

Circular Economy in business parks: Best practices and how to apply them.

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International Business & Management Studies: Thesis (abridged)



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1. Executive Summary

This thesis report is titled *“Circular Economy in business parks: Best practices and how to apply them.”* The thesis company is called Cirkellab and is located in Dordrecht, the Netherlands. Cirkellab stimulates, creates, and connects in the transition to a circular economy in the Drechtsteden region. In order to do that, the company conducts research, advises, guides, and initiates business-cases around efficiency of raw materials and reuse, sustainable energy, and sustainable use of people. Cirkellab strives to provide a hundred circular innovations and solutions, and with that create a thousand new jobs and social work/learning opportunities, all within the next ten years.

The aim of this thesis is to do research into international cases of good examples of business parks and industrial areas operating in a circular way, and how these examples could be translated into concrete and applicable ideas for both the Drechtsteden region and other regions. The desired end result for the thesis is a plan of action detailing how to apply the lessons learned and best practices from the international examples to the (Drechtsteden) region.

The report deals with the following two questions:

1. What are the best practices with regards to the operations of business parks and/or industrial areas under the idea of a circular economy?
2. How can these best practices be applied to business parks and industrial areas in the (Drechtsteden) region?

In order to answer these questions, these are some of the research objectives that were compiled:

- * A list of between 15 and 25 business parks of industrial areas with a focus on circular economy. These parks can be either operational or in the planning phase.
- * Three examples of the previously mentioned list will be chosen to study in-depth. The research will describe how these parks measure their success, and what the advantages and disadvantages are to the way they operate.
- * The research will describe the role of the (local) governments in circular business parks and circular economy in general.
- * The research will provide the ‘best practices’ and ‘lessons learned’ based on previously acquired information (first main research question).
- * The research will describe how stakeholders can be convinced to choose for a circular model (by interviewing the aforementioned people, and by desk research).
- * The research will deliver a report on “Business model Circular Business Parks.” All acquired information will be compiled, made orderly, given a logical order, and whatever else is required. This report will be the end product for Cirkellab.

These objectives led to a number of sub-questions which helped design the research, mainly dealing with the advantages and disadvantages of the circular model, how these parks measure their success, the differences between “regular” parks and circular parks, the role of the government in these parks, examples of failed parks, the specific lessons learned and best practices, and how to apply these in the Drechtsteden region. They also deal with questions like how to persuade stakeholders, what is a standard circular model, and what are the benefits to Cirkellab.

The most significant results of the study are the importance of collaboration, the closing of as many loops as possible, and the inclusion of so-called “anchor” tenants. Furthermore, the research concluded that

there is a lot of variation between circular parks, and there are great differences in size, level of commitment to the circular model, types of companies present, and presence of different sectors within a single park. The conclusions deal with a standard model for circular business parks, and how to apply the lessons learned from this report in practice.

In conclusion, this report deals with the question of how both planned and operational business parks can opt for a circular model, and it details the benefits and challenges related with this change. The report gives guidelines on how to persuade stakeholders of the change, and what barriers to look out for. It provides numerous real-world examples, and uses these to define clear instructions on how to help (local) governments and business parks with making the change to a circular model.

Note: This is the abridged version of the thesis, in which information irrelevant to the general public has been removed. This includes the student's personal motivations and reflections. If you believe you want to read the full version anyway, please contact the author at sschotel@gmail.com. Note that all relevant information regarding the research is already included in this version.

1.1. Overview of abbreviations used (in order of appearance):

IBMS – International Business & Management Studies
HRM – Human Resource Management
BBA – Bachelor of Business Administration
EIP – Eco-Industrial Park
PCSD – President's Council on Sustainable Development
TU – Delft University of Technology
UNEP – United Nations Environment Program
CE – Circular Economy
DEC – Devens Enterprise Commission
CEO – Chief Executive Officer
UN – United Nations
BCI – Buck Consultants International
CRM – Customer Relationship Management
DK4 – Dordtse Kil 4

1.2. Introduction case company

Cirkellab (www.cirkellab.nl) was founded in 2015 and stimulates, creates, and connects in the transition to a circular economy in the Drechtsteden region. In order to do that, the company conducts research, advises, guides, and initiates business-cases around efficiency of raw materials and reuse, sustainable energy, and sustainable use of people. Cirkellab strives to provide a hundred circular innovations and solutions, and with that create a thousand new jobs and social work/learning opportunities, all within the next ten years.

Cirkellab is a service oriented business, providing knowledge and experience for external parties in regards to circular economy and sustainability in general. The people working at the company all have large professional networks within both the Drechtsteden region and nationally, and have the support of the local governments. Cirkellab is the premier hotspot for research, information, and advice about circular economy in the region. Cirkellab does not have any competitors, as it is the only company of its kind in the Drechtsteden region.

In 2016, the company consists of four employees. Their projects include organizing a so-called Youth Lab (where local, circular, businesses presented their cases to students and asked them for input) and an extensive project for the local government in Dordrecht to map out all circular opportunities in the region (for certain sectors). There are plans to grow, and the company is already looking for a larger accommodation. No information about annual sales or profits over the last three years is available yet, since the company was only founded in February of this year, and did not register with the Dutch Chamber of Commerce until June. That being said, the company is very ambitious, and wants to influence the way the Drechtsteden region does business. In light of this, they are trying to find examples of best practices regarding circular economy in other regions of the world. That is where this thesis comes into play.

1.3. Management issue

The aim of this thesis is to do research into international cases of good examples of business parks and industrial areas operating in a circular way, and how these examples could be translated into concrete and applicable ideas for both the Drechtsteden region and other regions. The desired end result for the thesis is a plan of action detailing how to apply the lessons learned and best practices from the international examples to the (Drechtsteden) region. The plan has to have a concrete framework, and the results have to be both attainable and realistic. It will offer advice and guidelines on how to create and operate a circular business park. The plan has to be a document the company can present in an advisory capacity.

1.4. Thesis objective

The objective of the thesis is to identify good examples of circular economy with regards to the operation of business parks and/or industrial areas, both in the Netherlands and especially worldwide (e.g. the Kalundborg Symbiosis in Denmark, or Park 2020 near Amsterdam), and to translate the best practices and lessons learned from these examples into concrete and applicable ideas for existing and new business parks/industrial areas in the Drechtsteden region (Dordrecht, Zwijndrecht, Papendrecht, Sliedrecht, Hendrik-Ido-Ambacht & Alblasterdam).

Also included in the thesis will be a formal plan of action detailing how to implement the suggestions from other (international) regions with regards to the efficient, effective, and most of all circular operations of business parks and/or industrial areas, which Cirkellab can use in their business model.

1.5. Research objectives

Following is a list of research objectives. They are the deliverables, derived from the research questions (see chapter 1.6), the research will produce.

- * A list of between 15 and 25 business parks of industrial areas with a focus on circular economy. These parks can be either operational or in the planning phase.
- * Three examples of the previously mentioned list will be chosen to study in-depth. The research will describe how these parks measure their success, and what the advantages and disadvantages are to the way they operate.
- * The research will describe the kind of companies that are usually present in circular business parks, how large the parks are, and note any remarkable differences between circular and regular business parks.
- * The research will provide between one and five examples of failed circular business parks. It will describe why and how these failed, and will come to a conclusion on what could have been done differently in order to prevent this failure.
- * The research will describe the role of the (local) governments in circular business parks and circular economy in general.
- * The research will provide the 'best practices' and 'lessons learned' based on previously acquired information (first main research question).
- * The research will compose a list of existing and planned business parks and industrial areas in the Drechtsteden region, and describe what they are already doing in regards to circular economy or sustainability.
- * The research will provide a list of between 5-10 persons/companies/agencies to be interviewed with regards to drivers for circular economy.
- * The research will describe how stakeholders can be convinced to choose for a circular model (by interviewing the aforementioned people, and by desk research).
- * The research will deliver a report on "Business model Circular Business Parks." All acquired information will be compiled, made orderly, given a logical order, and whatever else is required. This report will be the end product for Cirkellab.

1.6. Research design

The thesis will have two main research questions, each followed by a number of sub questions, from which the research objectives will be derived.

1. What are the best practices with regards to the operations of business parks and/or industrial areas under the idea of a circular economy?
 - a. Which business parks or industrial areas in the world can be identified as having a circular character?
 - b. How are these parks measuring their success?
 - c. What are the advantages and disadvantages of operating under the idea of a circular economy?
 - d. What are the most notable differences in comparison to 'regular' business parks?
 - e. What kind of businesses are present in these areas?
 - f. What are examples of failed circular business park (projects)?
 - g. What were the reasons for the failure?
 - h. Could these failures have been prevented?
 - i. What is the role of the government in these areas?
 - j. Taking into account all of the above, what are the specific lessons learned and best practices found from circular business parks

2. How can these best practices be applied to business parks and industrial areas in the (Drechtsteden) region?
 - a. What business parks and industrial areas are present in the Drechtsteden right now?
 - b. Are they doing anything with regards to sustainability or circular economy already?
 - c. How can the stakeholders be convinced to switch to a circular model?
 - d. Are there any new business parks or industrial areas planned for the near future?
 - e. If so, what kind of plans are there for those already?
 - f. How can the best practices and lessons learned be converted into a model for circular business parks, in any region?
 - g. How will this model benefit the thesis company?

The idea behind these questions is to correctly identify the best practices regarding circular business parks, and how to translate these into a usable guidebook that Cirkellab can use to further their goal of stimulating circular economy in the Drechtsteden region and beyond. These questions will form the framework for collecting all information needed to meet the objective of the thesis. The list of questions was compiled in consultation with Cirkellab, and all parties believe the answers will help create a sufficient end product the company can use in their advisory capacity.

2. Theoretical foundation

2.1. Introduction

The literature the research will make use of will vary greatly, but most will come from journals, books, and reputable online sources regarding circular economy and business parks in general. Examples include Harvard Business Review, the Yale Journal of Industrial Ecology, reports by the Ellen MacArthur Foundation, the United States Business Council for Sustainable Development, Indigo Development Research Centre, research published by Delft University of Technology and other reputable (international) universities and research centres. In the bibliography at the end of the report a full list of works used and cited can be found.

The works cited are chosen because of their relevance and reliability. In order to assure validity and credibility, several different sources will be used (triangulation). These range from interviews, financial statements, company reports, company databases, governmental reports, other relevant secondary data, information and knowledge available within Cirkellab, et cetera. Several measures will be taken in order to ensure the reliability of the data. Some of them, like triangulation, have already been discussed above. Experience shows that most people in this professional area (circular economy) are very helpful, especially towards students. This is a great thing to help assure the commitment of informants. Furthermore, the aforementioned professional network inside Cirkellab will also help ensure commitment from external parties. The control measures are already mentioned above, namely triangulation and checking the information of the informants against known data. In order to check the professional quality of the interviewer and the interview questions, they will be reviewed by the company supervisor, and if needed and/or possible, the thesis supervisor. In order to prevent bias, the results will be checked by both the company supervisor and the thesis supervisor, and perhaps the thesis second reader as well. The interviews will be recorded both digitally and manually by using a voice recorder or camera, and by taking notes.

The research questions have an exploratory nature. It is suspected that there is a relationship between some phenomena. There are two main research questions in this thesis. The first deals with what the best practices and lessons learned from (un)successful (international) business parks and industrial areas operating under a circular economy model are. The second question asks how these best practices and lessons learned can be turned into concrete recommendations and how to apply these recommendations within the (Drechtsteden) region. The phenomenon that is suspected is a relationship between circular economy and economic benefits. In other words: when running a circular business park, all parties inside the park reap demonstrable economic and/or environmental benefits.

2.2. Theory

For the first research question most information will come from desk research. This question pertains mostly to other successful circular business parks, which are often very willing to share their success. However, their claims will always be checked through other sources to ensure the validity of the data. The reason this concept is chosen is because of the vast amounts of information already available, and it would not be an efficient use of time to study things that have already been studied in such detail. However, this does mean there might be some limitations on the research, as some information might be hard to find. If this is the case, other concepts like interviews will be used to try and collect the missing data.

The second research question will mostly make use of data collected from interviews and knowledge available within Cirkellab, supported by a small amount of desk research. This question deals with the practical application of the theory learned in question 1, and as such must be tested in practice. This will be done through various interviews with key figures in the sector, checking the answers against each other to ensure valid data. The limitations on this might be that there will not be sufficient interviews available. In order to overcome this, a back-up list will be used, in order to ensure enough data to draw logical conclusions.

3. Methodology

3.1. Research questions

The thesis has two main research questions, each followed by a number of sub questions, from which the research objectives have been derived.

1. What are the best practices with regards to the operations of business parks and/or industrial areas under the idea of a circular economy?
 - a. Which business parks or industrial areas in the world can be identified as having a circular character?
 - b. How are these parks measuring their success?
 - c. What are the advantages and disadvantages of operating under the idea of a circular economy?
 - d. What are the most notable differences in comparison to 'regular' business parks?
 - e. What kind of businesses are present in these areas?
 - f. What are examples of failed circular business park (projects)?
 - g. What were the reasons for the failure?
 - h. Could these failures have been prevented?
 - i. What is the role of the government in these areas?
 - j. Taking into account all of the above, what are the specific lessons learned and best practices found from circular business parks

2. How can these best practices be applied to business parks and industrial areas in the (Drechtsteden) region?
 - a. What business parks and industrial areas are present in the Drechtsteden right now?
 - b. Are they doing anything with regards to sustainability or circular economy already?
 - c. How can the stakeholders be convinced to switch to a circular model?
 - d. Are there any new business parks or industrial areas planned for the near future?
 - e. If so, what kind of plans are there for those already?
 - f. How can the best practices and lessons learned be converted into a model for circular business parks, in any region?
 - g. How will this model benefit the thesis company?

The idea behind these questions is to correctly identify the best practices regarding circular business parks, and how to translate these into a usable guidebook that Cirkellab can use to further their goal of stimulating circular economy in the Drechtsteden region and beyond. These questions will form the framework for collecting all information needed to meet the objective of the thesis. The list of questions was compiled in consultation with Cirkellab, and all parties believe the answers will help create a sufficient end product the company can use in their advisory capacity.

Data collection instruments to be used are, as discussed, desk research, case studies, and interviews. The research questions guide the interviews, and the desk research will help formulate the observation criteria. A lot of organizational documents will be analyzed and their contents used in the development of this thesis and the answering of the research questions.

3.2. Research strategy & data collection

Unit of analysis

The unit of analysis in the thesis are the characteristics, processes, activities and phenomena related to circular business parks and industrial areas. What are the characteristics that make the parks work (or not work), what processes are most important within the park (for example, inter-park logistics), what activities are needed for the park to work optimally (how are the businesses inside the park working together?), and what other phenomena can be distinguished.

Unit of observation

The unit of observation for the thesis are the people within the circular business parks, namely the project leaders and/or public relations managers. They will have the information required to answer the research questions that cannot otherwise be found by desk research. Another unit of observation will be the responsible people within the (local) governments who have ties with the business parks. They will often have information about the requirements for business parks in general, and for circular business parks in their area in particular. The last unit of observation will consist of information within Cirkellab, both its employees and its databases.

This strategy is chosen because it will give the best results for the thesis, and will assist the author in correctly answering all questions, and as such deliver the most benefit to Cirkellab. The people to be interviewed are chosen because they are leaders in their fields, and have vast amounts of expertise. They are selected by the author with help from Cirkellab.

3.3. Assuring credibility

In order to assure validity and credibility, several different sources will be used (triangulation). These range from interviews, financial statements, company reports, company databases, governmental reports, other relevant secondary data, information and knowledge available within Cirkellab, et cetera.

The control measures are already mentioned above, namely triangulation and checking the information of the informants against known data. In order to check the professional quality of the interviewer and the interview questions, they will be reviewed by the company supervisor, and if needed and/or possible, the thesis supervisor. In order to prevent bias, the results will be checked by both the company supervisor and the thesis supervisor, and perhaps the thesis second reader as well.

4. Research findings

4.1. Introduction to Circular Economy

In nature, waste does not exist. Everything that dies gets reused, and everything is part of a continuous cycle. Circular economy is an alternative economic model that tries to mimic this cycle. Instead of the linear “take-make-waste” model the world is following now, circular economy tries to limit the use of natural resources through various ways. This research will have numerous examples of this, and as such, they will not be discussed right here. For more information on the subject, the author would like to direct you to the Ellen MacArthur Foundation, the leading institute on all things related to the circular economy, as well as Cirkellab.

4.2. Introduction to Circular Business Parks

Kalundborg, Denmark: the world's first example of separate industries working in unison to create a competitive advantage by exchanging materials, energy, information and products.

In the 60's and 70's of the previous century, private conversations between a few enterprise managers in the Kalundborg region unintentionally formed the basis of a new way of operating business parks and industrial areas. When talking about the needs of their respective industries, people from Statoil, an oil and gas company, and people from Gyproc, a local gypsum production company, realized that the excess gas produced by Statoil could be used by Gyproc to dry the plasterboards they were producing. Statoil agreed to supply the gas, and the first connection was made. One year after this agreement, in 1973, what is now known as the Kalundborg Symbiosis got its third partner. When the nearby power plant (now Dong energy) expanded their operations they were connected to the Statoil pipelines in the area. In the years after that, several other businesses flocked towards the industrial area, each linking up in different ways. The term ‘industrial symbiosis’ was first used in 1989 to describe the collaborations at Kalundborg (Kalundborg Symbiosis, 2016).

After the success of the Kalundborg Symbiosis, it was the US government that became very interested in the concept of so-called Eco-Industrial Parks (EIPs), and in June 1993, President Clinton established ‘The President’s Council on Sustainable Development (PCSD). The objective for the PCSD was to advise the President on “matters involving sustainable development.” (Federal Register, 1993). Back then, they defined five, in their opinion, major characteristics of a successful EIP. These included:

- * some form of material exchange between multiple separate entities,
- * industries within close proximity to each other,
- * cooperation between plant management of the different corporations,
- * an existing infrastructure for material sharing that does not require much retooling, and
- * "anchor" tenants.

We can see that these guidelines, first proposed in the 90s, still have some importance, as a research team of the Delft University of Technology (TU), working on EIPs, describe their minimum requirements for the cases they were focused on as follows (Korevaar, Galgani, & Yak, 2011):

Diversity

Are there more than two different industrial sectors present in the cluster?

Industrial focus

Is there a main industrial focus present in the cluster?

Industrial symbiosis

Do the firms or industrial sectors present have at least two apparent symbiotic relationships?

- * Byproducts
- * Energy cascade
- * (Waste)water
- * Shared infrastructure/services

Information & environmental orientation

Does the park communicate a clear attention to the environment, or is the environmental character of the park a main focus point.

Both sets of characteristics placed great importance on cooperation and the exchange of materials, and both mention a shared infrastructure. While the PCSD paid special attention to the industries being in close proximity to each other, the TU team was more interested in diversity and industrial focus. Furthermore, the PCSD believed in attracting so-called anchor tenants, large corporations with resources to support early implementation, and argued that resources should be made available to recruit these corporations for planned EIPs (PCSD, 1997). Other countries soon followed, and as the popularity of sustainability increased, so did the number of EIPs, industrial symbioses, and parks based on circular economy. In 2005, the United Nations Environment Program, together with the Chinese government, started the 'Circular Economy initiative' in an effort to address unsustainable patterns of production and consumption (UNEP, 2005). Ernest Lowe, commissioned by the Chinese government, defined yet another set of guidelines for successful EIPs in his paper "*An Eco-Industrial Park definition for the Circular Economy.*" Just like the previous examples, one of his most important points is the synergistic linkage of the various enterprises, with the exchange of by-products not recycled internally (Lowe, *An Eco-Industrial Park definition for the Circular Economy*, 2005).

4.3. What are the best practices with regards to the operations of business parks and/or industrial areas under the idea of a circular economy?

In this part the findings regarding the first research question and all its sub questions will be listed. The first research question is as follows: *What are the best practices with regards to the operations of business parks and/or industrial areas under the idea of a circular economy?*

The following sub questions and their findings will lead into the conclusions and recommendations in the next chapter.

4.3.1. Which business parks or industrial areas in the world can be identified as having a circular character?

Table 4.1 is a list of business parks and industrial areas that are either operational or planned, which (will) have characteristics of Circular Economy (CE). Out of these, three will be chosen to study in-depth (question 1B).

Table 4.1

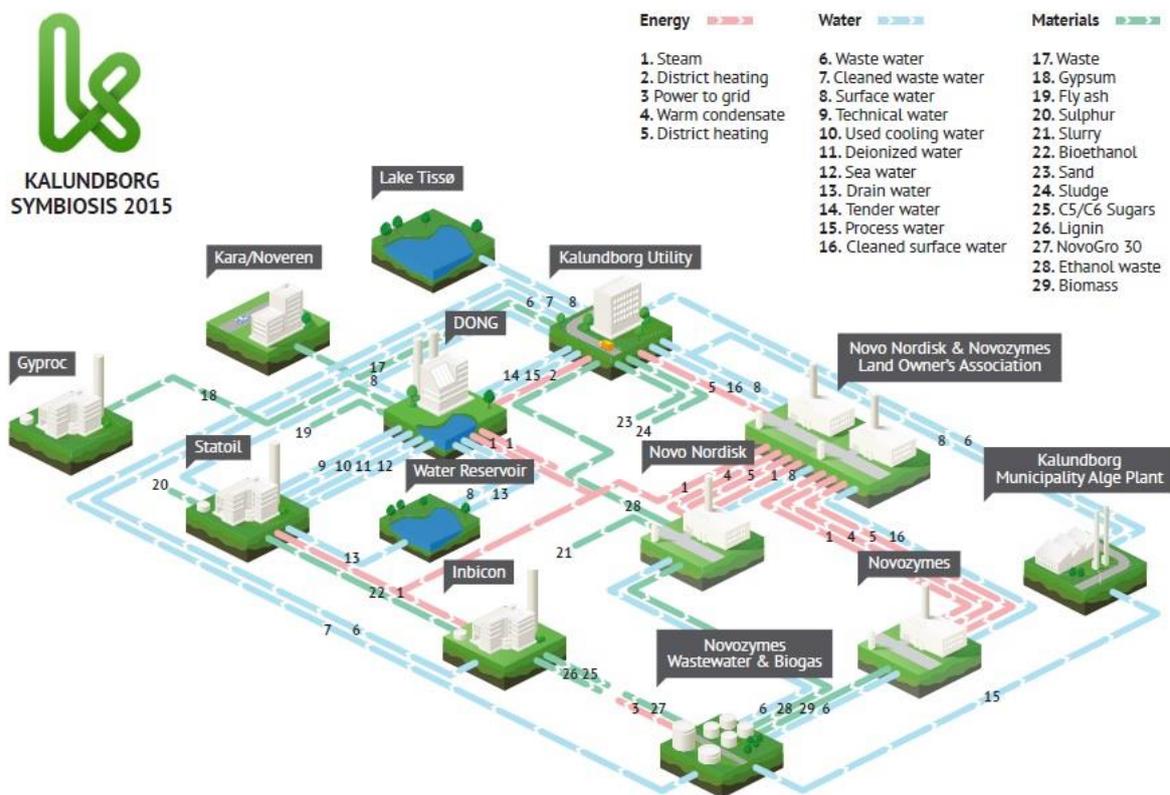
Operational		
Name	Location	Notes
Kalundborg Symbiosis	Kalundborg, Denmark	First industrial symbiosis
Rantasalmi	Rantasalmi, Finland	
Devens Eco-Industrial Park	Devens, Massachusetts, USA	Reuse of a former military base
Cape Charles Sustainable Technologies Park	Cape Charles, VA, USA	The first planned EIP in the USA
Green Tech Valley	Styria, Austria	
The Textile Recycling Valley	Northern France	
Tianjin Ziya Industrial Zone	Tianjin, China	China has specific laws promoting Circular Economy
NISP Network	Humber region, UK	
London Sustainable Industries Park	London, UK	
TXI/Chapperal Steel	Midlothian, TX, USA	
Port of Houston	Houston, TX, USA	
Wheatbelt Town of Narrogin Industrial Symbiosis	Narrogin, Australia	
Guayama	Puerto Rico	
Cabazon Resource Recovery Park	Cabazon, CA, USA	
Biopark Terneuzen	Terneuzen, Netherlands	
Alberta's Industrial Heartland	Alberta, Canada	
Planned		
Name	Location	Notes
Park 2020	Hoofddorp, Netherlands	
Schiphol Trade Park	Schiphol, Netherlands	
Kilpilahti	Kilpilahti, Finland	
Innovista Park	Hinton, Canada	
The Brownsville Project	Brownsville, TX, USA	
Landskrona	Landskrona, Sweden	
Berks County Eco-Industrial Park	Berks County, PA, USA	

In order to see if having a circular character (or circular aspects) has any positive impact on a business park, three of the aforementioned parks will be studied in-depth, over the next set of sub-questions. The parks that will be studied, and the reasoning for picking these parks are as follows:

The Kalundborg Symbiosis

As mentioned before, the Kalundborg Symbiosis was the first business park that embraced a circular character. Born out of coincidence and growing organically, it has become an example for parks all over the world. From their website: “*The Kalundborg Symbiosis is an industrial ecosystem, where the by-product or residual product of one enterprise is used as a resource by another enterprise, in a closed cycle.*” Diagram 4.1 shows the different enterprises and the material flows between them.

Diagram 4.1 (symbiosis.dk)



A lot of research regarding the park is already readily available, and as such, it makes for a great place to start when investigating circular business parks.

Devens Eco-Industrial Park

This repurposed military base, located 30 miles west of Boston, is a prime example of a planned eco-industrial park. In 1993 it was announced that Fort Devens, as the base was known then, would be closing in 1996. Half the land would go to the Army Reserve, but the northern half of the base was to be decommissioned and sold off (McMorrow, 2011). To help the surrounding area dealing with the impact of the base suddenly transitioning back to civilian property, the Massachusetts General Court passed ‘Chapter 498’ which created the Devens Enterprise Commission (Vanasse Hangen Brustlin, Inc., 1994). This commission made sustainability their priority, stating “Development must be sustainable, which means achieving a balance of economic, social and environmental needs while maintaining and enhancing the natural resource base.” as their first objective in their goal statement (DEC, 1993). The way they have gone

about reusing the existing facilities, and their focus on sustainability and cooperation makes the Devens Eco-Industrial Park a great example for new parks.

Rantasalmi

The Rantasalmi business park was the first planned eco-industrial park in Finland. It is based around forestry works in the mid-Nordic region, and has been operational since 2005. There had been some other EIPs in the country, but those all evolved organically over time. The regional council in Rantasalmi (a nearby town with the same name) wanted to take the lead on the project, and hired an engineering firm to develop the site (Macaulay, 2013). What made this site attractive to the council was that the most important aspects of any successful EIP were already in place: a large company to take the role of “anchor tenant” (Rantasalmi Oy) multiple businesses in close proximity, cooperation on a management level between plants, and an existing infrastructure capable of supporting a circular model. The way a local government set about planning an EIP around already present industry makes it a great example for further investigation.

4.3.2. How are these business parks measuring their success?

To understand whether or not a business park is successful, one first has to determine how exactly these parks are measuring their success. One of the key aspects of the circular economy is cooperation. Symbiotic relationships between companies are important if there can be any form of sharing, whether it is in information, (waste-) material flows, or infrastructure. Heeres, Vermeulen and de Walle (2004), as well as Mirata (2004) establish five different types of barriers regarding symbiotic relationships, which were later again used by Gibbs and Deutz (2007):

1. Technical barriers occur when exchanges are not viable.
2. Economic barriers include economically unsound or risky exchanges.
3. Informational barriers arise when the right people and the right information do not meet.
4. Organizational barriers occur when the exchanges intended do not fit the current corporate organizational structure.
5. Regulatory or legal barriers also exist.

It can be surmised that in order to be successful, a business park with circular aspects need to surmount these barriers. Furthermore, the parks need demonstrable examples of the progress they make in relation to either regular business parks, or to their own situation before the change to a more circular model (for example, amount of energy saved, percentage of lower emissions). Following will be a rundown for the three parks on whether or not they pass the barriers, and how they present their success to the outside world.

The Kalundborg Symbiosis

Being the most known circular park, the Kalundborg Symbiosis has gone to great lengths promoting their successes. Researchers at Yale estimated the following resource savings at Kalundborg (Chertow & Lombardi, 2005):

- Groundwater savings: 2.1 million m³ per year.
- Surface water savings: 1.2 million m³ per year.
- Oil savings: 20.000 tons per year.
- Natural gypsum: 200.000 tons per year.

On their own website, the symbiosis also lists some results measured in 2010:

- Yearly CO₂ emissions reduced by 275.000 tons.
- Biogas made out of yeast slurry from the production of insulin.
- Recycling of 150.000 tons of gypsum from desulphurization of flue gas (SO₂) replacing the need to import natural gypsum.

Looking at these figures, it becomes clear the collaborations at the Kalundborg Symbiosis have had a positive effect, both environmentally and economically. With this information, we can see if some of the aforementioned barriers can be surmounted. First of all, the technical barrier. Looking back at diagram 4.1, we can see there are several exchanges happening simultaneously between a number of different enterprises. If there have been any technical problems, they have obviously been solved. This shows that other parks with a similar set-up can learn from Kalundborg when they are faced with technical barriers.

Similarly, the numbers show the economic barrier has also been overcome. Chertow & Lombardi (2005) suggest that a collective annual savings, primarily on resources, are upwards of \$15 million, from a total investment of \$90 million. Qi, Huiming and Junfeng (2009) mention that most industrial symbiosis networks are primarily economic, and the financial benefit to the parties are seen as the most important reason for their development. With this in mind, the way the Kalundborg Symbiosis presents their results is typical: after all, savings on water and oil equal financial benefit. If the businesses at Kalundborg all have demonstrable lower water and energy costs compared to similar businesses outside of an EIP, one could link that fact to the success of the symbiosis. For example, the company Gyproc (seen in diagram 4.1) has reported a 90% to 95% savings in oil consumption after they switched to gas supplied by the DONG Energy plant (International Institute for Sustainable Development, 2013). The next barrier, informational, has also clearly been overcome by the Kalundborg Symbiosis.

The park is, as mentioned before, a shining example of how an industrial symbiosis is supposed to work. The sole reason the symbiosis was constructed in the first place was specifically because the right information met the right people, as described at the start of chapter 4.2. At the same time, this success further shows the importance of good communication between members of an industrial park. It is easy to see why this is one of the barriers though. A key aspect of these undertakings is openness and a willingness to share. If one company in a park *does* want to be a part of the symbiosis, but does *not* want to share a proportional piece of the responsibilities, the symbiosis will be doomed to fail. Luckily, this is not the case at Kalundborg, as its success allowed them to attract only companies that had a synergy with the park. This segues into the next barrier, namely the organizational barrier. This is more of an issue in naturally forming parks rather than planned parks, as with a planned park, you can determine beforehand whether or not a certain company will be a good fit in regards to organizational structure. In a park like Kalundborg, where existing companies naturally found each other, this can be a much larger problem. For example: if one of the companies supplying their waste materials would already have had a similar deal with a company in a different park, the partnership within Kalundborg would perhaps not have been possible. Fortunately, this was not the case at Kalundborg, where there were very little organizational barriers to cross, but it should be noted that for other naturally developing parks, this could be a real concern, which is why the previous barrier (information), is so important. If a company cannot contribute to the symbiosis, the information provided by them should make that clear beforehand, rather than down the line.

Regulatory or legal barriers can also be difficult to cross, as they depend largely on outside influence (politics). Luckily, the European Commission has started a “zero-waste program” back in 2014, while Denmark in particular adopted a resource strategy that treats all waste as a resource that should either be reused or recycled (Braw, 2014). The Kalundborg symbiosis has the support of the Green Transition Fund, which is an initiative from the Danish Ministry for Growth and Business, focused on creating industrial symbiosis (Christensen, 2015). Furthermore, the Kalundborg business park keeps close ties with the Kalundborg municipality, which further helps the smooth transition of resources (Crane & Matten, 2010). Crane and Matten also argue that voluntary agreements between the government and businesses are becoming very common at a regional, national or even transnational level. This is an example of the mutual benefits a park like Kalundborg can bring. R.T.T. Forman even argues in his Urban Ecology book that one of the main reasons a park like Kalundborg has persisted in the first place was because of the presence of the power station, in essence a public utility, supported by the government (Forman, 2014). All

When looking at all this information, it seems like the Devens park is rather successful. For further evidence, the five barriers will be checked again. When looking at the above diagram, it shows a plethora of material and service flows between the inhabitants of Devens. Because of the variety of businesses in the park, it can be hard to always find a fitting match for every waste stream. In this regard, there are still some technical barriers to be overcome. This does not mean Devens fails the 'success test.' It simply means a lot of progress can still be made, by trying to find new uses for unused waste streams, actively recruiting specific businesses that are known to have a good fit within the Devens community, or increasing the role of both "the Great Exchange" and the EcoStar Exchange.

The economic barrier seems to have already been surmounted by the park, as the numbers Lowitt (2012) provides show the estimated savings. However, this does not mean there are no further economic barriers, as another study showed that two of the biggest (sustainability) challenges companies in Devens faced were reducing the cost of materials (improving materials efficiency) and reducing the cost of energy (improving energy efficiency) (Veleva, Todorova, Lowitt, Angus, & Neely, 2014). Both of these indicate that a lot of progress can still be made from an economic point of view. Informational barriers, on the other hand, are all but non-existent at Devens.

The level of collaboration between companies at Devens is very high, with 86% of organizations at Devens have partnerships with other locals (Veleva et al., 2014). Similarly, 79% of interviewed companies acknowledged that their organizations could benefit from future collaborations, especially in the areas of information sharing, joint purchasing, and joint services (Veleva et al., 2014). Collaborations like these are very important for industrial symbioses, as they help create "short mental distance", "trust", "openness", and "communication" (Ashton & Bain, 2012). As mentioned previously, 86% of organizations engage in collaborations. However, this means that 14% of Devens inhabitants are not collaborating. Organizational barriers could be at the source of this problem, because the current exchanges at Devens might not fit with their current corporate organizational structure.

At this point, it is important to make a distinction between two types of eco-industrial parks, circular parks, or industrial symbioses. Some parks might expect all their participants to engage in all forms of collaboration, and will not allow parks with non-viable waste stream (i.e. businesses whose waste cannot be reused by another company on site). An example of this is Kalundborg, which only allows companies to settle if they can optimally close their loop (Cooke, 2010). A different approach is taken by parks like Devens, which allows any organization in their park, as long as they fit within the "sustainable mind-set" (Lowitt, 2012).

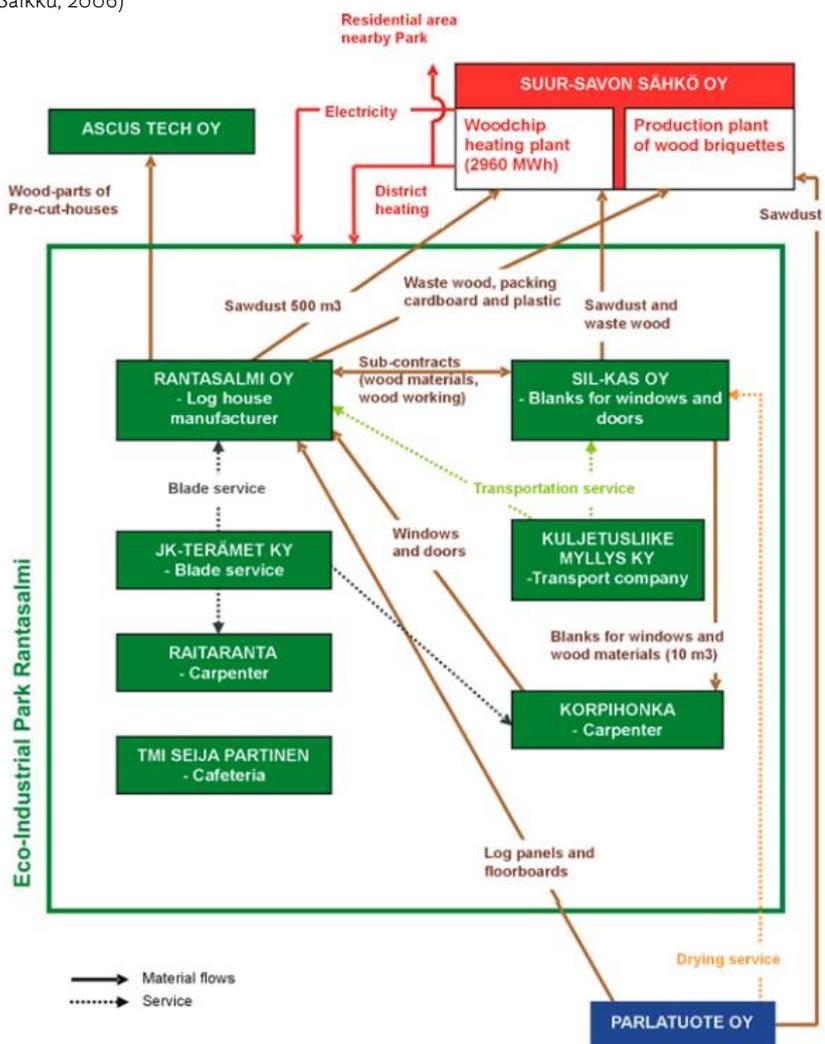
Another park which follows this philosophy is Park 20|20 in Hoofddorp, the Netherlands. In an interview with the author, park manager André Buikema said the following: "When a company wants to settle in our park, we will not tell them no because they are not 'sustainable.' We do not have any list with what qualifies as sustainable." When asked for a specific example, he pointed out the FIFPro House (main office of the worldwide representative organization for all professional footballers). "Take FIFPro for example. When they settled here, they had no idea on whether or not they were a sustainable organization. I told them, "You work with people, which is a form of sustainability." As long as a company has at least an intention to become more sustainable, they are welcome on this park (Buikema, 2016)." With this in mind, one cannot conclude there are limiting organizational barriers. The information provided by Veleva et al. did not include reasons as to why some companies did not join the collaboration, so it could be possible that the companies themselves are practicing sustainability, but simply do not have a suitable collaboration partner within Devens. Lastly, regulatory or legal barriers. Lowitt (2011) argues that a critical success factor for any eco-industrial park is a "strong relationship between industry and local government." This is shown in Devens by the inclusion of several governmental and non-profit organizations (see diagram 4.2). When asked about local government responsiveness at Devens, 66% of respondents rated it "very responsive." A further 24% rated them as "somewhat responsive" (Veleva V., 2012).

Furthermore, as mentioned at the start of this chapter, the US government was adamant about integrating the lessons learned from Kalundborg in their own country. Devens was one of the parks the PCSD's (President's Council on Sustainable Development) projects, triggered by the closing down of the military base and the need to reuse the land (Deutz, Lyons, & Bi, 2015). In conclusion, it can be said that Devens has shown their success through their own publications and numbers, independent research (like the works of Velava and Lowitt), as well as surmounting every barrier listed by Heeres et al., Mirata, and Gibbs and Deutz.

Rantasalmi

Rantasalmi has yet another way of describing their successes. In their report on Green Business Model Innovations, Henriksen, et al. (2012) describe the success of Rantasalmi in ambiguous terms, stating that the park realized several different benefits by forming the partnership. The most important of these are the environmental benefits stemming from the exchange of surplus (waste) material and the exchange of goods, equipment, and services, as well as the financial benefits coming from increased efficiency, lower transportation costs, and saved costs on heating and electricity. For unknown reasons, the Rantasalmi Industrial Park has chosen not to release exact figures on the benefits, although several independent studies (Saikku, 2006), (Macaulay, 2013), (Lehtonen, 2007), (Henriksen, et al., 2012), (Korevaar, Galgani, & Yak, 2011) all agree the project was a success. The unofficial slogan for Rantasalmi was "no more sawdust." The following diagram shows the different partners and their exchanges, and as such, where all that sawdust would be going:

Diagram 4.3 (Saikku, 2006)



While hard facts and figures were not provided, one can check whether or not the barriers mentioned earlier were overcome at Rantasalmi. First of all, the technical barriers: Since Rantasalmi is based around a single type of production, this barrier was a non-issue. The entire plan was based around setting up the park in such a way the participating companies could benefit from each other's waste streams, services and information. The second barrier, much like the first, was taken into account right from the planning phase. By grouping together compatible companies, the risk of economically unsound or risky exchanges was minimized. In fact, the park even went a step further, and implemented a system where companies could rent idle equipment or workforce from others for a reduced price (Henriksen, et al., 2012). Because of this, machines would have less down-time, resulting in greater efficiency, and in the end, lower total costs. The third barrier, informational, was also not a problem at Rantasalmi.

Before the park was opened, the project leaders took great care into first getting together parties that could work well together. While the sharing of information is not high on the list of priorities in the park, it still has a spot. The companies all work in unison, and as such are required to share vital information. If one company fails, others might be taken down with them. This nearly happened in 2010, when one of the bigger companies in the park declared for bankruptcy (Mäkelä, 2011). However, the other companies had contingency plans, and operations could continue in their normal way (Mäkelä, 2011). The organizational barrier was also not applicable to Rantasalmi. That barrier occurs when exchanges do not fit the current corporate organizational structure. As companies were selected with a specific goal in mind, this did not happen. Lastly, regulatory barriers were also not much of an issue. Both the Finnish (local) government (Regional Council of Etelä-Savo) and the EU (ProMidNord) had a hand in creating the park, ensuring the smooth operation (Saikku, 2006). Another example of how the legal barriers were overcome is how the park was operated: 49% was owned by the municipality, 49% by the large companies, and 2% was held by a smaller company. This way both the government and the large companies had an equal vote in the future of the park, with eventual ties being decided by the tie-breaker (the 2%), although this never happened (Macaulay, 2013).

In conclusion, although Rantasalmi did not produce any figures on their success, it is evident that the park is quite successful, and has reached the goals it set for itself (i.e. reducing environmental impact and lower the costs). It is a clear example of how with proper planning, a park like this is relatively easy to realize. We learn that in order to set up a completely new circular business park, the planning phase is absolutely crucial, and that the sharing of important information also plays a huge part in the success or failure of a park.

4.3.3. What are the advantages and disadvantages of operating under the idea of a circular economy?

Advantages

First and foremost, and probably the biggest motivator for companies as well as governments: a circular economy will result in lower costs. A lot of companies say they want to be sustainable, but only if it does not cost them too much. In an interview, CEO of ParkTrust business park management Ad van den Berg (2016) said: "organizations want to invest, they know they cannot stay behind. However, these investments must be budget neutral within five years. Any longer than that, and companies will not be interested." As seen in the examples of the three business parks discussed, they all pride themselves on their cost savings. In fact, a central pillar of the circular economy is about how things like energy efficiency and generating value from waste streams can greatly increase profits of organizations (Ellen MacArthur Foundation, 2015). The parks mentioned previously all show that by embracing a circular character, costs can be saved, and profits can increase. In their 2015 report "Towards a Circular Economy: Business Rationale for an Accelerated Transition" (Ellen MacArthur Foundation, 2015), the Ellen MacArthur Foundation names several

drivers for change. These deal mostly with the disadvantages of the regular (linear) model, but as such, are also advantages for a circular model. These drivers are as follows:

- * **Economic losses and structural waste**
In Europe, material recovery and recycling only results in 5% of the original value of the raw materials. Even industries and sectors many people would think of as optimized have a high level of structural waste. For example, on average a car is parked 92% of its life, a regular office is only in use 35-50% of the time (including working hours), and no less than 31% of food is wasted during the value chain (from farm to plate).
- * **Price risks**
A linear system increases a company's exposure to price risks. Things like volatile resource prices and supply disruptions can cause businesses to decrease investing, and increase costs of protecting against these risks. For example, both agricultural output and metals have experienced the highest price volatility in the last decade than ever before (Dobbs, Oppenheim, Thompson, Brinkman, & Zornes, 2011). Naturally, when switching to a system that requires less direct input (because more raw material gets recycled), these risks will decrease.
- * **Supply risk**
Closely related to the price risks is the supply risk. A lot of areas in the world are largely dependent on the import of certain goods. For example, the European Union imports six times as much natural resources and other goods as it exports (Timmermans, Katainen, Vella, & Bienkowska, 2015). Again, with a more circular model, the need to import natural resources would decrease.
- * **Regulatory trends**
More and more governments see the importance of changing the way business is done. With natural resources depleting and an ever-increasing world population, governments are looking for alternative systems. Sustainability is always high on the agenda, as shown by the large number of climate change laws. In the last seven years, the number of these laws have increased by no less than 66%, from 300 to 500 (based on 66 countries) (Nachmany, et al., 2014). According to the Ellen MacArthur Foundation (2015), this trend, coupled with other aspects, makes the transition to a circular economy possible at scale.
- * **Advances in technology**
Because of innovations in the last years, more efficient collaboration and knowledge sharing is now possible. This is another example of a benefit a business park can reap by opting for a circular model. Aspects like forward and reverse logistics, renewable energy, material tracking and others all promote the collaboration of companies within a business park, as well as making these collaborations as circular as possible.
- * **Acceptance of alternative business models**
According to Ad van den Berg (2016), companies on business parks are always open to new ideas, as long as they do not cost too much. In an interview, some examples he named were companies coming together and creating new job opportunities for people with a distance to the labor market. By banding together, and each taking on part of the costs, they started initiatives like giving cleaning jobs (for the park as a whole, not for companies themselves) to disadvantaged people, or the introduction of free-to-use electric bicycles, in order to reduce emissions from cars. This shows business parks are interested in making changes, even if they are not fully aware they are promoting the ideas of a circular economy. Another example was given by Jeroen Put of Cirkellab. He

told me than oftentimes when he goes out to companies to talk about the circular economy, he asks what they are already doing in that regard. Most companies say they want to start, but are not doing anything right now. However, when asked to describe their business process, the companies actually already describe several things that fit perfectly into the ideas of circular economy (Put, 2016). This shows that alternative business models are not only accepted, they are already, at least partly, practiced. However, usually this does not come from an environmental viewpoint, but purely from an economical one. Businesses will always put “making money” as their top priority, but as both this research, and the research of others shows, a circular model can actually help make money, instead of just costing money. This is especially relevant for business parks, as the collaboration between companies on these parks can generally increase profits for all participants. It no longer has to come from an ideology, but just from good business practice instead.

* Urbanization

According to the United Nations (2014), for the first time in history, over half the world population lives in urban areas. According to the UN, this number is expected to rise to 66% by 2050. The more urbanized the world becomes, the smaller the “circles” can get. For businesses, this means more efficient logistics, asset-sharing, and treatment of returned (end-of-use) materials. For business parks this could mean reduced costs. For a simple example: instead of having to ship all over the region/country/world, more and more business will be localized (as more people will live in a smaller area). This means collaboration on things like logistics could become much simpler.

In conclusion, opting for a circular model has a lot of advantages for business parks. Examples like Kalundborg and Rantasalmi prove that companies can increase their profits, while Devens proves that collaboration on a large scale can still work. Things like shared services, shared information and increased efficiency can lead to increased innovation and saving costs.

Disadvantages

There are also some disadvantages to the circular model. For example, not every company will see “shared information” as an advantage. In a world where some companies refuse to make even their waste streams public (in fear of their competition figuring out their business strategy), convincing people to share their information can be a daunting task. It is up to the frontrunners of the circular economy to convince them how sharing information is actually an advantage. This can be done by illustrating examples of working circular parks like Kalundborg, where the sharing of information has undeniably helped create the symbiosis. In other words, the benefits outweigh the disadvantages.

Another disadvantage is the increased regulation some circular ideas will face. In an interview with Simon Cox, manager of BlueCity010 business park in Rotterdam, he mentioned how the local government was not sure in what sector some of the companies in the symbiosis were located. This meant it was hard to get the correct permits and documentation (Cox, 2016). This further shows the importance of having good connections with the (local) government. Regulations can be a hard barrier to overcome, and maintaining good relations can help business parks pass this barrier. Another example of these regulations can be found in Dordrecht, at the coffee company Pelican Rouge. Sustainability officer Ignas Janssen had the idea to use coffee grounds as a soil improver (like a fertilizer). Research showed that the coffee grounds were beneficial to plant life, and as such, a waste stream could be used to make a profit instead. However, government regulations thwarted this initiative, as coffee grounds were deemed “waste” and as such, it was not allowed to be spread over arable land (Janssen, 2016). Local councilmen Jasper Mos and Rik van der Linden agreed that legislation is running behind on innovation (2016). In other words, whenever innovation happens, governments do not have the correct legislation in place. Instead of making new laws, potential projects like the ones mentioned get halted, waiting for the government to adjust or create legislation. This

can be a disadvantage to business parks, because companies often do not want to wait, and according to van den Berg (2016), definitely do not want to put in more time than necessary when other parties are causing the delay.

Lastly, there is the risk of a core company pulling out. When a park includes a full symbiosis, the removal of one company can be detrimental to every other business in the park. However, this risk is mitigated through the information sharing. As mentioned before, Rantasalmi lost one of its biggest companies due to bankruptcy, but the other parks still continued their collaborations as much as possible.

In conclusion, while there are definitely some disadvantages, some of these can be overcome by providing the right information. Others, like the regulation, can be overcome by engaging good relations with the (local) governments. If a government has partnered with the business park (like the case is in Kalundborg, Devens and Rantasalmi), this disadvantage has much less of an impact than when there is no real partnership (like at BlueCity010).

4.3.4. What are the most notable differences in comparison to 'regular' business parks?

The most obvious difference is the vast amount of collaboration. As the diagrams earlier in this chapter show, nearly every company is connected to one or more other companies in some way, either by providing services, taking in waste streams, or sharing information. According to van den Berg (2016), regular business parks also have collaboration (in fact, he names it the single most important aspect of a successful park), but they are nowhere near as intensive as they are in circular business parks. Buikema (2016) offers that his park (Park 20|20) actively encourages socializing between the different companies on his park, a sentiment echoed by van den Berg. However, true circular parks take this sentiment to an entirely new level. An example of this can be found at Rantasalmi, where idle equipment and personnel from one company can be 'hired' by another. Or at BlueCity010, where companies are selected largely based on their (matching) waste streams.

Another prime difference is the fact that circular business parks will always try to close the loops as much as possible, resulting in less waste than a regular business park. While most companies and parks will try to reduce their waste as much as possible (it is the economic thing to do, after all), circular parks go the extra step, and try to find a new life for the waste they *do* have.

However, as mentioned before, circular parks will have to deal with more regulations than regular parks, especially considering the reuse of 'waste' material. This is another big difference between regular and circular business parks. Companies that want to settle on a circular park can be dissuaded because of the increased regulations, and circular park management can have a hard time finding companies that comply with all regulations. This again shows the importance of having good relations with the (local) governments, because that way regulations can either be changed more quickly, or even worked around in some cases. For example, Simon Cox (2016) had an example of how a certain start-up company could not join the park, because the local government did not know how to classify the company, and as such, they were unable to get proper documentation and permits.

The last notable difference is the presence of anchor tenants. These are large companies that can attract other businesses to the park. Kalundborg has Dong Energy, Statoil and Gyproc, Devens hosts Bristol-Myers Squibb, and Rantasalmi is based around the large woodworking company of Rantasalmi Oy. These are all well-known names within their respective areas, and help secure the recruitment of other suitable companies. While regular business parks also have large companies providing a certain attraction, circular business parks directly use this attraction to find and recruit companies that are compatible with the rest

of the park. This compatibility in turn increases the collaboration, efficiency, and ultimately, profitability of businesses in the park. However, this means circular parks often have to employ targeted recruitment, more so than regular business parks, where nearly any company can join. Some parks deal with this differently than others. For example, BlueCity010 actively searches out for companies with matching waste streams, while Park20|20 welcomes nearly any business, and then tries to link them up with other companies in the park. Both approaches have their advantages and disadvantages, but both can work excellently.

4.3.5. What kind of businesses are present in these areas?

This question is hard to answer, because no two business parks are the same, and even within the concept of circular parks or eco-industrial parks, there are still more differences than similarities. There are parks with companies all within the same (general) branch, like Rantasalmi (wood industry) and Kalundborg (science/chemical), but also parks with specific matching waste streams from a variety of different sectors (BlueCity010). There are parks with companies that all strive to be sustainable, and form a cradle-to-cradle movement (Park 20|20), and then there are just parks that attracted businesses for a variety of reasons, with no obvious overlap (Devens). The fact that all these different types of parks can be successful shows that there is not one specific set of guidelines a park can follow and be a success. The type of businesses present is therefore not a valid measurement of success. The only unifying factor each studied park did have, was the presence of an anchor tenant.

4.3.6. What are examples of failed circular business park (projects)?

Unsurprisingly, it was very hard to find information on failed business parks. Most of these will either not have an internet-presence, or have deactivated their website. There was not much theoretical information on this subject either. Luckily, a contact of Cirkellab had some experience with a failed park in the Hoeksche Waard (the Netherlands). The Dutch government wanted a business park there to meet the rising demand of area for port-related businesses near Rotterdam, while making this park as sustainable as possible. Buck Consultants International (BCI) then researched the feasibility of such a park, commissioned by the state secretary of Economic Affairs. After this independent research, it was no longer a question of whether or not a park should be constructed, but only how to proceed from that point. However, the House of Representatives asked for another independent study, to check the results of the first one. This second study, done by STOGO, revealed that the first one did not actually comply with all the questions the House wanted answered. The conclusion was that BCI's recommendation was based on faulty and incomplete data. Because the original question could not be answered correctly, STOGO recommended further independent research. When asked about this park Adri Bakker (who worked for the Dutch ministry at that time) said: "Luckily, that park was never built. The first research only mentioned vacancy in surrounding industrial areas, but did not take that into consideration for their own plan" (Bakker, 2016).

Unfortunately, this was the only case on which any information could be gathered, and it did not fail because of any circular economy-related reasons, but simply because the park turned out to be unnecessary (see sub-question G.).

4.3.7. Sub Question G: What were the reasons for the failure?

The reason the park at Hoeksche Waard failed was because the first research did not adequately answer the questions asked. Further research concluded that the plan was not feasible, because the problem it was meant to address (increasing demand for area for port-related businesses) did not exist. There were

several other parks within the region that had a large amount of vacancy (parks in Dordrecht and Moerdijk). This shows the importance of good communication during a project like this. While BCI had the best intentions, ultimately their research did not actually cover what was asked of it, and as such, its conclusions were meaningless.

4.3.8. Could these failures have been prevented?

The failure could have been prevented by better communication, especially in the starting phase of the project. After BCI had made their project initiation document, they should have asked if it covered everything it needed to cover. On a positive note, the failure was not related to any circular economy reasons. However, this does mean that not a lot can be learned in regards to the topic of this research paper.

4.3.9. What is the role of the government in Eco-Industrial areas?

The role of the government has been addressed multiple times already. The previous parts have shown that the government can either be a boon or a burden. The most important part is a good collaboration between government and a business park, as van den Berg (2016) mentioned several times. They are the ones who make the legislation, and they are the ones who issue the correct permits and documentation. The most successful examples of circular business parks all have the government as their partner, whether it is a local government, regional government, or state government. These public-private partnerships are a great way to ensure collaboration between both parties, as both of them will have a stake in the success of the park. Previously mentioned examples include the struggles Simon Cox of BlueCity010 experienced when dealing with the local government in Rotterdam, but also the success Kalundborg achieved through their partnership with the nearby municipality. In China, the government does so much to promote circular economy that they have instituted several economic benefits and subsidies to circular businesses and business parks. In his 2005 paper “An Eco-Industrial Park (EIP) to support moving toward the Circular Economy (CE),” Ernest Lowe mentions the Chinese Circular Economy Initiative, which aims to higher productivity and efficiency of resource utilization (Lowe, 2005).

In conclusion, the role of the government varies greatly between parks, and can be different in every country, region, and city. However, it is of great importance that parties intending to embrace a circular character maintain good relations with their government, as this is shown to have a great positive effect. On the other hand, this means that governments should be open to input from the business community. Van den Berg (2016) claims this is actually one of the most important aspects, as he feels governments often make very nice plans, but fail to include the businesses themselves in the creation of these plans. Governments need to create support within the community for their plans, and this starts with involving them from the planning phase all the way to the execution.

4.3.10. Taking into account all of the above, what are the specific lessons learned and best practices found from circular business parks

The first and foremost lesson to be learned is that collaboration is key. Without collaboration, both between companies themselves, and companies and the government, a park is doomed to fail before it even starts. If a party is interested in making their park circular, the first thing should be to see what collaborations are already in place, and where to go from there. Collaborations can be found on almost any business park, especially those with an association for their entrepreneurs. These can range from a very small scale (collective waste disposal), the very large (completely closed loops). To make a park more

sustainable and more circular, these collaborations should be mapped. This way it becomes easier to see which collaborations can still be optimized, which do not make sense, and which can be started up altogether. As mentioned before, companies sometimes not realize they are already practicing (parts of) circular economy. Mapping out collaborations is the first step to a circular business park.

Of course, for business parks that have yet to be built, this step is irrelevant. If there are no businesses yet, naturally there are no collaborations. However, this is such an important aspect of the circular economy that the planners of the project should already design their park with collaborations in mind. For example, a park could include a shared water source, a green energy park, or other shared facilities. These can even help attract businesses to the park, as they can decrease costs of, for example, water, sewage, or electricity. A good example of this is Park 20|20, which has its own garden that sends its produce to the restaurant located on the park. Furthermore, the buildings are all heated and cooled with a central water source. This water source also provides water for all of the greenery spread out throughout the park. If a new business wants to settle in the park, the park management makes sure the central amenities can handle the increased pressure. If not, they are adjusted.

The second lesson learned is the importance of anchor tenants. These large, well-known companies offer a certain attraction to the park. Van den Berg (2016) argues that the presence of a company with a certain status plays a huge part in the decision for other companies to settle in a certain park. He describes it as a “if it is good enough for them, it is good enough for us”-mentality. Every park investigated had one or more of these anchor tenants, and the aforementioned PCSD also mentioned them as one of their core characteristics for eco-industrial parks. As an applicable lesson, this could mean that project planners have to include businesses in a very early stage, possibly collaborating with them on the design. If a party can get a large company to serve as an anchor tenant, the park can even be designed around that company. This is a win-win situation: the park will have an easier time attracting other businesses, it will have a better idea what kind of features the park needs, and it ensures a steady cash-flow to the realtor of the land, while the company can have (part of) the park designed to their needs, attract other suitable companies, and through collaboration decrease costs. However, it is by no means an easy task to find a suitable anchor tenant, as the kind of companies you would want often have very specific wishes for the area they will locate it. In an interview with the Vancouver Sun, real estate developer Ledingham McAllister vice-president Brian Leung argues that the key to attracting the right anchor tenant is acquiring a desirable piece of land, preferably in an area where there is an obvious need (Leung, 2014).

Next up are the barriers discussed previously. In order for a circular business park to work, the companies located on it need to be able to clear all five barriers. To recap, there are technical barriers, economic barriers, informational barriers, organizational barriers, and regulatory or legal barriers. Here, a distinction should be made between operational parks and parks that are still being planned. For a planned park, it is much easier to clear the barriers, as evidenced by Rantasalmi. However, they still need to be taken into account when developing a new park, as missing any one barrier could potentially mean the difference between failure and success. The lesson to be learned here is, again, communication. By knowing the potential barriers, it becomes easier to clear them. There should be a detailed plan on how the park is going to clear these barriers. This is where outside assistance could come into play, as companies like Cirkellab specialize in custom advice for type of projects.

Existing parks, on the other hand, have an entirely different set of challenges when dealing with the barriers. Instead of ‘planning around them’, they have to adapt their business practices to them. Examples like Kalundborg and Park 20|20 show that this is definitely possible, but again, outside expertise could be required to steer it in the right direction. Instead of having companies each do their own research (in their own way), it would be best to have one outside force examine the park as a whole, as they can often see things parties on the inside cannot (or take for granted). Research can show which barriers can already be

cleared, and which need to be worked on. It can also tell if the barriers can be overcome at all, or if the task is impossible. In short: being able to clear all the barriers is a vital part of a successful circular business park, and the examples show clear illustrations on how to do this.

Another lesson one can learn from the examples is that, when planning a park, it is a good idea to look for companies with compatible waste streams, so that one's waste is another's resource. This also applies to operational parks, and the study into existing collaborations can help identify matching streams. It is also important for existing areas that want to embrace a circular character that they map out all waste streams as well as required resources in depth, so it becomes easier to find matches. A very simple example of this is residual heat generated by some processes. If the company itself cannot use this heat, it might be beneficial to see if surrounding companies can use it.

It is also important to be aware of potential risks and disadvantages, and have a clear idea on how to deal with them if or when they happen. Most risks can be mitigated, and most disadvantages can be avoided, but being aware of them is the first step. On the flip side, be aware of potential advantages you can get by opting for a circular model, and plan accordingly. A circular economy offers unique opportunities and it is imperative that these opportunities are grasped.

In conclusion, whether you are dealing with an existing park or a park still being planned, it is absolutely vital to have a solid plan of action. The plan should entail all the lessons learned above, and detailed information on how to apply them. Outside help is recommended, in order to get a fresh look on the situation and add the necessary expertise to the project. Be aware of both advantages and disadvantages, and make sure that you are able to clear all the barriers. The first step is collaboration, then come the barriers, and finally there will be the benefits.

4.4. How can these best practices be applied to business parks and industrial areas in the (Drechtsteden) region?

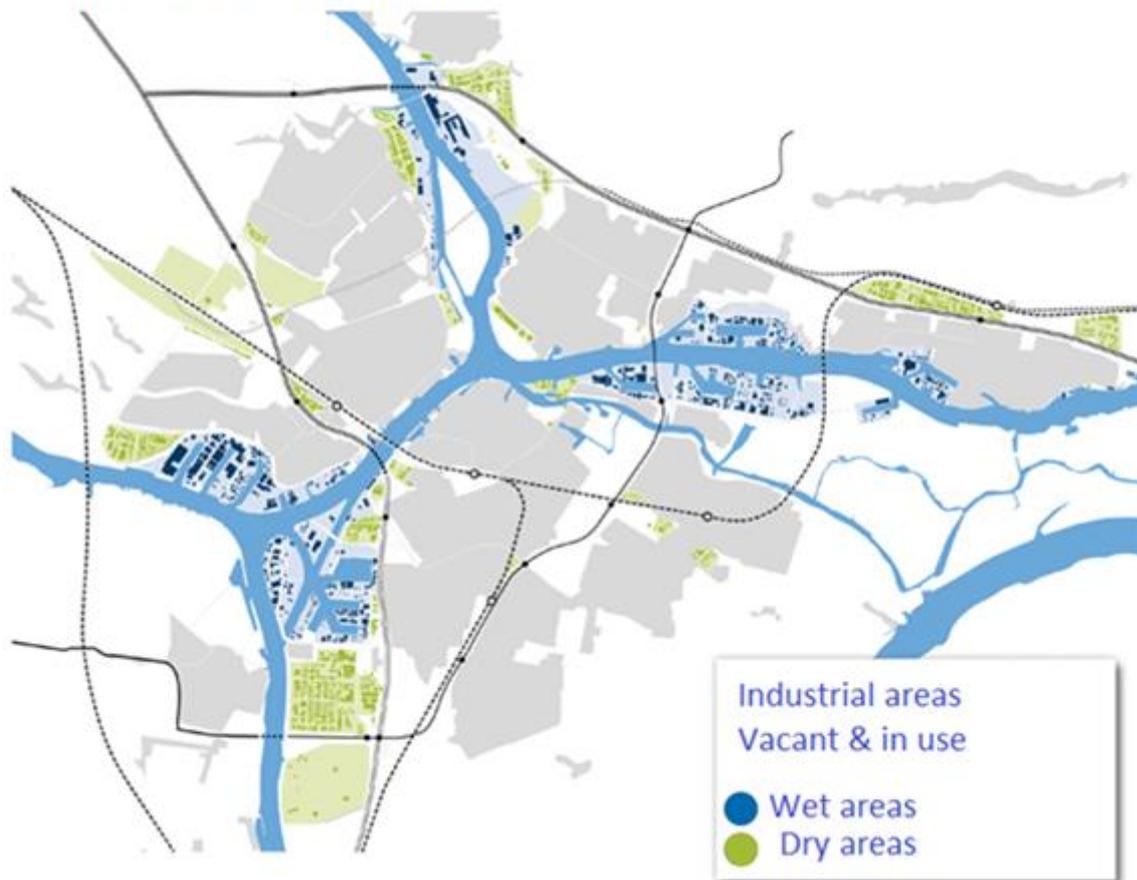
This part will deal with the second research question, which is as follows:

How can these best practices be applied to business parks and industrial areas in the (Drechtsteden) region?

4.4.1. What business parks and industrial areas are present in the Drechtsteden right now?

There are a number of business parks and industrial areas within the Drechtsteden. A large portion of them are in the maritime sector, and the region is one of the most important maritime hubs in the Netherlands (after Rotterdam and Amsterdam). Diagram 4.4 shows the location of these areas, as well as their purpose, with wet areas indicating maritime sector.

Diagram 4.4 (DrechtstedenMaritiem.nl)



In the larger region of Zuid-Holland-Zuid (18 municipalities between Leerdam and Stellendam), there are a total of 156 industrial areas, with a combined surface area of 2.814 hectares (CBS, 2016).

4.4.2. Are they doing anything with regards to sustainability or circular economy already?

Two people were interviewed for this question, both in different camps. First of all, the aforementioned Mr. Ad van den Berg was interviewed. Mr. van den Berg is CEO of ParkTrust, a private company that handles park management for 40 industrial areas in the region. His company is the binding factor between businesses in the areas, and organizes any overarching projects for these businesses. He has years of experience, and was able to deliver a unique view on the questions at hand. The second interviewee was Mr. Gerard Nijenstein, process manager restructuring business zones for the Regional Economic Consult Zuid-Holland-Zuid. For the last seven years he has worked to ensure the restructuring of several business zones within the region, giving advice on the restructuring, as well as advice on park management and planning. Both gentlemen were able to provide in-depth information about business parks in the Drechtsteden region and give advice on what they thought should be done. These two were selected because of their experience, and because they represent both sides of the equation: public and private sector.

According to Mr. van den Berg (2016), companies are searching, and lack guidance when attempting to work on their sustainability. His company tries to coordinate initiatives on the parks themselves, for example by arranging waste management for all companies. By organizing, the park had a stronger bargaining position, and was able to agree to a lower price. These types of collaboration are exemplary for a circular model, where strength through collaboration is a key aspect. However, in his opinion, the driving factor behind any sustainable project has to be profitability. Companies want to invest, but as mentioned before, want to be budget neutral within five years. Mr. Nijenstein (2016) had a similar statement in his interview, citing a payback period of between three and five years.

While circular economy on itself is not yet on the agenda for these parks, they already do a lot regarding sustainability. In fact, some areas like the ones described by the two gentlemen were already, unknowingly, in the process of adapting certain aspects of the circular model. For example, a large steel manufacturer found out they had a lot of residual heat after processing. After research showed that this heat was disconnectable (able to be captured and used elsewhere), the company started searching for alternative uses of this heat in the surrounding area, both in other businesses and a heat-net in the Drechtsteden. Unfortunately, both these options turned out to not be feasible (yet), so the company is currently looking if they can change their business practice in order to reuse that heat themselves. This clearly shows some of the aforementioned barriers at work, namely both technical barriers (they could not find a suitable recipient for the heat) and organizational barriers (changing of business practice to accommodate reuse). In other words, an example like this shows that real-world practice confirms the theory.

Other examples of sustainability in practice include municipalities stimulating electric vehicles by offering charging points for a reduced price, park management stimulating alternative means of transport by letting people use electric bicycles, certain cities offering 'sustainability scans' to industrial areas at a reduced rate. Lastly, the municipality of Goeree-Overflakkee is attempting to make all their electricity for households and industry come from sustainable sources before 2020. According to Nijenstein, right now over 50% of all energy is green, and the municipalities' goal seems attainable. He argues that the city is distinguishing itself in a very special way (Nijenstein, 2016).

In conclusion, a lot of ground can still be won in this area, but the examples and interviews mostly show that both government and private sector are ready and willing, as long as it will not cost them too much money.

4.4.3. How can the stakeholders be convinced to switch to a circular model?

In his paper “Persuading Stakeholders” (2011), Chris Smith argues that in order to convince stakeholders to switch business models, there are several aspects one needs to keep in mind:

- * Who do you need to convince?
- * What goals are important?
- * What concerns are there likely to be?
- * What risks are involved, and how can they be mitigated?
- * What benefits are likely to persuade each stakeholder?
- * What are the “hard” benefits (in monetary value) the change can provide?
- * What are the “soft” benefits (intangible benefits) the change can provide?

These aspects are also used in other studies like “Business Case Essentials” (Schmidt, 2004), and in papers like “The Key Benefits of CRM” (Wooden, 2012). These aspects apply to nearly any major business decision, and as such, also the one regarding the change to a circular model. Furthermore, these aspects seem to mirror the information received through interviews mentioned previously, namely those with Mr. van den Berg and Mr. Nijenstein.

The first question is: Who do you need to convince? In order to convince stakeholders to do anything, you first need to know who makes the decisions. Regarding the goings-on on business parks, this is usually the local government of the municipality in which the park is located, often combined with either a business association under the leadership of park management (Berg, 2016). Furthermore, the companies located at the parks also need to be convinced, as they need to agree to change their business practices. This causes a large variety of stakeholders that need to be convinced, and each will require a different approach. It is up to the initiating party to find out who to talk to, and how to convince them.

In order to convince anyone, you need to know what goals are important. This also can vary greatly between the different stakeholders. For example, one may have the environment and sustainability high on their agenda, while another is purely motivated by profitability. Both Smith (2011) and Van Den Berg (2016) agree that the initiator of the change must find out what goals are important to which stakeholder, and adapt their strategy to these goals. On the other side of the goals, there are the concerns. This largely follows the same advice as the previous section, with the initiator finding out what stakeholder could have what concern, and plan accordingly. It is important to note that concerns can both be legitimate and emotional, and the initiator needs to plan around both options. Legitimate concerns can often be translated into risks, which is the next aspect in convincing stakeholders. The initiator must have done research to the risks the change to a circular model brings with it (refer to question 4.1c to see the different disadvantages/risks of this model), and also have in-depth knowledge on how to mitigate or avoid these risks.

When trying to convince stakeholders to switch to a circular model, it is usually because the initiator believes the change will bring certain benefits. It is important to understand what benefits are most likely to persuade each stakeholder, so the initiator can build their argument around those benefits. This refers back to one of the previous aspects, which talked about the importance of knowing what goals are important to the particular stakeholders. The difference is that a goal can be a vague concept (like “sustainability” or “higher profit”), while benefits are more defined. There are two types of benefits, which Smith (2011) calls “hard” benefits and “soft” benefits. Hard benefits are those that can be put into numbers that can be swapped to have a monetary value. For example, a hard benefit of changing to a circular model can be the calculable reduction of waste materials, which can be directly translated into money saved (as less trash means lower costs). An example of a soft benefit could be the positive publicity a company gets for putting sustainability high on their list of priorities. It is important for the initiator of the change to study both types of benefits, and, as mentioned before, understand which benefits are most likely to persuade which stakeholder.

When asked how stakeholders can be convinced to switch to a circular model, both van den Berg (2016) and Nijenstein (2016) largely agreed with each other. In summary, their answers came down to:

- * Have a clear plan.
- * Have convincing arguments.
- * Be budget-neutral within five years.
- * Have realistic, short-term goals.
- * Bring examples of other successes.
- * Have a customized plan that is financially and technically sound.

When trying to persuade stakeholders, a clear plan is one of the first things needed. What that means is that instead of going to a company and talk about vague ideas, you need to bring demonstrable solutions. For example, if you notice the office is lit by regular lighting, you could offer to calculate how much the company would save on a yearly basis by switching to LED-lighting. These clear plans have to lead to convincing arguments. As mentioned before, knowing what arguments are best suited to persuade each stakeholder is vital. Also, these plans cannot be too long-term. According to both van den Berg and Nijenstein, businesses want to be budget-neutral (that is: having earned back their initial investment) within five years. They argue that businesses are often willing to make drastic changes, but do not want to be stuck with long-term costs. The initiator must make sure his plans account for this in their feasibility. This leads into the next point of having realistic, short-term goals. Instead of telling a business park they should be completely circular by this time next year, make concrete plans with several stages. For example, set up a plan for a park to have found a certain number of collaborations within the first year, reduce dependence on finite resources within five years, and be completely circular in ten years. By cutting up the plan in short terms, you both give the project benchmarks, and you keep it relatively short-term and realistic. To understate their arguments and plans, the initiator can bring up relevant examples of other successes. For example, if a municipality has plans for a new industrial area, the initiator can bring examples such as Kalundborg, Devens or Rantasalmi to show the success of the circular model.

Finally, the most important part of convincing stakeholders is having a customized plan that is financially and technically sound. No two business parks are the same, and a park with just five companies will need an entirely different strategy than a park with 50. This is why it is nearly impossible to have a single set of arguments on how to change any stakeholder's mind. Instead, the above guidelines should be followed to come up with a customized plan, that takes into account all the specifics and variations of each business park.

4.4.4. Are there any new business parks or industrial areas planned for the near future?

According to the municipality of Dordrecht (2011), between the years 2012 and 2020, another 16.900 m² of industrial area will be completed. The largest part of this, nearly 13.000 m², will be located in the to-be-built Dordtse Kil 4 (DK4), while the rest will be used to expand existing parks or develop small new parks.

4.4.5. If so, what kind of plans are there for those already?

Dordtse Kil 4 will be a business park populated mostly by logistics companies and related industry. The municipality of Dordrecht is highly committed to make the area as sustainable as possible. However, unfortunately there are no plans to apply a circular model to the area. On the other hand, DK4 is planned to be run on sustainable energy, and has applied for a BREAAAM certificate, an international hallmark for sustainable area development (Municipality of Dordrecht, 2016).

4.4.6. How can the best practices and lessons learned be converted into a model for circular business parks, in any region?

One of the goals of this thesis was to find a way to make a model for circular business parks in any region. Naturally, there will be a different approach for existing parks and planned parks. They will have some overlap and some differences. Both will be discussed separately in this question. By taking all the best practices and lessons learned from the entirety of chapter 4, the following models can be made. An outside company can follow these models to (help) install a circular model in a business park.

Existing Parks

It is nearly impossible for an existing park to switch to a completely circular model within the five years mentioned by van den Berg and Nijenstein (2016). The chances that every waste stream on the park can be matched with the resource requirements for another are slim to none. However, as this study has shown, it is also possible to partly embrace the circular model, and only apply it to those areas where it makes the most sense (for an example, see Devens). Furthermore, when a park expands its horizon and plans ahead for 10, 20, 30 years, the switch to a circular model can be made more strategically, by planning what new companies the park should attract when others leave.

The first order of business is to map out all waste streams and resource requirements for all businesses on the park. By doing this, it becomes clear what, if any, collaborations can be formed. The second step is actually making these connections. This has to be financially and technically sound for all partners. For example, if a business on the park processes wood, and the waste wood gets bought by a company in a different city, it needs to be calculated if the first company can make a higher profit by selling it to a local company (as the costs of, for example, shipping, storage, and/or logistics might go down). Naturally, there has to be a valid local connection in the first place, as mentioned previously. For every waste- or material stream, these calculations are different. Because of this it is not possible within the scope of this research to make a standardized calculation, instead they have to be done for each park separately (referring back to having a customized plan). Companies are usually willing to make these calculations themselves, because in theory, they can cause their profits to increase. As mentioned before, increasing profits is usually high on the list of priorities of companies when making strategic decisions.

The next step, once the connections are made, is to close as many other loops on the park as possible. Devens did this by creating the EcoStar Exchange and the Great Exchange. By facilitating companies on the park to dispose of their unwanted resources and materials, recycling and reuse can go up. Park management plays an important role in this step, as they are usually the ones with the means to bring together the different businesses on their parks, and can help facilitating the closing of these loops. Another aspect of this is trying to get the energy for the park from renewable resources (in cooperation with the local government). Other things to be looked at include water and sewage, promoting of 'environmentally friendly' forms of transportation, and other similar initiatives.

Once the streams are mapped out, collaborations are formed, and most loops are closed, it is up to the stakeholders to decide if they want to go further. There might be other aspects of the circular economy the stakeholders may choose to pursue. Unfortunately, after this there is not much else existing parks can do to become more circular in the short term. Companies leaving the park should be replaced by companies that better fit into the system, and new innovations should be watched to see if anything can be improved. As mentioned before, existing parks can become more circular by switching their focus on the long term.

In conclusion, switching an existing park to a circular model brings many benefits, as discussed previously, but it will be nigh impossible to attain a try circular character, unless the stakeholders can agree to some drastic changes. If they do, an existing park could maybe follow the model for planned parks, which will be discussed next.

Planned parks

When planning a new business park from the ground up, there are a lot more opportunities to become a fully circular park like Rantasalmi or Kalundborg. By choosing to follow a circular model, stakeholders should go over all of the following:

- * Five barriers
- * High level of collaboration
- * Closing loops
- * Anchor tenants
- * Solid plan of action

As discussed previously, starting with an anchor tenant can be a huge benefit to any new park. This should be one of the first priorities for any region planning a new park. From this point, the actual planning of the park becomes a lot easier. In collaboration with the anchor tenant and outside expertise, a plan can be formed on how to overcome the five discussed barriers (technical, economical, informational, organizational, and regulatory). The technical barrier can be overcome by planning a park around the anchor tenant, and making sure the surrounding companies all fit within the larger plan of resource-, material-, and waste exchange. An example of how this was done can be found in Rantasalmi, where the woodworking plant Rantasalmi Oy was joined by several other companies supplementing each other. The economical barrier becomes easy to clear when there is a solid plan of action right from the start. The only difficulty in this is that it might take longer than usual for a park to completely fill up with companies, as better matches have to be made, and not just any company can settle in any park. This is a consideration for the party exploiting the area. However, with proper planning, this barrier should be able to be cleared. An example of this is Park20|20. In the midst of the financial crisis, they managed to attract more companies, against higher rates, because their story/plan (and the added benefit it brought) convinced the companies of the capital gain it would entail (Kanters, 2016). The informational barrier can be overcome with help from outside expertise. Bringing the right people with the right information together can be a daunting task (for example, Kalundborg originated from a chance encounter), but with outside help, this becomes a much more manageable task. The organizational barrier is another example of a barrier that can be overcome with the help of outside expertise. People experienced in the field of circular economy can help businesses change their organizational structure to accommodate a circular character. On planned circular parks, where companies are gathered around an anchor tenant, this is especially important. It would be disastrous if a company brought in for a specific waste stream cannot actually operate within a symbiosis. In order to clear this barrier, again, a solid plan is needed, in which is detailed what exactly is asked of companies settling in the park. Another way to mitigate this risk is to spread the risk, by having more than one supplier of the same (waste) stream. Lastly, the regulatory barrier. This one can be overcome by maintaining solid relations with the (local) government. If a municipality is serious about creating a circular business park, it would be highly advantageous to form one or more public-private partnerships, so both the government (public) and the businesses in the park (private) have a stake in the success of the park. This way, regulations can be changed or adapted more quickly. Examples of this can be found in both Devens and Kalundborg, where there is a lot of cooperation between (local) governments and private companies.

In other words, in order to successfully plan a circular business park, a solid plan of action is needed. This plan should entail all details on how the barriers will be overcome, what (type of) collaborations will be formed, how the loops will be closed, and what (kind of) anchor tenant should be attracted. This thesis contains information for the initiators of the change to help come up with convincing arguments, construct a plan of action, and information on how to mitigate the risks and overcome the barriers.

In conclusion, it is hard to make a single model that works for every specific business park. That is why outside expertise is needed to come up with a custom plan that is both financially and technically sound

and beneficial for all parties. This thesis can be used as a guideline for that plan, going over what needs to be addressed, and how to address it.

5. Conclusions

5.1. Overall conclusions

This section will deal with the conclusions based on the entire research. It will largely follow the last sub-questions of both research questions, as they already have some form of conclusion encapsulated within them.

The overall conclusion is that it is hard for an existing business park to make the switch to a pure circular park in the short term, because the chance that the waste streams perfectly match the resource requirements are slim to none. Parks like Kalundborg evolved over many years, naturally forming the collaborations and symbiosis. However, this does not mean that existing parks cannot do anything. There are plenty of opportunities to embrace certain aspects of the circular model, which parks like Devens and Park 20|20 have proven. Long term plans are necessary for existing parks that want to make the switch, as they can help guide stakeholders in deciding which new companies to attract, or how to change business operations.

Planned parks, on the other hand, are perfectly capable to decide on using a circular model. The mentioned barriers are easier to overcome, and the opportunities and advantages outweigh the risks and disadvantages. In order to convince stakeholders to opt for the circular model, custom plans have to be made that are both financially and technically sound. Cirkelab's expertise comes into play here, as the company can position itself as an independent source of knowledge.

In conclusion, there are definitely opportunities in this area, and there is still a lot of ground to be won. Both businesses and governments are open to new ideas and radical changes, as long as one can prove the changes are economically sound and beneficial. The largest barrier might be the one between the public and private sectors, but with the help of public-private partnerships, like the ones in the three discussed parks, this barrier can be overcome as well.

5.1.1. Research question 1: conclusions

Which parks have a circular character?

The research provided a list with 23 planned or existing parks with a circular character. Out of these, three were chosen to study in-depth (Kalundborg, Devens and Rantasalmi). The way these parks operated was described, as well as how they overcame the five barriers, measured their success, and what lessons could be learned from them. Unfortunately, the research was unable to provide an example of a failed circular park. After intense research, the only park the author could find was one that did fail, but not because of any aspects relating to its circular nature.

Role of the government?

As discussed, the (local) government can either be a boon or a burden. Several drivers and barriers were discussed, including advice on how to overcome these barriers. The conclusion the research made was that for a park to be successful, good relations with the (local) government must be maintained, preferably in the form of public-private partnerships, so both "sides" have a stake in the park.

How are they measuring their success?

This varied between the three studied parks. While Kalundborg provided a lot of exact facts and figures, Rantasalmi prided itself more on their vague concepts and ideas. Devens was a mix of both, promoting their exchanges as well as some key financial facts. All parks prided themselves on their partnerships and collaborations, which were found to be a key aspect of the circular model.

What are the advantages/disadvantages?

This section also included the differences between regular parks and circular parks. The biggest advantage was the fact that in all three cases, there was a financial benefit. Sustainability is no longer just something that only *costs* money, but it actually *earns* it. On the other hand, the biggest disadvantage was increased regulations, and the fact that legislation sometimes had to “catch up” to the innovations. There were a number of differences between normal and circular parks, the most important one being the vast amount of collaboration occurring in the latter.

5.1.2. Research question 2: conclusions

Role of stakeholders

Discussed were the various drivers and barriers for the stakeholders, ways to locate the stakeholders, and how to persuade them to opt for a circular model. The research showed that convincing stakeholders is doable, as long as you have a customized plan that is financially and technically sound. Drivers included willingness to change and opportunities for higher profits, while barriers included risks and the “us-versus-them” mentality.

What parks are present/planned?

The research showed that there was a lot of existing industrial area in the Drechsteden region, as well as some newly planned areas. The most important of these was the Dordtse Kil 4, but unfortunately, while they *will* have a sustainable character, they will not opt for a circular model. However, this does not mean that the entire area is now lost, as individual companies on the park can embrace certain aspects of the circular model individually, or form some sort of collaboration. Outside expertise, like that provided by Cirkellab, can help these businesses both increase their profit and have a positive impact on the environment.

What are the best practices?

Several best practices and lessons learned were formulated within the report, the most important of which included being able to identify and overcome the five barriers, the importance of anchor tenants, and the extensive use of collaborations. International examples of this were discussed in order to realize a framework for regional business parks. This resulted in the circular model for existing and planned parks.

The next section will deal with the recommendations that follow from the research findings and conclusions. There will be a lot of overlap, as most recommendations were already encapsulated within the research questions.

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7. Appendix

Overview of figures and tables

Table 4.1

Operational		
Name	Location	Notes
Kalundborg Symbiosis	Kalundborg, Denmark	First industrial symbiosis
Rantasalmi	Rantasalmi, Finland	
Devens Eco-Industrial Park	Devens, Massachusetts, USA	Reuse of a former military base
Cape Charles Sustainable Technologies Park	Cape Charles, VA, USA	The first planned EIP in the USA
Green Tech Valley	Styria, Austria	
The Textile Recycling Valley	Northern France	
Tianjin Ziya Industrial Zone	Tianjin, China	China has specific laws promoting Circular Economy
NISP Network	Humber region, UK	
London Sustainable Industries Park	London, UK	
TXI/Chapperal Steel	Midlothian, TX, USA	
Port of Houston	Houston, TX, USA	
Wheatbelt Town of Narrogin Industrial Symbiosis	Narrogin, Australia	
Guayama	Puerto Rico	
Cabazon Resource Recovery Park	Cabazon, CA, USA	
Biopark Terneuzen	Terneuzen, Netherlands	
Alberta's Industrial Heartland	Alberta, Canada	
Planned		
Name	Location	Notes
Park 2020	Hoofddorp, Netherlands	
Schiphol Trade Park	Schiphol, Netherlands	
Kilpilahti	Kilpilahti, Finland	
Innovista Park	Hinton, Canada	
The Brownsville Project	Brownsville, TX, USA	
Landskrona	Landskrona, Sweden	
Berks County Eco-Industrial Park	Berks County, PA, USA	

Diagram 4.1 (symbiosis.dk)

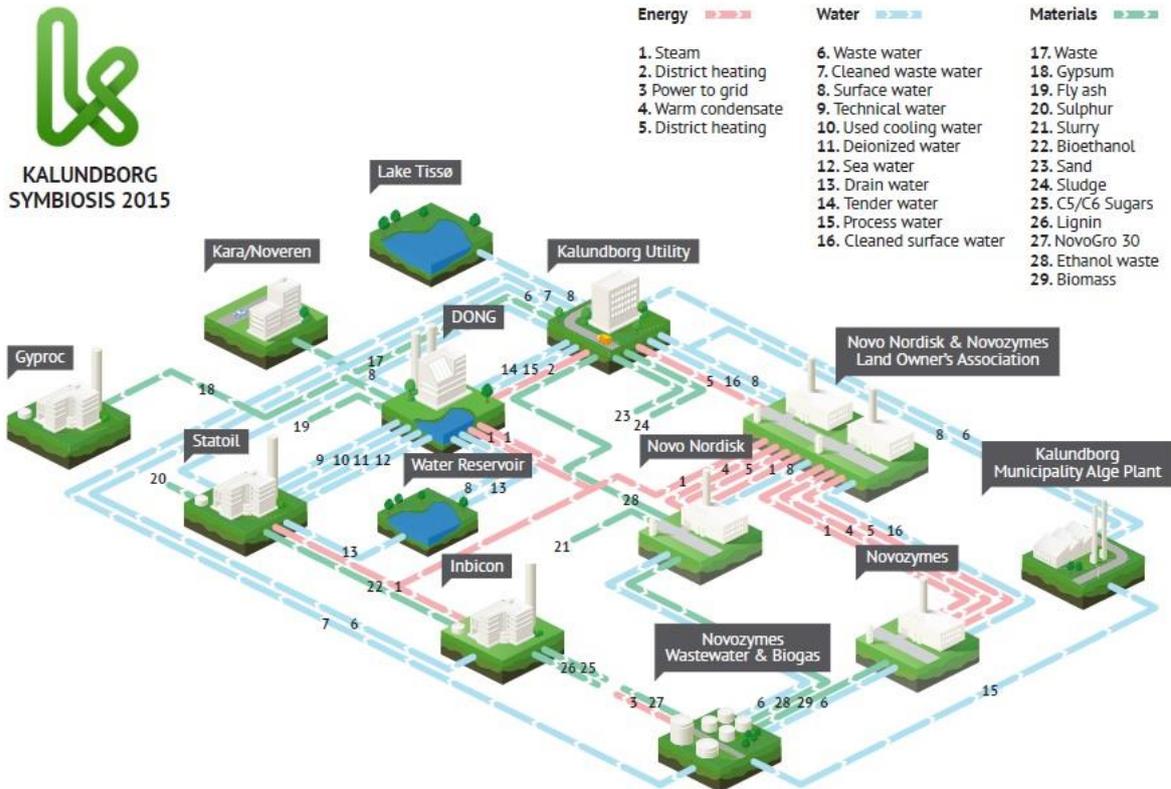


Diagram 4.3 (Saikku, 2006)

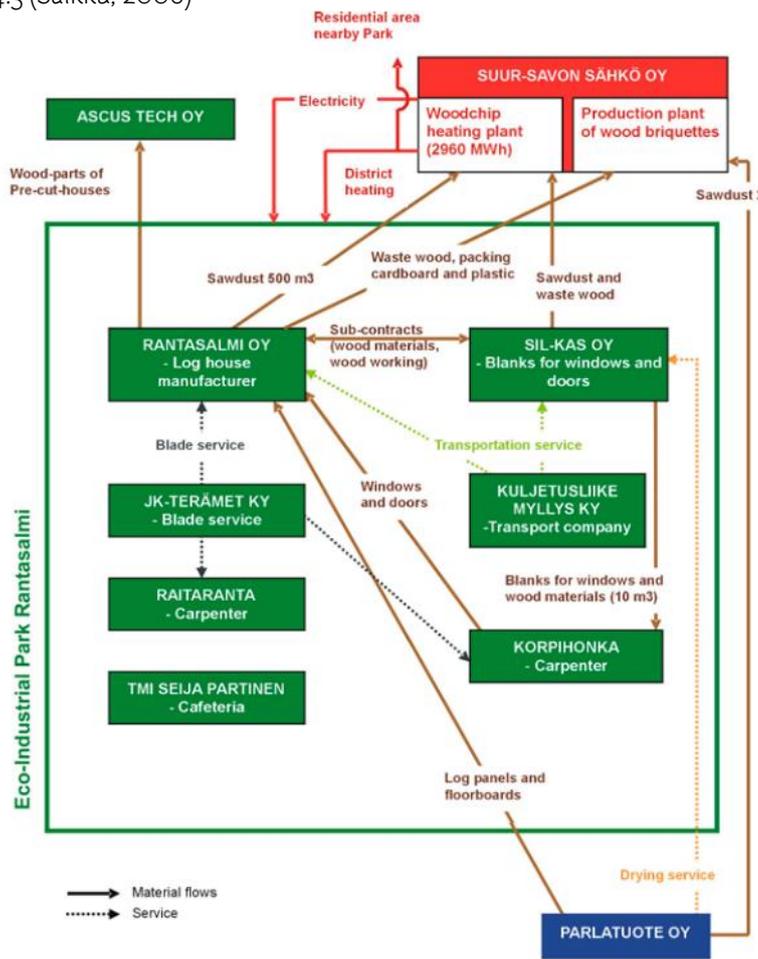


Diagram 4.4 (DrechtstedenMaritiem.nl)

