREG project is only feasible for large-scale projects. Nevertheless, Mr Geertse stated that the planned expansion of the *Biopark Terneuzen* would not have been possible without subsidies from the EU and are attractive for such large-scale projects.

Having analysed the interviews, a number of common obstacles and success factors have been identified. The most challenging obstacles as perceived by the interviewees were *economic* or *technological uncertainties* and the restricted *time* available for the development of an eco-industrial park. A well-structured and coordinated *communication* was identified as an essential success factor. Additionally, a range of *economic factors*, such as *accurate predictions*, the creation of *incentives* and the allocation of *guarantees* for investments, were stated to be important for the success of a project. Other success factors were the conduction of an *inventory* and continuous *evaluation*, an adequate *legal framework* and the availability of *knowledge*.

4.2. Framework conditions

The interviews revealed a series of obstacles and success factors that influenced the development of existing eco-industrial parks in the Netherlands. These findings determined the focus of the PESTEL analysis, carried out for the project in Bielefeld. As common obstacles and success factors were identified, the analysis was set out to elaborate which of the identified factors were present in the given situation. Furthermore, the findings were used to determine the key drivers of the project.

4.2.1. Political

The political framework conditions for the project can be divided into three layers. Firstly, the local authorities, followed by the provincial government and the federal government. The local government is highly involved in the process of planning and designing a *Cradle to Cradle* industrial park and has chosen to participate in the C2C-BIZZ project of the EU

(Bielefeld, 2014). Moreover, the participation of municipalities and their cooperation with local businesses is an important element of the sustainability strategy of the provincial government of NRW (Land Nordrhein-Westfalen, 2014b). Already in 2009, the provincial government of NRW acknowledged the benefits of circular economies and set up an informative brochure for citizens and municipalities (Ministerium für Umwelt und Naturschutz, 2009). In 2010 the European Union launched the *Cradle to Cradle Network* as part of the INTERREG program. The goal of this project was to provide a platform to share experience with C2C, draw up action plans, establish links between governmental institutions and promote stakeholder involvement (European Union, 2010).

4.2.2. *Economic*

The province of North Rhine Westphalia still is the industrial core region of Germany and global companies as well as a large number of medium-sized businesses are located here. With the expansion of industrial parks, an extensive infrastructure was built (Land Nordrhein-Westfalen, 2014). Even though the economic crisis still has an impact on the economy of North Rhine-Westphalia, its current economic predictions estimate a 1.8% economic growth. Additionally, industrial enterprises and medium-sized businesses reported high requests and a good order situation (Land Nordrhein-Westfalen, 2014a). As stated by Xiao-di and Tie-jun (2000) the trend of green marketing and products has emerged since the beginning of this century and is estimated to be in the focus of international businesses for the next century.

4.2.3. *Social*

In 2011, the provincial institute for health and work of North Rhine-Westphalia predicted a decline in population of 4% till 2025. Additionally to the decline in population, the life expectancy estimated to increase, resulting in an overall increase of the population of NRW (Terschüren, 2011). In order to maintain social cohesion it is important to preserve, maintain and implement shared spaces and green areas, such as community gardens (Ministerium für Klimaschutz, 2014). Even though NRW is a traditional industry region, unemployment rates have been an issue for several years. In Mai 2014, the unemployment rate of NRW decreased to 8.3%, which is a medium to high rate if compared to the overall level in Germany (6.6%). In Bielefeld an average of 7.3% of the population was unemployed and at the same time 1.376 apprenticeship training positions were left open (Bundesagentur für Arbeit, 2014).

4.2.4. *Technological*

The development of industrial parks is known through a long tradition of industrial development in North Rhine-Westphalia (Land Nordrhein-Westfalen, 2014). Several institutes carry out research on the implementation of *Cradle to Cradle* in the built environment (Mulhall & Braungart, 2010). The translation of the *Cradle to Cradle* principles by Westerlo et al. (2012) introduced a first set of measures that facilitate the implementation process. The availability of *Cradle to Cradle* products increases proportionally to the increasing underlying knowledge. Databases as the one developed by the *Cradle to Cradle* Products Innovation Institute (2014), provide an overview of existing construction materials.

4.2.5. *Environmental*

As stated by the World Resource Institute in Washington D.C. (WRI) in 2000, energy and material use is expected to threefold over the next 50 years. Moreover, the availability of essential materials for the construction of large-scale buildings, such as sand for concrete, are already in short supply in parts of the world (The Economist, 2009). In order to sustainably work with nature's resources, the city Bielefeld has set up a successful pilot project in 1999. In cooperation with Dresden, Heidelberg and Nordhausen, an eco-budget plan was introduced, which aimed to continuously work with and portion the use of nature's resources (Bielefeld, 2014a). Additionally, the city engaged in a series of projects to contribute to a more sustainable future. Firstly, an action plan was set out in 2008, which aimed at decreasing CO₂ emissions by 40%, as well as increasing the use of renewable energy to 20% in 2020 (Bielefeld, 2014b). Further, the city participated in the European project Covenant of Majors, which is a collaboration of cities from various European countries and emphasises their key role in achieving sustainability goals (Bielefeld, 2014c). Further, the city has won the European Energy Award Gold in 2011 and increased its performance since (Bielefeld, 2014d). Lastly, the structural change in NRW is expected to cause a decline in available areas for the development of industrial parks (Land Nordrhein-Westfalen, 2014c).

4.2.6. *Legal*

In 2013 the provincial government of North Rhine-Westphalia made a cabinet decision to develop a sustainability strategy for the province (Land Nordrhein-Westfalen, 2014b). Core elements of this strategy are among others the protection of the climate, sustainable economies, the protection of natural resources, demographic changes, fair working

conditions, integration and intercultural work, social cohesion and collaboration and the sustainable development of cities and urban areas (Bundesregierung, 2014).

4.2.7. Key drivers

Having analysed the macro-environment of the project in Bielefeld, the key drivers were identified. In order to do so, the findings of the interviews were used to determine which of the present factors are expected to have the most substantial impact on the project. One example is the strong environmental commitment of the city. As the interviews revealed, a coordinating and actively participating municipality can be an important success factor for a project. The continuous ambitions are thus expected to be an important key driver for the project. All identified key drivers for the project in Bielefeld were summarised in table 1 below and will be described in the following.

Politic	Economy	Social	Technology	Environmental	Legal
C2C-BIZZ	Industrial core region		Increase of C2C materials	Strong environmental commitment	Sustainability strategy
Sustainability strategy NRW	Economic growth		Available knowledge	Scarcity of resources	
	Green trends in market			Structural change	
	Infrastructure				

Table 1 - PESTEL analysis, key drivers (own creation)

The identified key drivers will be summarised in the following:

- **C2C-BIZZ**

The INTERREG project of the European Union can provide financial support, as well as knowledge and a basis for to exchange experience.

- **Sustainability strategy NRW**

Depending on the outcome of the planned sustainability strategy for NRW, this strategy could have a significant impact on the implementation and development of sustainable productions system.

- **Industrial core region**

North Rhine-Westphalia has been and still is the industrial core region of Germany. A huge number of mid-scaled industries is located in this region, that are more likely to adapt the *Cradle to Cradle* principles to develop unique selling points and foster their market position.

- **Economic growth**

Even though the economic crisis has not yet completely been overcome, the predicted growth and the recovery of the market will lead to new investments and the expansion of located companies.

- **Green market trends**

The increasing awareness of the consumer and the overall trend for “green” products will require companies to adapt more sustainable productions techniques.

- **Infrastructure**

As the range of required products for the realisation of a *Cradle to Cradle* industrial park is limited and the material produced all over the world, the excellent infrastructure of the region contributes to the overall accessibility of these materials.

- **Increase of C2C materials & available knowledge**

As the knowledge about the *Cradle to Cradle* principles continuously increases and thereby the available assessed raw material, more and more companies develop products fully designed according to the Cradle to Cradle Design Protocol.

- **Strong environmental commitment**

As the city already participated in a series of projects to decrease its environmental impact, it has been shown that a continuous ambition for sustainability is present. Not only has the city won prizes for its project but it has also initiated sustainability projects as the eco-budget plan.

- **Scarcity of resources**

As recent documentaries confirmed, some essential raw material for the building industries have already become scarce goods. With future predictions for the developing countries, the worldwide availability of materials will drastically decrease and increase the need for circular resources.

- **Structural change**

The continuous expansion of the cities in NRW has led to the creation of “mega-cities” with extensive land consumption. An extreme example is the area covered by Dortmund, Bochum, Essen and Duisburg, where the borders of the cities are connected to each other. This trend requires the development of multi-purpose areas.

4.3. SWOT analysis

Having analysed the macro-environment of the project in Bielefeld and with the common success factors in mind, the key drivers for the project were identified. On the basis of these findings, a SWOT analysis will be carried out that will analyse strengths, weaknesses, opportunities and threats of the project.

Strengths (S)	Weaknesses (W)
Area available (Green field) Industrial core region High level of infrastructure Coordinating municipality Strong environmental commitment	Lack of knowledge with C2C Willingness for investments High investments and unknown rates of return Lack of experience (eco-industrial parks)
Opportunities (O)	Threats (T)
Shift of economic focus (green trends) Support of European Union (INTERREG) Sustainability strategy Economic growth Increase of C2C materials available Materials produced around the world	Unknown concept of C2C Costs and transport of available materials Inconsistent position of federal government Materials produced around the world

Table 2: SWOT analysis of C2C project in Bielefeld (own creation)

4.4. Recommendations for Bielefeld

In order to be able to answer the problem statement of this research, common grounds of the analysed projects and a *Cradle to Cradle* project were elaborated. It has been shown, that both approaches have overlapping goals. The *Cradle to Cradle* approach, however, was identified as being more strict and focussing on a broader range of aspects. On the basis of the analysis of the framework conditions and derived strengths, weaknesses, threats and opportunities, a TOWS analysis was conducted which will provide suitable recommendations for the project in Bielefeld.

	Strengths (S) Area available (Green field) Industrial core region High level of infrastructure Coordinating municipality Strong environmental commitment	Weaknesses (W) Lack of knowledge with C2C Willingness for investments High investments and unknown rates of return Lack of experience (eco-industrial parks)
Opportunities (O) Shift of economic focus (green trends) Support of European Union (INTERREG) Sustainability strategy Economic growth Increase of C2C materials available	SO options 1. Promote the promising framework conditions to start a pilot C2C project	WO options 1. Provide measures to support implementation through sustainability strategy
Threats (T) Unknown concept of C2C Costs and transport of available materials Inconsistent position of federal government Materials produced around the world	ST options 1. Develop supply systems 2. State intentions	WT options 1. Increase knowledge of C2C 2. Create incentives for the investments and instruments to facilitate pre-financing 3. Elaborate goals and binding agreements for the implementation of C2C

Table 3 - TOWS matrix for C2C project in Bielefeld (own creation)

4.4.1. Promote framework conditions

As the evaluation of the framework conditions has shown, the present framework conditions are beneficial for the launch of a *Cradle to Cradle* industrial park. The available area, highly developed infrastructure and the long industrial tradition of the region in combination with the predicted, stable economic growth and the steady increase of available building materials provide a fertile ground.

4.4.2. Provide support

The planned sustainability strategy for North Rhine-Westphalia involves the collaboration of multiple ministries of the provincial government and was set out to be completed in 2015/16. As it will be elaborated in dialogue with local authorities and other stakeholders, the city should use its influence on the provincial authorities. Moreover, the city should emphasise the necessity to implement measures to facilitate and support the implementation of *Cradle to Cradle* through pre-financing and the development of subsidies, by providing the required knowledge and expertise.

4.4.3. Develop supply system and state intentions

As most building materials designed according to the *Cradle to Cradle* principles are produced in various countries around the world, the municipality should facilitate the development of a supply system. As the required infrastructure to delivering materials via land, water or air already exists, the most efficient system can be chosen and detailed plans developed. In order to create incentives and foster the trust of located and wanted companies in the support of local authorities, a letter of intend should be signed with participating parties.

4.4.4. Provide knowledge, incentives and agreements

As most companies and authorities are not familiar with the concept of *Cradle to Cradle*, the city should organise informative meetings and discussions for interested parties. The required knowledge can be provided either by experts from EPEA, a company founded by Michael Braungart, or by invited practitioners with experience in projects around the world. By sharing and exchanging knowledge, companies and the municipality can get an insight in

potential costs and benefits and reflect on ways to implement Cradle to Cradle. Accordingly, participating in projects such as the C2C-BIZZ, will increase the knowledge available to the municipality. Other positive stimuli can be developed through the creation of incentives, as has been done by the province of Brabant, the Netherlands. So called “green deals” are small subsidies that can be used to finance and implement the usage of waste streams. However, additional measures to support the extensive development phase of a project are required.

4.4.5. Further recommendations

On the basis of the findings of this research, additional recommendations to those elaborated with the help of the TOWS matrix were developed.

Firstly, the primary data indicated that communication is an essential element for the success of a project. The project in Bielefeld should therefore involve all direct and indirect stakeholders in the development of the project in an early stage. Elaborating potential stakeholders and carrying out a stakeholder analysis will provide the required data to developing a communication strategy. Furthermore, a contact person for located companies and interested stakeholders should be assigned, as this will form trust between companies and municipality.

Secondly, before the project is launched, an inventory of interested companies, their characteristics (energy demands, material consumption, required land, etc.) should be carried out. The revealed information can be used to identify potentials for the exchange of waste streams (implementation of circular streams) as well as to form clusters. The progress of the project should be evaluated continuously in order to identify impending problems and to determine whether the project is still on track.

Thirdly, the interviewees stated that the participation in an INTERREG project comes with a large amount of administrative work. As the project sizes defined whether or not the required time would be compensated by the benefits deriving from the participation, the municipality should pre-define the scale and goal of the project. By elaborating a detailed plan will provide a basis on which it can be decided to whether or participate in future EU financed projects.

Lastly, it is recommended to first launch smaller projects and to examine the deriving benefits of the implementation of *Cradle to Cradle*. By involving interested companies in continuously increasing projects, the transition from traditional production sites to eco-effective sites can be simplified.

5. Discussion

In the following, the findings of this research will be analysed with regard to the literature review that has been carried out before. Through the comparison of the theoretical data provided by the literature review and the empirical data gathered by the conducted interviews, the proposed theories introduced in the literature review will be confirmed or contradicted.

5.1. Evaluation of results

The conducted interviews resulted in a relatively good responds rate. As the population of potential interviewees was narrowed down by the required expertise and experience, a total amount of 7 interviews provided sufficient insight into the present situation. Approached interviewees did either respond and chose to participate or did not respond at all. Therefore it cannot be determined whether interviewees refused to participate due to for example a lack of time or a lack of interest. Nevertheless, those who were approached and estimated their own experience as insufficient for participating in this study, forwarded received requests to suitable colleges. The interviewees of the analysed EIP's were involved in different stages of design and realisation of their park and therefore provided a wide range of experience. As the revealed common obstacles and success factors were mentioned throughout the interviews, it is believed that the saturation point was met.

While conducting the interviews it became evident, that particular interview questions led to the same responses as others. Question number 4 and question 10 often resulted in a list of stakeholders and their function within the project. Likewise, question 5 proved to be an unnecessary question, as it was often answered in question 3 and most parks evolved from a given situation.

The analysis of the framework conditions in Bielefeld provided an insight in the current situation and thereby laid the basis for the SWOT analysis and recommendations. This analysis could also have been carried out as part of the literature review, however, having analysed obstacles and success factors the analysis was focussed on specific aspects. The chosen chronology thus increased the significance of the analysis.

The overall findings of this study and their applicability to the project in Bielefeld are based on the assumption, that the *Cradle to Cradle* principles and the design of an eco-industrial park both have similarities in their approaches. Throughout the interviews it became evident, that the chosen goal of an industrial park has a minor influence on the obstacles faced.

5.2. Integration in research

This research was carried out to elaborate to which extend existing sustainable industrial parks in the Netherlands can serve as inspiration for the project in Bielefeld. It was found, that most industrial parks faced common obstacles and problems.

Heeres et al. (2004) identified a series of stakeholders of whom active participation is required. The overall findings of this study can be confirmed by the results of this research as it became evident, that the contribution of municipalities, provincial government, experts, universities and research institutes, as well as the located companies is essential for the success of a project. Additionally, Heeres et al. (2004) emphasised that, after participation is assured, the first essential task is to gather information about the located or desired companies, which was confirmed through the interviews.

As stated by Pellenbarg (2002) and proven in this study the absence of several identified success factors can be a critical limitation and hamper the success of a project. Heeres et al. (2004) identified further limitations, such as technical or economic unfeasibility, a lack of information and legal regulations. As the primary data of this research revealed, the most challenging obstacles faced by EIP's in the Netherlands are *economic* or *technological uncertainties* and the restricted *time* available for the development of the park. The findings of Heeres et al. (2004) can thus be confirmed.

In 2002 Pellenbarg analysed factors of success and failure of eco-industrial parks in the Netherlands. One of the essential success factors identified was the collaboration between companies and local government. The initiative for the design of an EIP should start from the companies involved and not from government (Pellenbarg, 2002). The findings of this research can partly confirm the overall findings of the study. As the interviews revealed, collaboration and communication between companies are vital factors for the success of a project and should be maintained throughout its development. However, the starting point of the analysed eco-industrial parks proved that the initiation by municipalities or other governmental institutions can lead to the successful realisation as well. The results of the interviews indicated, that the initiator of a park is less important than their required contribution.

The role of an anchor company as a leader in the cooperation process and coordinator of the project was discussed by Heeres et al. (2004). The outcome of this research has shown that a coordinator and contact person for the involved companies is an essential success factor. This required function can be fulfilled by an anchor company, like the public sector or an NGO.

Gevaert (2005) stated that governmental support through subsidies and knowledge transfer are of great importance. This research confirms this. Nevertheless, as investments should come from the market, a project should not entirely rely on subsidies but used them to create incentives.

6. Conclusion and outlook

6.1. The bottom line

This research set out to investigate the extent to which sustainability projects in the Netherlands serve as inspiration for a *Cradle to Cradle* project in Bielefeld. This aim has been reached by exploring the experience of practitioners had made during the development and realisation of eco-industrial parks in the past.

The careful elaboration of the method for the conducted in-depth interviews allowed applying theoretical knowledge to reality. While it was difficult to find interview partners participating in this study, the 7 interviews conducted, provided valuable information. The interviews were conducted without complications but, due to limitations of time, some had to be cancelled.

The results of this research confirmed the findings of the literature review in most instances. Findings regarding the driving forces and the role of the initiator of an EIP required further attention as they partly conflicted with the results of existing research. From the results of this study it can be derived that most sustainable industrial parks in the Netherlands faced common obstacles during development and realisation. The interviewees recommended that future projects should focus on the communication among all involved stakeholder. Furthermore, financial benefits of participating companies should be determined as accurate as possible and thereby incentives created. Starting with an inventory of the present conditions, followed by continuous evaluation of the progress made, projects are enabled to identify potential obstacles in an early stage. Implementing an adequate and explicit legal framework as well as utilising knowledge provided by educational institutions can additionally foster the development of sustainability projects. The analysis of the framework conditions revealed that the present situation provides beneficial conditions for the launch of the project. Nevertheless, a series of threats and weaknesses need to be overcome. In order to do so, several strategic options were elaborated. Making best use of the given situation and profiting from the provided knowledge of existing projects in the Netherlands, the city Bielefeld should be able to successfully develop a *Cradle to Cradle* industrial park. However, financial uncertainties need to be limited, incentives created and overall measures to facilitate the process be applied in advance.

6.2. Limitations of research

The interviews conducted via telephone provided the researcher with personal and in-depth information. However, due to the few cases where the *Cradle to Cradle* principles were applied in the architectural environment in the Netherlands, one of the major limiting factors of this research was the confined range of the research population. As the research population comprises of highly educated individuals with a high level of responsibility within their companies, NGOs or municipalities, approaching them was difficult.

One crucial aspect of this research to be successful was the response rate of the interviewees. From the 20 approached parks, a total of 12 replied and 7 participated in this research and provided sufficient data to reach the saturation point. However, a broader range of participants could have increased the significance of this research.

Lastly, the short amount of time available to carry out this research was as a major limitation. Conducting interviews with several interviewees all over the Netherlands was a time consuming method and the researcher had a highly limited amount of time to organise and conduct the interviews. Additionally, some interview partners did not want to participate in this study due to their obligations or because they did not consider themselves to have sufficient experience. Another important limitation was the degree to which the interviewees were able to go into depth. As the time frame of interviewees was narrowed, the interviews were conducted within a maximum of 30 minutes.

Due to the discussed limitations above, caution should be taken when interpreting the results of this research.

6.3. Suggestions for further research

The results of this research provided an insight in common obstacles and success factors of sustainable industrial parks in the Netherlands and were the basis for recommendations for the project in Bielefeld.

Firstly, the findings of this research were based on the transferred knowledge derived from eco-industrial parks, which were applied to a Cradle to Cradle project. As the number of projects designed according to the Cradle to Cradle principles continuously increases, additional research in faced obstacle and success factors can provide valuable information. Moreover, the number of successful eco-industrial parks and thus the experience with these projects is significantly larger than the practical knowledge gathered from Cradle to Cradle projects. Therefore, a study confirming the assumption that both approaches face common

obstacles would increase the potential research population and thus the value of future findings.

Secondly, the primary data revealed that the quality and quantity of communication among the involved stakeholders is a central success factor of a project. Additional research in the design of communicational structures and the coordination of communication should be carried out.

Thirdly, as the experience with the realisation of eco-industrial parks in Germany was extremely limited at the moment this research was carried out, only participants from the Netherlands were approached. Therefore, a study should be carried out in the future that determines whether or not common obstacles and success factors of projects depend on the country they are developed in.

Fourthly, most of the revealed obstacles were related to technical or economic uncertainties. In order to draw a conclusion on whether or not these common obstacles have changed over time or new success factors have been applied, it is recommended to conduct the research again in the future.

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Appendices

Appendix 1 – Interview questions

Through the research carried out for my Bachelor dissertation I would like to determine to which extent sustainability projects in the Netherlands can serve as inspiration for a planned Cradle-to-Cradle project. In order to do so, I would like to ask you a series of questions about your person, your profession and your experience with such a sustainability project. The findings of this interview will be used to identify common obstacles and strategies to overcome them. Furthermore, a list of recommendations will be elaborated, which will contribute to the success of future projects. All of the provided data will be used only within this research and recorded interviews will be deleted at the end of this study. A printed version will be published via Van Hall Larenstein University of Applied Sciences in Leeuwarden. If you wish to have your personal information anonymised, please indicate so in your response or during the interview.

1. What is/was your function within the project?
2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realisation, operation)?
3. Who initiated the project (e.g. a company, local government, etc.)?
4. Who was involved in the development/design of the project?

The primary goal of my research is to determine which obstacles typically occur during the development and realisation of a sustainable industrial area and how these obstacles were overcome. The following questions therefore focus on your experience with the project.

5. Did you and your team have a certain concept in mind for the design of the project (e.g. an eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)?
6. What was the primary goal of the project and was it reached?
7. Which obstacles did you face during the development of the project concept?
8. Which strategies were chosen to overcome them?
9. What were important success factors for the realisation of the project (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?
10. Which important stakeholders were involved in this phase?
11. Why was their participation important?

The last four questions focus on your broader experience with sustainability projects and possible recommendations of yours.

12. Looking back at obstacles and problems that occurred during your project, which recommendations would you make to increase the success of future projects?
13. All in all, are you satisfied with the result of the project?
14. What are goals for the future of the project? (e.g. expansion, other cooperation, etc.)

Thank you for your time and participating in this study!

Appendix 2 – List of interviewees

Name	Project, Province	Description of work
Bert Krikke	Ecommunitypark, Friesland	Project manager; responsible for the design
Jacco Rentrop	Zeehaven- & Industrierrein Moerdijk, Brabant	Program manager spatial development, environment and sustainability
Jeroen Zwart	De Meerpaal, Utrecht	Policy advisor for economic affairs, coordinator and contact person
Sonja Demandt	Beatrixhaven, Limburg	Directeur at Parkmanagement BV, Park Manager Beatrixhaven
Peter Geertse	Biopark Terneuzen, Zeeland	Commercial Manager at Zeeland Seaports
Guus Mulder	TNO, Delft	Afdeling Strategie en Beleid, consultant onderzoeker
Frank de Bruijn	Provincie Noord-Brabant	Energie(rest)stroommakelaar at Provincie Brabant

Appendix 3 – Interviews

Interview Bert Krikke (Ecomunitypark)

1. What is/was your function within the project?
 - Ik ben de projectdirecteur van Ecomunitypark. Deze functie houdt in, dat ik betrokken ben bij de conceptontwikkeling, de inrichting van de park, het bepalen van de gewenste bedrijven die meedoen aan het project, de onderscheiding van andere projecten en ook bij het opstellen van de masterplan.
2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realisation, operation)?
 - Ik ben nu al een jaar of 5 met het project bezig.
3. Who initiated the project (e.g. a company, local government, etc.)?
 - Het project werd gestart door Anne Jan Zwart, de directeur van Ecostyle. Die had het idee om voor Ecostyle een nieuw terrein te bouwen met andere bedrijven. We hadden te weinig ruimte om uit te breiden. Anderzijds is er ook gezegd door Anne Jan Zwart heeft dat er direct een hele slag gemaakt wordt en met overheden, andere bedrijven en onderwijs samen gewerkt wordt. Daarvoor heeft die grond gekocht en is begonnen met het ontwikkelen van het idee en kennis. Met hem heb ik dan het hele concept van Ecomunitypark ontwikkeld.
4. Who was involved in the development/design of the project?
 - Natuurlijk hebben we voor onderdelen, zoals concept bedenken en plannen opschrijven, bedrijven bijgehaald. Voor het opstellen en uitwerken van de planning hebben wij een aantal bedrijven bij betrokken. Zo is "Interra" (Joure) erbij betrokken geweest. Verder was er nog een las-bouw architect bij betrokken, die al andere parken in Nederland en Engeland op een duurzame manier heeft ontwikkeld. De "Powerhouse Company" (Rotterdam) hebben we ook erbij gehaald om als master-architect de bouw te bewaken. Deze drie bedrijven hebben de eerste fase (gebiedsvisie, de concepten en de masterplan) samen uitgewerkt. Bedrijven die op het terrein willen vestigen halen dan zelf een architect en vak personeel erbij voor hun gebouwen. Er is dan wel Powerhouse bij betrokken om de kwaliteitsbewaking uit te voeren.
5. Did you and your team have a certain concept in mind for the design of the project (e.g. an eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)?
 - Voor het project hebben wij gekeken naar de richtlijnen van de BREEAM methodiek.
 - We zitten nu nog wel in de laatste planning fase en zijn bezig met het afronden van juridische stappen. In de toekomst zijn de uitwisselingen van reststromen wel iets waar wij de bedrijven en de park op sturen. Maar de planning kan pas beginnen, als bekend is welke bedrijven er komen. In de koopcontracten is wel vastgelegd, dat bijv. bedrijven met groot dakvlak deze beschikbaar moeten maken om zonnepanelen op te gaan leggen. De uitwisseling van duurzame energie willen wij op deze manier bevorderen. Het opwekken van duurzaam energie is dus een van de eisen waar bedrijven aan moeten voldoen.
6. What was the primary goal of the project and was it reached?
 - We wilden een duurzaam park maken volgens de BREEAM methodiek. Alle bedrijven die komen, krijgen een setje maatregelen erbij en moet aan deze handreiking voldoen om duurzaam te kunnen opereren.
 - Het doel is op zich een duurzaam park te maken en dat doel is ook niet verandert. De methodiek is wel veranderd, maar het is maar de manier hoe we daar willen komen.

7. Which obstacles did you face during the development of the project concept?
 - Er waren en zijn onzekerheden in de omvang van bedrijven die op het terrein zullen komen.
 - We wilden bijv. eerst grond uitgeven in appartementsrechten, maar uiteindelijk hebben we wel daarvoor gekozen om de kavels te verkopen.
 - “Het eerst idee was om met een ESCo te gaan werken (Energy Service Company), maar uiteindelijk bleek, dat er te veel onzekerheden waren en we besloten hebben om de planning wel ESCo ready te maken.”
8. Which strategies were chosen to overcome them? → n.v.t. project nog in de planning fase
9. What were important success factors for the realisation of the project (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?
10. Which important stakeholders were involved in this phase?
11. Why was their participation important?
12. Looking back at obstacles and problems that occurred during your project, which recommendations would you make to increase the success of future projects?
 - Achteraf gezien, hadden wij het hele energieverhaal sneller moeten aanpakken. We hadden niet op tijd scherp gekregen onder welke kosten een ESCo gaat opperen en wat de voor of nadelen zullen zijn van vernieuwing op de markt in vergelijking met een ESCo. We hadden nog eerder moeten beginnen.
 - Een reden zou kunnen zijn, dat we dachten dat het eenvoudiger zou zijn om het bij bedrijven tussen de oren te krijgen. Ze moeten daar wel op instemmen. Het probleem was niet de samenwerking maar de inhoud van een ESCo. De onbekendheid van het nieuw product en het aan durven waren hier belangrijke factoren.
 - Het is ons niet gelukt om in die tijd die we daarvoor hadden een concrete planning voor een ESCo zodanig op te stellen, dat we alle onzekerheden bij betrokkene partijen weg konden nemen. Maar deze onduidelijkheden hebben puur met ESCo te maken.
13. All in all, are you satisfied with the result of the project?
 - Het gaat allemaal te langzaam. We hadden wel sneller kunnen afronden. We hebben een jaar extra verbruikt, om op het gebied van biodiversiteit en energie ons kennis te verbreden. Hiervoor hebben wij met verschillende partijen en onderwijsinstellingen samen gewerkt. De tijd was dus niet weggegooid. Al met al ben met het project ook tevreden.
14. What are goals for the future of the project? (e.g. expansion, other cooperation, etc.)
 - Ik hoop dat we met een jaar of vijf met de helft van het project zijn en dat er wel de helft van de gebouwen al staat.

Interview Jacco Rentrop (Moerdijk)

1. What is/was your function within the project?
 - Wij zijn het havenschap Moerdijk, een exploitatie en beheer organisatie. Mijn functie daarbij is programma manager ruimtelijke ontwikkeling, milieu en duurzaamheid.
2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realisation, operation)?
 - Binnen het havenschap werk ik 12 jaar.

3. Who initiated the project (e.g. a company, local government, etc.)?
 - Ik werk hier 12 jaar. Voorheen werd tussen enkele bedrijven een aantal één op één (duurzame) koppelingen gerealiseerd. Het ging hierbij om o.a. rest-stoom en CO2. Ook werden enkele leidingen met product-reststromen één op één gerealiseerd. Dit was de ontwikkeling tot 2002. Na die periode ben ik bij de havenschap begonnen en heb een overzichtskaart gemaakt waarop op basis van de informatie uit de milieumonitoring synergie kansen aanwezig waren om reststromen met elkaar of tussen bedrijven onderling uit te wisselen (industriële ecologie). In 2006 werd samen met provincie Noord-Brabant (samenwerkend binnen het samenwerkingsverband Duurzame verbindingen Moerdijk) de opdracht gegeven om een inventarisatie te maken van bedrijven die aanwezig zijn die mogelijk synergievoordelen zouden kunnen behalen door uitwisseling van stofstromen. Toen heette het project nog de "Proeftuinen Moerdijk". Dit heeft geresulteerd in een succesvol warmtenet waar meerdere bedrijven opzitten. Het project is dus ontstaan uit de initiatie van enkele bedrijven in samenwerking met het havenschap, provincie en gemeente Moerdijk.
4. Who was involved in the development/design of the project?
 - Gemeente en provincie waren wel de belangrijkste constante factoren.
 - Daarnaast waren de bedrijven op het terrein betrokken en wij als havenschap hebben het project en de ontwikkeling gecoördineerd. Nabij het haven- en industrieterrein Moerdijk zitten ook een kassencomplex (tuinders), een logistiek park wat ontwikkelt gaat worden en bedrijven die daar nog kunnen komen.
 - In de laatste tijd is ook het ministerie van infrastructuur en milieu erbij betrokken.
 - Op dit moment wordt het stoomcluster Middenweg onderzocht. Dit staat onder regie van provincie en havenschap en aangesloten bedrijven. Hiervoor is in maart 2013 een intentieverklaring getekend. Op dit moment wordt de business case doorgerekend.
5. Did you and your team have a certain concept in mind for the design of the project (e.g. an eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)?
 - In 2006 hebben wij het terrein geanalyseerd en de aanwezige en mogelijke clusters van bedrijven vastgesteld. Met dat voorbeeld zijn wij verder gegaan met een groot onderzoek voor de stakeholders zoals gemeente en provincie, waarbij de haalbaarheid van meerdere clusterings op het haventerrein werd aangetoond en bleek, dat er nog meer te behalen was. De grootste klap hopen wij dan deze zomer te maken met het oprichten van een groot stoomleiding waar onder andere ook een glasfabriek bij betrokken is. Het concept is dus het uitbreiden en aanleggen van energie en reststroom uitwisselingen binnen het haventerrein.
6. What was the primary goal of the project and was it reached?

Toen de tijd is tijdens het project "Proeftuinen" naar duurzame verbindingen het wensbeeld ontstaan om een groot leidingsysteem (Multicore) te ontwikkelen. Hierop zouden leveranciers van warmwater, stoom, CO2 als afnemers aangesloten worden. Dit is een toekomst beeld naar de toekomst.
7. Which obstacles did you face during the development of the project concept?
 - Zo 5 jaar geleden werd geprobeerd om een ESCo op te richten. Dit is helaas toen niet gelukt omdat de private partijen niet wilden investeren als er niet de normale rendementen (15-16% op geïnvesteerd vermogen) zouden worden afgesproken. Toen bleek voor ons, dat de markt duurzame verbindingen niet serieus nam. Er telt alleen het economisch rendement en een economisch incentive zijn, anders werken de bedrijven niet mee. Er komt het risico en de afhankelijkheid van elkaar boven op.
 - Het project wat nu in de stijgers staat (laatste mogelijke uitbreiding) gaat het om een project van rond 5 miljoen Euro en daar moet nauwkeurig geregeld worden wie wat levert en onder welke voorwaarden. Het risico is hier veel groter en daarom moeten ook de juridische aspecten heel goed geregeld worden. Wij kunnen en willen als havenschap niet garant staan voor zonn omvangrijke investering. Voor gemeente en provincie geldt nu hetzelfde. Het is niet de core

business van deze partijen, vandaar dat er een nieuwe entiteit voor moet komen een zogenaamde ESCO (Warmte Service organisation).

8. Which strategies were chosen to overcome them?
 - Wij hebben als havenschap gezegd, dat als wij duurzame ambities hebben en weten dat de markt het niet oppakt, dat wij dan tijdelijk het (financieel) gat moeten invullen. Dit hebben wij gedaan door een oplossing te bieden waarbij het havenschap de pijpleiding exploiteert die bedrijven vervolgens terug huren voor gebruik. De betrokken bedrijven onderling afspraken maken over de leverantie (kwaliteit, leveringszekerheid e.d.) van het restproduct wat geleverd word. Ze moeten dan zelf onderling regelen. Het Havenschap kans dit niet doen omdat wij geen invloed hebben op de leverantie van restproducten.
9. What were important success factors for the realisation of the project (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?
 - De rol van de havenschap is de constant factor op het terrein. De bedrijven hebben een bepaald vertrouwen nodig. Als je dat kan doen, dan krijg je ook draagvlak en kunt bedrijven verbinden.
10. Which important stakeholders were involved in this phase?
 - Gemeente
 - De provincie heeft een bijdraag geleverd in de vorm van expertise om het project draaiend te houden. Dit betekend ook dat ze in bepaalde mate subsidies hebben uitgegeven om onderzoek te doen.
 - Het ministerie voor milieu en infrastructuur faciliteert met juridische aspecten
 - De ondernemers
 - De havenschap
11. Why was their participation important?
 - Zie vraag 10.
12. Looking back at obstacles and problems that occurred during your project, which recommendations would you make to increase the success of future projects?
 - Aan de bedrijven kant begint het al met de inventarisatie. Er moet heel goed naar gekeken worden of de energie er ook is, welke kwaliteit de stromen hebben, of deze ook over een 15 tot 20 jaren gegarandeerd kunne worden.
 - De organisatie moet goed uitwerken hoe ze van plan is om het project te financieren. Welke rendementen worden geëist? Je moet precies de kostprijs van warmte of energie weten, want als de kosten van het gezamenlijk netwerk moeten een aantrekkelijk incentive bieden om de bedrijven te stimuleren het risico te nemen.
 - De bedrijven worden van elkaar afhankelijk gemaakt en daarom moeten de afspraken nauwkeurig gemaakt worden en ook voor storingen en kwaliteitsverschillen opties in de contracten opnemen.
13. All in all, are you satisfied with the result of the project?
 - Je hoort wel een van de grote projecten in Rotterdam of ergens anders, maar wij doen het hier op een kleine schaal niveau en hebben hier vier- tot vijftal duurzame verbindingen liggen. En we groeien nog steeds.
14. What are goals for the future of the project? (e.g. expansion, other cooperation, etc.)
 - Als het gepland project zo gerealiseerd kan worden, dan worden er 12 miljoen kuub traditioneel gas niet meer ingenomen. Dat betekend een reductie van 23 kiloton CO2 per jaar, wat neer komt op 11.000 huisaansluitingen, met die het milieu niet meer wordt belast. Dat is ook een bijdrage leveren aan je omgeving en een stukje verantwoording afleggen. En de bedrijven zien er ook wel kansen in het gebruiken van synergiën en wij willen ook graag nog

meer met hun bereiken. Maar dat hangt wel van de ontwikkeling af, dat je bijv. het warmtebedrijf hier op het terrein kunnen realiseren.

Interview Jeroen Zwart (De Meerpal)

1. What is/was your function within the project?
 - Ik ben beleidsmedewerker economische zaken bij de gemeente Houten.
2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realisation, operation)?
 - Het terrein is eind jaren negentig ontworpen, maar ik ben pas in 2006 in dienst gekomen. Ik ben in beeld gekomen voor het verkopen van kavels op het terrein en als aanspreekpartner voor gevestigde bedrijven.
3. Who initiated the project (e.g. a company, local government, etc.)?
 - Het project werd door de gemeente Houten in samenwerking met een energieleverancier opgericht. Geïnteresseerde bedrijven konden dan kavels op het terrein kopen.
4. Who was involved in the development/design of the project?
 - Vanuit de gemeente Houten was de afdeling projectontwikkeling erbij betrokken, waar ook een projectleider uit werd gekozen.
 - Stedenbouwkundig bureau, verkeersbouwkundig bureau en een landschapsarchitect
5. Did you and your team have a certain concept in mind for the design of the project (e.g. an eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)?
 - Het project is ingedeeld in 4 fasen. Het doel voor fase 1 werd samen met de energieleverancier opgesteld. Er werd voor gekozen om met een KWO (koud-warmte opslag) te werken en alle bedrijven worden aangesloten op een groot warmte-netwerk. Er werden in fase 1 ook geen gasleidingen aangelegd en zo moesten de bedrijven die er wilde komen mee doen aan het project.
6. What was the primary goal of the project and was it reached?
 - Het doel voor fase 1 was om een KWO op te richten, maar dat werkt helaas niet. Bij uitval van het systeem, kan er niet direct weer opgestart worden. Door de opbouw van het systeem is het ook moeilijker om het probleem vast te stellen. Het bleek dat het systeem over het algemeen nog niet was aangesloten op de pragmatiek en gebruik binnen de park.
7. Which obstacles did you face during the development of the project concept?
 - Tijdens het oprichten van de horizontale putten van het KWO systeem bleek al dat sommige putten buiten werking zijn getreden.
 - Verder waren na het aanleggen van de 3 leidingen tijdens aanvang van het systeem al twee buiten werking waren.
 - Het systeem treed soms meerdere dagen buiten werking en storingen konden maar moeilijk vastgesteld worden. Verder was er ook geen vervangend systeem om in die tijd de benodigde warmte te kunnen leveren. Sinds alle bedrijven op een systeem zijn aangesloten, hadden meteen ook alle bedrijven last van storingen.
 - Inmiddels lopen de contracten uit en wil de energieleverancier van het KWO systeem af. De energieleverancier wil dat er een gasleiding in het terrein gelegd wordt. De gemeente is

voorzitter van voortzetting van de huidige verwarmingssysteem. Er is nu overleg hoe dat kan gebeuren en wie een eventueel alternatief gaat betalen.

8. Which strategies were chosen to overcome them?
 - Na fase 1 heeft de leverancier ervoor gekozen om in fase 2 weer een gasleiding aan te leggen. Het project heeft dus niet het resultaat opgeleverd, wat de gemeente en het bedrijf hadden verwacht en het bleek ook niet meer mogelijk om dit weer recht te trekken.
9. What were important factors for the failure of the project (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?
 - De schaal van het project was te klein. Het is in totaal misschien 17 hectare en als er een storing optreedt, had direct het hele terrein er last van. Verder werd er maar een KWO opgericht, waardoor er geen vergelijking mogelijk was.
10. Which important stakeholders were involved in this phase?
 - Zie vraag 4.
11. Why was their participation important?
 - De gemeente heeft het project gecoördineerd en de doelen vastgelegd.
 - De betrokkene bureaus hebben de benodigde kennis aangeleverd.
12. Looking back at obstacles and problems that occurred during your project, which recommendations would you make to increase the success of future projects?
 - Voordat met een pilot wordt begonnen moet altijd goed doorgrond worden welke ervaringen met het systeem al gemaakt werden.
 - Verder is het belangrijk om goed aan te kunnen tonen, wat het project voor de bedrijven oplevert en welke alternatieven er zijn als het niet werkt.
 - Ook het maken van afspraken over het project is een belangrijk aspect.
13. All in all, are you satisfied with the result of the project?
 - Enerzijds ben ik trots dat wij een pilot project hebben gedaan en de stap hebben durven nemen om een nieuwe en duurzame technologie toe te passen.
 - Anderzijds ben ik niet tevreden met de samenwerking met de energieleverancier. Er bleek dat de slagkracht niet voldoende was om bij de problematiek boven op te blijven zitten. Er miste de inzet en de ondersteuning (bijv. nood lijn). Bij de leverancier miste de wens om het project een succes te laten worden.
14. What are goals for the future of the project? (e.g. expansion, other cooperation, etc.)
 - Het bedrijventerrein zal verder als een duurzaam terrein ontwikkeld worden. Daarom willen wij investeringen in mini-windturbines of zonnepanelen bevorderen. Verder willen wij graag dat bedrijven er meer van bewust worden van de verantwoordelijkheid die ze hebben in het ontwikkelen van duurzaamheid. Er zijn wel sommige bedrijven die dit al doen, maar wij willen er graag nog meer.

Interview Sonja Demandt (Beatrixhaven)

1. What is/was your function within the project?
 - Enerzijds ben ik de parkmanager van SIM (Samenwerkende Industrierterreinen Maastricht e.o.) in Maastricht en anderzijds ben ik directeur bij stichting "Parkmanagement BV". Parkmanagement BV is voor 100% een dochterorganisatie van de Limburgse Werkgevers Vereniging. De organisatie heeft tot doel de samenwerking tussen de ondernemers en de overheid te verbeteren, evenals de samenwerking tussen de ondernemers onderling. Kortom, om de kwaliteit van de bedrijventerreinen te verbeteren.
In deze functies begeleid ik onder andere de ontwikkeling van duurzame bedrijventerreinen en ondersteun ik ondernemersverenigingen. In Limburg zijn een aantal parkmanagers werkzaam voor een regio en voor de diverse projecten over de stichtingen heen.
 - Door mijn functie binnen de ondernemersvereniging ben ik betrokken bij het project ECO2Profit, waarbij de bedrijventerreinen "De Beitel", "Roermond" en "Roerstreek" betrokken zijn.
2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realisation, operation)?
 - Ik kwam in 2008 in dienst. We zijn toen met "Eco2profit" (of: duurzame bedrijventerrein) begonnen. Het project had een doorlooptijd van 3 jaar.
3. Who initiated the project (e.g. a company, local government, etc.)?
 - In samenwerking met LIOF, Provincie Limburg, Parkmanagement BV en enkele provinciale Ontwikkelingsmaatschappijen in België.
4. Who was involved in the development/design of the project?
 - De contract partners.
5. Did you and your team have a certain concept in mind for the design of the project (e.g. an eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)?
 - Dat is voorafgaand vastgesteld.
6. What was the primary goal of the project and was it reached?
 - Ons doel vanuit de stichting is altijd om de kwaliteit van het bedrijventerrein te verbeteren.
 - We hebben bijv. in Beatrixhaven en Roermond een aantal zonnepanelen kunnen realiseren.
 - Wij hebben binnen het project ervoor gekozen om duurzame groene daken te realiseren, een aantal haalbaarheidsstudies te laten uitvoeren (wamtenet, Biomassacentrale etc.) en een energiecoördinator in te zetten. Het streven van de Gemeente Maastricht is om in 2030 klimaatneutraal te zijn.
7. Which obstacles did you face during the development of the project concept?
 - Een van de problemen met het project Beatrixhaven was dat de uitgangspunten zijn veranderd. De economie kwam in een recessie en dat heeft natuurlijk altijd invloed op projecten waarin geïnvesteerd dient te worden. Daarom was de evaluatie belangrijk om bijv. te bepalen of iedereen nog in staat was om te investeren en of er met intentieovereenkomsten gewerkt kan worden.
 - Een tweede probleem was dat de economische situatie is veranderd en ondernemers er minder of niet bereid waren om te investeren.
 - De voorbesprekingen van het project zijn gestart in 2008 en de subsidie kwam pas in 2010.
 - Tijdens het project voor groene daken is door de Universiteit een berekeningsmethodiek voor gemaakt. Dus de besparing was relatief eenvoudig te berekenen. Door de economische situatie lag de focus van de bedrijven op het overleven en niet zo zeer op nieuwe risico's nemen. Als de economische zaken wat beter worden, worden projecten op het gebied van

duurzaamheid weer opnieuw opgepakt. In Beatrixhaven krijgen wij dan een nieuwe afslag waardoor je daar mooi over de groene daken heen zult kunnen kijken.

- Verder hadden wij wat problemen met INTERREG. We liepen er tegenaan dat gemaakte uren niet werden betaald. Als er binnen een INTERREG project meer dan 2% fouten in de declaraties worden vastgesteld over alle deelnemers van de verschillende projecten, worden de betalingen stop gezet. De declaraties vanuit mijn project werden door 3 accountants gecontroleerd en er zaten geen fouten in. Het project werd officieel in September vorig jaar afgerond. Het heeft drie jaar gelopen en er is tot nu toe niks betaald. Een gemeente of een ander overheidsorgaan kan dat wel aan, maar als je een klein bedrijf bent dan moet je wel kijken hoe je je rekeningen kunt betalen. Er lopen in zo'n project heel veel bedrijven in verschillende landen mee en je moet als ondernemer er wel bedacht op zijn, dat er door een aantal bedrijven fouten gemaakt kunnen worden, waardoor je zelf het risico loopt niet betaald te worden.

8. Which strategies were chosen to overcome them?

- Als je kijkt naar het inrichten van een duurzaam bedrijventerrein moeten de bedrijven mee worden genomen in het proces, maar ze moeten niet alles opnieuw uit hoeven te zoeken. Als je niet zelf de kennis hebt zal je iemand moeten inhuren die de juiste calculatie kan maken, want er moet wel altijd een voordeel inzitten. Voordeel kan in de vorm van financiële aspecten uitgedrukt worden, maar ook in de vorm van een verbeterd imago.
- Een van de meest belangrijke aspecten was zeker de communicatie tussen ondernemers en overheden en ondernemers onderling. Dit is dan ook een van de meest belangrijke taken van het parkmanagement.
- Wat betreft de betalingen van Europa zullen wij gewoon moeten afwachten.

9. What were important success factors for the realisation of the project (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?

- Voor een project is het belangrijk als je aan kunt tonen dat er voordelen, als een verbeterde gezondheid van de medewerkers of besparingen op energiekosten in zitten. Als een bedrijf aan kan tonen dat het maatschappelijk verantwoord onderneemt dan is dat ook een goed punt.

10. Which important stakeholders were involved in this phase?

- Het is altijd afhankelijk van het project.
- Stakeholders van Beatrixhaven waren de ondernemers, overheden en Universiteiten

11. Why was their participation important?

- De samenwerking van ondernemers en overheden is belangrijk voor onder andere de juridische, economische en stadsbouwkundige aspecten.
- Hoogeschole of Universiteiten kunnen betrokken worden, om bijv. uit te rekenen welke voordelen een groen dak op zal leveren.
- De communicatie tussen de stakeholders is dan ook een van de meest belangrijke factoren voor het succes. Daarom is ook een goed parkmanagement/ manager een belangrijk stakeholder.

12. Looking back at obstacles and problems that occurred during your projects, which recommendations would you make to increase the success of future projects?

- Een belangrijk punt is zeker de haalbaarheid van een project. Je moet aan kunnen tonen, dat het project voor de ondernemers winst kan opleveren. Daar moet je wel goede getallen voor kunnen presenteren en die verkrijgt je het best als je op een klein schaal een proef doet. Je kunt bijv. een van de ondernemers een groen dak laten realiseren en die kan zelf testen of het wel of niet voordelen oplevert. Om de financiële risico's te beperken, kunnen alle bedrijven van een terrein in het proefproject investeren. Een voordeel hiervan is dan ook, dat de ervaring geëxtrapoleerd kan worden en er samen voor het investeren en het implementeren

van bijv. zonnepanelen of groen daken gekozen kan worden. Hoe meer bedrijven eraan mee doen, hoe groter de kortingen op de inkoop.

- De evaluatie is een andere belangrijke factor. Er zit nooit een strakke lijn in de verschillende projecten en daarom is het belangrijk om tussendoor een de voortgang te evalueren en zo mogelijke problemen vroeg te identificeren. Vaak zijn ondernemers bijv. bij het aanleggen van een warmtenet heel enthousiast. Omdat de opgeleverde warmte over tientallen jaren gegarandeerd moet worden, is een eerste stap het analyseren van hun eigen bedrijf. Hierbij blijkt soms dat er niet het verwachte overschot aanwezig is en dat er maatregelen omgezet kunnen worden, om efficiënter te gaan produceren. Daardoor komt de uitwisseling misschien niet tot staan, maar de bedrijven kunnen hun productieprocessen verduurzamen en zo minder CO2 uitstoten.
- De draagvlak van een project is ook een heel belangrijk aspect.

13. All in all, are you satisfied with the result of the project?

- Behalve INTERREG is het project wel goed verlopen. Maar als het eerder werd gedaan had er meer uit kunnen komen.

14. What are goals for the future of the project? (e.g. expansion, other cooperation, etc.)

- Ik zou graag heel veel meer willen bereiken op alle bedrijventerreinen waar ik aan mee werk. Dit geldt niet alleen voor Beatrixhaven. Doelstelling is om alle bedrijventerreinen in Limburg te laten aansluiten
- In Maastricht hebben ze de doelstelling opgesteld, dat ze vanaf 2030 klimaatneutraal willen werken. Dat bereik je niet zonder de industrie, want die gebruikt 60 tot 65% van de energie. Daarom is het belangrijk om hier te beginnen.
- Graag zou ik er ook naar kijken om coöperaties elkaar energie te laten kunnen leveren, om ze zo onafhankelijk van het elektriciteitsnet te maken.

Interview Peter Geertse (Biopark Terneuzen)

1. What is/was your function within the project?

- Ik ben commercieel manager bij Zeeland Seaports, dat tot 2011 een overheidsinstantie was en daarna verzelfstandigt is (vergelijkbaar NS). Verder ben ik betrokken bij stichting Biopark Terneuzen en daar ben ik ook manager van. Met betrekking tot de park ben ik dus projectmanager. Door deze twee functies ben ik met name bezig om ervoor te zorgen dat de stichting functioneert en aan de verplichtingen voldoet. Aan de andere kant vervul ik een commerciële functie om partijen bij elkaar te brengen en nieuwe projecten te initiëren.

2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realisation, operation)?

- Ik werk nu 6 jaar aan het project.
- Ik ben sinds de uitvoeringsfase bij het project betrokken.

3. Who initiated the project (e.g. a company, local government, etc.)?

- Toen ik aan het project ben begonnen, waren er al lokale initiatieven tussen bedrijven onderling. Toen heeft Zeeland Seaports besloten om deze initiatieven in de regio te bundelen en is het project Biopark gestart.

4. Who was involved in the development/design of the project?

- Zie vraag 8.

5. Did you and your team have a certain concept in mind for the design of the project (e.g. an eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)?
 - Het doel van het project Biopark was om bedrijven, met name door de uitwisseling van reststromen, te laten samenwerken. Het doel van het project is in de loop van de jaren wel veranderd en aangepast aan de realiteit. Het project wordt inmiddels vaak ook in het buitenland als voorbeeld gebruikt van koppelingen van agrochemie.
6. Which obstacles did you face during the development of the project?
 - Een probleem was misschien dat de ontwikkeling van het project zijn hoogtepunt heeft gekend met de crisis in 2008/2009. Dit was ook de tijd waar de financiering een probleem was. Er waren zeker meer projecten en onderdelen succesvol als de financiering makkelijker was geweest.
 - Een tweede belangrijke factor was de inconsequentie van de overheid. Op begin was de focus van het project heel erg op biobrandstoffen. De afgelopen jaren bleek, dat de door de overheid toegezegde bijmengverplichtingen van biobrandstoffen van 10% halverwege op 3,5% zijn gestopt. Hierdoor ontstond een overcapaciteit en werden fabrieken gebouwd die failliet gingen. Dit had ook invloed op de financiering van ons park.
7. Which strategies contributed to the success of the project? → n.v.t. / Not applicable
8. What were important success factors for the realisation of the project (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?
 - Regie en het bij elkaar brengen van betrokkene partijen door een onafhankelijke partij (Zeeland Seaports)
 - Betrokkenheid van lokale en regionale overheden
 - Soms kan een project stranden op afhankelijkheid van twee partijen, omdat ze niet met elkaar samen willen werken. Door het invullen van een derde bedrijf die tussen geschakeld wordt, kan een Win-winsituatie en vertrouwen bij de betrokkene creëert worden. De leiding door een betrouwbare en onafhankelijke partij speelt hier ook een belangrijke rol in.
 - Een belangrijk functie van de onafhankelijke partij is dan ook het relatiebeheer van betrokkene bedrijven en het zorgen voor contact.
9. Which important stakeholders were involved in this phase? Why was their participation important?
 - De overheden hebben een belangrijke rol binnen het project, omdat ze het project op verschillende manier ondersteunen. De financiële ondersteuning was in de vorm van subsidies, maar ook in de cofinanciering van INTERREG projecten. INTERREG speelde een belangrijke rol voor het project en daar zijn de overheden onmisbaar in.
 - De bedrijven, want zonder de bedrijven was het project niet mogelijk.
 - Kennisinstituten. Het project Biobased Europe is grotendeels ontstaan uit kennisinstellingen. De hogeschool Zeeland is bij het project Biopark direct betrokken.
10. Looking back at the development of the project, which recommendations would you make to increase the success of future projects?
 - Tijdelijk beginnen met het creëren van draagvlak in de regio en bij de overheden die voor vergunningen moeten zorgen. Alle partijen die direct of indirect bij het project betrokken zijn moeten deelnemen in het succes hiervan.
 - De eerste insteek zal altijd zijn om investeringen te laten plaatsvinden zonder subsidie. Soms hebben wij wel kleine bedragen bijv. voor het uitvoeren van haalbaarheidsanalyses ontvangen (green deals), maar de uiteindelijke investering moet uit de markt komen.
 - Mijn ervaring met INTERREG heeft positieve en negatieve aspecten. Het was het grootste INTERREG project ooit en zonder de INTERREG subsidie was het project er nooit gekomen (Biobased Europe). Maar als we kijken naar de uitvoeringsfase is het wel heel arbeidsintensief en veel administratie. Voor een groot project loont het wel, maar voor kleine projecten is het

minder geschikt omdat je dan meer tijd kwijt bent om de administratieve aspecten dan aan de uitvoering van het project.

11. All in all, are you satisfied with the result of the project?

- Ja! Daar kan ik volmondig ja op zeggen. De financiële crisis heft wel invloed gehad op de schaal van het project, maar als we terug kijken naar het project zijn we wel tevreden. Er zitten in het gebied vele multinationals die over het algemeen in zichzelf gekeerd zijn, maar nu wel samenwerken. We waren er positieve van verrast, dat deze bedrijven heel erg coöperatief meedenken en werken in dit project.

12. What are goals for the future of the project? (e.g. expansion, other cooperation, etc.)

- Wij denken nog flinke stappen te kunnen maken in de vervanging van fossiele energiebronnen. Er is nog voldoende energie beschikbaar door restwarmte. Ook op gebied van waterzuivering en reductie CO₂ en NO_x willen wij verbeteren.

Interview Guus Mulders (TNO)

1. What is/was your function within TNO?

- Ik werk bij de afdeling Strategie en Beleid en ben daar consultant onderzoeker. In opdracht van het Platform Energietransitie Gebouwde Omgeving (PeGO) ben ik vijf jaar lang betrokken geweest bij de verduurzaming (energie) van 10 bedrijventerreinen.

2. How long have you been involved in the sustainable industrial projects? In which phases did you get an insight (initiation, design, realisation, operation)?

- 6 jaar

3. What are typical initiators of such projects (e.g. a company, local government, etc.)?

- Hete is belangrijk om een onderscheid te maken tussen de situatie waar een bedrijventerrein vanuit een "green field" wordt ontwikkeld en de situatie waar een bestaand bedrijventerrein verduurzaamd wordt.
- Bij nieuwe bedrijventerreinen is het meestal de gemeente die o.a. naar structuurplannen beslist dat er een bedrijventerrein zal komen. Vervolgens gaat die infrastructuur aanleggen en proberen de grond te verkopen. Vaak werkt de gemeente samen met een projectontwikkelaar.
- Bij een bestaand bedrijventerrein is het minder duidelijk. Dit ligt me name aan de mate van organisatie van de gevestigde bedrijven. Op een gedeelte van de bedrijventerreinen in Nederland is een ondernemersvereniging, die bijv. een parkmanagement aan zich heeft gebonden, waardoor een meer collectief identiteit ontstaat. De gemeente heeft vooral in de eerste fase vaak een aanjagende rol.
- Vergeleken met burgerinitiatieven zijn er weinig soortgelijke initiatieven die door ondernemers zijn geïnitieerd. Daar is vaak een intermediaire organisatie voor nodig.

4. Do the initiators commonly have a certain concept in mind for the design of the project, or do they mainly focus on a certain idea and work out own ways to reach this goal? (e.g. eco-industrial park, Cradle to Cradle, high energy efficiency, other sustainability aims)

- Dat hangt van de initiatiefnemer af. Als er een nieuw bedrijventerrein gebouwd wordt, is het vaak een van de onderdelen die in de plan (bijv. duurzaamheidsambities, etc.) staat en dus een van de redenen die rechtvaardigt dat er een nieuw bedrijventerrein gestart wordt. Ons ervaring is wel, dat de ambities vaak verlaagd worden als er in de eerste fase weinig partijen grond kopen. De meeste gemeentes zijn wel geneigd om snel van hun doelen af te wijken.

- Als men kijkt naar bestaande bedrijventerreinen wordt er vaak vanuit de bestaande mogelijkheden een project ontwikkelt. Er hoeft niet per se een duurzaamheidsambitie achter zitten. Vaak gaat het minder om het realiseren van collectieve projecten, maar wordt gedacht uit de bestaande mogelijkheden en zo de verduurzaming van het bedrijventerrein stimuleert. Meestal komen de doelen voort uit de bestaande mogelijkheden.
5. Which obstacles are faced during the development and realisation of these projects?
- Laag invloed van energiekosten; voor vele ondernemers zijn de kosten voor energie maar een kleine percentage van hun totale productiekosten. Daarom leveren besparing op dit gebied relatief lage financiële voordelen op. Bedrijven moeten als grootverbruiker heel lage prijzen betalen en daarom is het minder interessant voor hun om hierop te besparen.
 - Imago is maar een beperkt driver; de algemene trend voor duurzame producten is maar een stimuli voor bedrijven die direct producten voor de consumenten produceren. De eerste schakel naar de consument is heeft meestal wel duurzame ambities, maar stellen ze niet dezelfde eisen aan hun toeleveranciers.
 - Intrinsieke motivatie van ondernemers; Vaak hebben de ondernemers wel een haart voor hun omgeving. Ze willen graag zelf duurzaam zijn, maar dat is niet voldoende om incentives te creëren om duurzame maatregelen te beslissen. Dit komt bijv. ook door een gebrek aan tijd en kennis om de beste mogelijkheden op te zoeken voor een verduurzaming van hun bedrijf.
 - Groeien is belangrijker dan verduurzaming; Als een ondernemer de kans heeft om voor bedrag X of een nieuwe machine te kopen en zijn productie te verhogen of hetzelfde bedrag te investeren in LED-verlichting en andere energiebesparende maatregelen, zal die ervoor kiezen om meer te kunnen produceren. De ondernemer wil uitbreiden en de incentives om energie te besparen zijn veel te laag. Dit geldt met name voor midden en klein bedrijven (MKB).
 - Langdurige verplichtingen bij collectieve projecten; Als MKB organisatie bijv. in een reststroomuitwisseling willen coöpereren worden ze over een lange termijn in hun vrijheden beperkt. Verder weten deze bedrijven vaak niet of ze over een zo lang termijn nog bestaan en willen niet van een kleine organisatie afhankelijk gemaakt worden. Dit geldt voor de leverancier maar ook voor de afnemer.
6. What were important success factors for the realisation of these projects (e.g. cooperation of companies, motivation, trust, governmental support, etc.)? → question 8
7. What are important stakeholders involved in the different phases? Why was their participation important?
- Gemeente; organisatie en aanjagende rol
 - Ondernemersvereniging/parkmanagementorganisaties
 - Adviesbureaus; opbouw van coalities, expertise
 - Grote bedrijven; zien een kans in de ontwikkeling en proberen daar een voordeel uit te halen
 - Kennisinstellingen; onderzoek en procesanalyse,
8. Looking back at obstacles and problems that occurred during your project, which recommendations would you make to increase the success of future projects?
- Verantwoordelijk actor/ coördinator; Vaak is er bij het ontwikkelen van coöperaties op een bedrijventerrein geen actor voor die het bedrijventerrein relevant is en die de ontwikkelingen regelt. Het is belangrijk om een instantie te creëren die de partijen bij elkaar haalt. Als er op een terrein een parkmanagementorganisatie actief is, bied dat heel veel mogelijkheden. De organisatie is een heel belangrijk voorwaarde voor de succes van het project.
 - Zorg ervoor dat de ontwikkeling zo makkelijk mogelijk gemaakt wordt en bied een gesprekspartner; een gesprekspartner voor de gevestigde bedrijven hebben energie vaak niet op hun agenda staan. Maar als je parkmanagementorganisatie bent en bijv. de gezamenlijke

energie inkoop regelt, moet je met de ondernemers in gesprek over de hoeveelheden die ze verbruiken. Zo wordt je gesprekspartner voor hun en zorg je ervoor dat energie een onderwerp op hun agenda wordt. Door steeds kleine stapjes te nemen kun je steeds meer strategisch met de ondernemers in gesprek gaan. Dit kost wel veel tijd, maar levert ook veel op.

- Regionale afstemming en lange adem; als een gemeente ervoor kiest om voor een bedrijventerrein hoge duurzaamheidseisen op te stellen en in dezelfde regio is een terrein waar lagere eisen gelden, zullen ondernemers er vaak voor de makkelijke weg kiezen. Door het afstemmen met meerdere gemeentes zorg je voor gelijkwaardige “concurrentie” van de terreinen. Ook als er niet direct alle kavels verkoopt kunnen worden is het belangrijk, dat niet direct de eisen voor het terrein verlaagt worden.
- Onderhoud van bestaande terreinen koppelen aan eisen; op vele bedrijventerreinen hebben de gemeentes op onderhoud bespaart. Als er nieuwe LED-verlichting en andere vernieuwingen komen, kan aan de bedrijven gevraagd worden om zich te organiseren of ook aan hun panden iets te doen. Zo kan een eerste impuls creëert worden voor duurzame ontwikkelingen.
- Vertrouwen en aanspreekpartner; Als bijv. bij een bedrijf de ketel ophoudt, wil je dat de ondernemer contact opneemt met de organisatie die zich met de energie op het terrein bezig houdt. Zo komen ze bij de contactpersoon terecht die duurzame ontwikkelingen kan stimuleren. Het is daarom ook belangrijk om een partij te hebben die veel contactmomenten met de ondernemers heeft en ter gelijker tijd een partij die voor de ondernemers bezig is. De gemeente volgt meestal eigen doelen, maar het parkmanagement werkt voor de bedrijven en wordt daarom meer vertrouwd.

Thank you for your time and participating in this study!

Interview Frank de Bruijn (Provincie Brabant)

1. What is/was your function within the project?
 - Voor de provincie Brabant ben ik energie-reststromenmakelaar. Dit betekend, dat ik bedrijven bezoek en daar kijk, wat hun energieverbruik is, welke stromen er in en uit gaan en of er stromen bij zitten, die bijv. aan andere bedrijven gekoppeld kunnen worden.
2. How long have you been involved in the project? In which phase did you enter the project (initiation, design, realization, operation)?
 - 6 of 7 jaar
3. Who initiated the project (e.g. a company, local government, etc.)?
 - Eigenlijk is de overheid de enige aangewezen rechtspersoon, om een project te initiëren. Bedrijven willen wel vaak hun reststromen ter beschikking stellen, maar het is niet het corebusiness van de bedrijven om dit te organiseren. Punt een is, dat als er infrastructuur moet komen, de bedrijven over het algemeen geen geld hiervoor hebben. Punt twee is, dat ze er geen mensen voor hebben, omdat deze meestal al wegbezuinigd zijn. En ten derde, als er infrastructuur moet komen, moet die vaak over grond gebouwd worden die niet van hun is. De overheid moet dus kennis en mensen inhuren om deze projecten aan te gaan om bedrijven in de regio te houden. De incentives van de overheid liggen heel erg op vasthouden van de bedrijven, het uitbreiden van de bedrijvigheid, het halen van de milieudoelstellingen en het aantrekken van innovatie in de regio.

4. Which obstacles did you face during the development of the project?
 - De initiatie van dit soort projecten moet gedaan worden door de overheid en ik zie dat de overheid te weinig doet.
 - De tussenfinanciering mist. De bedrijven willen er wel aan dit soort projecten mee werken en daar hun geld in investeren, maar daar is een financiering voor nodig. Voordat alle contracten getekend kunnen worden moet de eerste idee verder ontwikkeld worden. Hiervoor is veel onderzoek nodig, moeten gespreken gevoerd worden en pas dan kunnen de contracten opgesteld worden. Maar de banken willen pas dan financieren als alle contracten getekend zijn. De financiering van de voorbereidende processen wordt op dit moment nog onvoldoende gefaciliteerd.
 - Gebrek aan kennis bij de overheid. Wat betreft de tussenfinanciering van de projecten, is er helaas nog niet doorgedrongen, dat de beschikbare middelen te laag zijn. Het is een te nieuw onderwerp.
 - Te lange terugverdientijd; De meeste bedrijven rekenen op een terugverdientijd van 3-5 jaar, maar de meeste projecten lopen 10 tot 15 jaar voordat ze terug verdient zijn. Hier zal de overheid in kunnen spelen en ervoor zorgen, dat de investeringen of de lange termijn afgezet kunnen worden.
5. Which strategies were chosen to overcome them?
 - Voor de problemen wat betreft de financiering van de voorbereidende fase is er in Brabant een kleine oplossing voor gevonden. Door "green deals" kan het risico van de partij die het idee omzet naar contracten afgedekt worden. In het geval dat het project niet doorgaat, kan diegene uit deze garantiefond betaald worden. Maar de garantiefond is veel te klein.
6. What were important factors for the success of projects (e.g. cooperation of companies, motivation, trust, governmental support, etc.)?
 - Een essentiële factor is het vertrouwen van de bedrijven; Als bedrijven onderling een coöperatie willen oprichten moet de overheid ervoor zorgen dat er regelingen komen om op de lange termijn afspraken te beslissen. Hiervoor zijn regelingen voor de financiering, het aanleggen van een leidingstelsel dat niet loop over grond van een bedrijf nodig, die de proces faciliteren.
7. Which important stakeholders were involved in this phase? Why was their participation important?
 - Gemeente en overheden; Ze zijn de enige aangewezen rechtspersoon, hebben de nodige grond, kunnen kennis inhuren en het project coördineren.
 - Financieringsinstellingen, zoals banken, energiefonds, pensioenfondsen en andere instellingen die dit soort projecten willen financieren tegen maatschappelijk aanvaardbare tarieven.
8. Looking back at obstacles and problems that occurred during your project, which recommendations would you make to increase the success of future projects?
 - De overheid moet initiëren waar grote reststromen over zijn en vervolgens analyseren waar koppelingen gemaakt kunnen worden met mogelijke afnemers daarvan. Bedrijven willen er wel aan mee werken, maar de initiatief moet door de overheid genomen worden.
 - Kennis en instrumenten; De overheid moet kennis met dit soort projecten verzamelen en instrumenten ter beschikking stellen om de ontwikkeling te faciliteren. Op dit moment deken ze bijv. dat energiefonds het probleem oplossen, maar dat is niet zo want de energiefonds gaan er pas in als het hele vooronderzoek is afgerond en de contracten getekend zijn. Voor de financiering hiervan moet de overheid wel instrumenten ontwikkelen. Dit kan bijv. ook door "revolving credits", wat betekent dat de overheid het geld met begin van het project terug krijgen.

Thank you for your time and participating in this study!